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World Trade Organization
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The Economics of Permissible WTO Retaliation

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The Economics of Permissible WTO Retaliation

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This version: September 2008

Abstract

WTO arbitrators rely on economics to establish the permissible retaliation limits authorized by the Dispute Settlement Understanding (DSU) which arguably serves to enforce the overall agreement. We examine how theoretical and quantitative economic analysis has and can be used in this stage of the DSU process. First, we identify, characterize, and categorize the major classes of disputes – e.g., those affecting import protection versus export promotion – and use the Bagwell and Staiger interpretation of the WTO principle of reciprocity to provide a theoretical framework that arbitrators can use to identify the maximum level of retaliatory countermeasures. Second, we allocate each of the ten DSU arbitrations that have taken place thus far into one of these categories and compare the arbitrators' actual approach with the theory. Third, we use this framework to identify three crucial elements to the arbitrators' decision-making process for each case: i) the *formula* that they decide to adopt for identifying appropriate countermeasures, ii) their political-legal-economic decision on a WTO-consistent *counterfactual* to use to implement the formula, and iii) the *quantitative methods* they use to necessarily construct the (unobserved) WTO-consistent counterfactual. We examine not only the arbitrations that have taken place thus far, but our approach also illustrates a template for many additional types of arbitrations likely to take place under the DSU. Finally, in the disputes in which this reciprocity approach has not been used, we identify procedural difficulties that arbitrators confront thus highlighting the constraints that hinder their use of economic analysis in practice.

Keywords: WTO, DSU, arbitrations, reciprocity, retaliation, market access, terms-of-trade externality

JEL Classifications: F13, F51, K33

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1 Introduction

In the twelve years following the WTO's 1995 inception, ten formal Dispute Settlement Understanding (DSU) cases reached the stage in which the respondent Member's failure to comply with WTO obligations compels DSU arbitrators to *authorize* the complaining Member to retaliate and apply countermeasures. This paper uses the lens provided by these ten cases to examine how arbitrators employ economic analysis at this critical stage of the DSU process. In order to lend an intellectual coherence to the arbitrators' approach, we first motivate the basis for DSU arbitrations in the WTO trade agreement via use of economic theory, as theory supplies a framework that complements the legal approach and allows arbitrators to put disputes into perspective.¹

We begin by developing a theoretical approach that facilitates examination of the countermeasure construction for each of the two major categories of prevalent cases in WTO dispute settlement – e.g., disputes over WTO-inconsistent import-restricting and export-promoting policies. This is an important initial categorization given that DSU arbitrations have been conducted under two different mandates – those that involve WTO-inconsistent trade restrictive measures and those that involve WTO-inconsistent government subsidies (WTO, 2005). In the first, pursuant to DSU Article 22.7, the duty of the arbitrators is to determine whether the level of suspensions sought by a complaining Member is "equivalent to the level of nullification and impairment" that resulted from the breach of WTO obligations. The second mandate, pursuant to Articles 4.10 and 4.11 of the Subsidies and Countervailing Measures (SCM) Agreement, requires arbitrators to evaluate whether proposed countermeasures by a complaining Member are "appropriate" in response to a prohibited export subsidy implemented by another Member.²

We adopt a theoretical approach for determining the limits to permissible DSU countermeasures that derives simply from the Bagwell and Staiger (2002) interpretation of the WTO principle of

¹ Sebastian (2008), also in this volume, describes the legal framework affecting the calculation and design of trade sanctions in the WTO dispute settlement process.

² Note that we do not use our framework to examine the *U.S. – Section 110(5) of U.S. Copyright Act (EC)* case, which fell under the DSU Article 25 arbitration that is an "alternative means of dispute settlement" (DSU Article 25.1).

reciprocity.³ A particular benefit of this approach is that it fits within one fundamental political-economic understanding of the purpose of the WTO as a trade agreement more broadly. We first adapt their interpretation of reciprocity in order to analyze separately the economic theory behind permissible retaliation for WTO-inconsistent import-restricting versus export promoting measures. Within these two broad categories, we focus on subsets of WTO-inconsistent measures disputed in practice. For import restrictions, we examine theoretical differences in the determination of countermeasures when the violation and/or WTO-consistent measure is a tariff, quota, other non-tariff measure on foreign exporters, or a domestic subsidy to import-competing firms. For export-promoting policies, we examine theoretical differences in the determination of retaliation limits when the WTO-inconsistent policies involve export subsidies in two-country and three-country models. Table 1 documents these ten DSU arbitrations that took place between 1995 and 2007 and allocates each one to the appropriate theoretical subsection of our analysis below.

Starting from the lens that the Bagwell and Staiger reciprocity formulation for countermeasure retaliation provides, we then turn to the actual arbitration cases. We first examine evidence from actual DSU reports to assess the extent to which the arbitrators' methods conform to the Bagwell and Staiger reciprocity formula. In some of the DSU cases that we examine, such as the arbitrations over WTO-inconsistent quantitative restrictions, the arbitrators' actual approach appears quite consistent with this theory. In other cases, the arbitrators explicitly signal in their report a preference to use such an approach despite the practical inability to do so for procedural, computational, or data limitation reasons. Furthermore, in other types of disputes involving export subsidies, arbitrators clearly deviate from this reciprocity approach in favour of alternatives. Nevertheless, even in such instances, analyzing the retaliation determination question from a theoretically-motivated perspective allows us to compare the arbitrators actual approach to one that might occur under this particular formulation of reciprocity.

³ Bagwell (2008) applies this theory to analyze several recent proposals aimed at improving the WTO dispute settlement system.

The basic theoretical framework to examining such DSU arbitrations allows us to identify the three crucial elements to the arbitrators' decision-making process: i) the *formula* that they decide to adopt for evaluating appropriate countermeasures, as well as its potential relationship to the theoretically-motivated Bagwell and Staiger reciprocity approach that is our benchmark; ii) their political-legal-economic decision on a WTO-consistent *counterfactual* policy necessary to use the formula that they provide; and iii) the *quantitative methods* they choose to use to necessarily construct the (unobserved) WTO-consistent counterfactual in reality.⁴ After we introduce the simple graphical analysis that forms our basic theoretical approach, we then describe elements of the quantitative methodologies used by arbitrators to evaluate the maximum allowable level of suspension of concessions.⁵

Note finally that we restrict attention to the economics that arbitrators use to determine the maximum limits to retaliation. We do not examine other retaliation-related issues in which the arbitrators play a lesser role, especially questions such as – given the level of permissible retaliation set by the arbitrators, what are the political-economic determinants of the target lists that complainants draw up? In which sectors do complainants choose to implement retaliation? When does it make sense for a complainant to choose GATT, GATS, or TRIPs retaliation? While these are interesting questions, we focus on the core issues to determining the *limits* to arbitrator-permitted retaliation because such questions are examined elsewhere in this volume and they are less relevant to the decisions made by the arbitrators.

The rest of this paper proceeds as follows. In section 2, we present the basic underlying model, the motivating underlying Bagwell and Staiger political-economic theory behind the WTO, as well the role and interpretation of the reciprocity principle that we use to identify a theoretical formula for the arbitrators' allowances for countermeasures. In section 3, we apply the theory to cases in which WTO-

⁴ We also choose not to pursue more normative questions such as whether particular arbitration decisions "make sense" from the perspective of economic theory or techniques. Furthermore, we leave untouched the question of the economic rationale behind and the proper design of WTO rules governing arbitrations and hence the issue of whether decisions made by arbitrations enhance the WTO dispute settlement performance more generally.

⁵ On this issue, see also WTO (2005) and Keck (2004). Nevertheless, because this particular element of the dispute process has received substantial discussion elsewhere, we do not focus on it here. See also Bernstein and Skully (2003), and Breuss (2004). For a broader economic analysis of the WTO system of retaliation, see Lawrence (2003).

inconsistent policies involved import-restricting measures, and we examine the relationship between actual DSU arbitrations over import-restricting measures in light of this theory. In section 4, we apply the theory to cases in which WTO-inconsistent policies involved export-promoting measures. Section 5 identifies other potential areas of theoretical interest given the DSU arbitrations that have occurred thus far, and section 6 concludes.

2 The Bagwell-Staiger Theory of Trade Agreements and the "Reciprocity Approach"

We start by providing an economic model to organize thoughts on the actual arbitration cases. The basic political-economic model is in the spirit of Bagwell and Staiger (2001a), who show that the major principles of reciprocity and non-discrimination of the WTO system allow countries to escape a terms-of-trade driven prisoners' dilemma.⁶

To begin, we assume that there are two large countries – the respondent (R) and the complainant (C) – and we note that the complainant's variables will be denoted by *. Let good x be the natural import (export) good of the respondent (complainant) country and let y be the natural import (export) good of the complainant (respondent) country, and we assume that these goods are traded in perfectly competitive markets. For example, the markets for good x are illustrated in figure 1. The model is thus a two country, two good, partial equilibrium model, and one in which we assume governments use the policy tools at their disposal to maximize an objective function consisting of a "politically" weighted sum of consumer surplus, producer surplus, and tariff revenue across their two sectors.⁷

⁶ Bagwell and Staiger (2001a) is the partial equilibrium version of the model they originally introduced in a general equilibrium framework in Bagwell and Staiger (1999). The Bagwell and Staiger (2001a) model can be interpreted as a general equilibrium model by introduction of a numeraire good whose trade is determined by a requirement of overall trade balance. For a book-level synthesis of these theories, see Bagwell and Staiger (2002).

⁷ If "political" weight were all equal to unity, the objective function of governments would correspond to social welfare. As it is well understood from the theory of collective action (Olson, 1965) and confirmed by a large body of empirical evidence (Gawande and Krishna, 2003, present a survey), governments tend to give a higher weight in their objective function to organized special interests, such as import-competing industries, relative to diffuse consumer interests. The Grossman and Helpman (1994) lobbying model provides a micro-analytic foundation to this political economy representation.

In such an environment, Bagwell and Staiger provide important interpretations for the WTO core principles of reciprocity and non-discrimination through most-favoured-nation (MFN) treatment. In the presence of large countries that are able to affect their terms of trade (and thus world prices), reciprocity can be shown to neutralize an important internationally-transmitted externality that occurs when one country's use of a unilateral trade measure redistributes surplus from its trading partner to itself. The WTO principle of MFN treatment ensures that externalities associated to trade intervention travel through world prices only. In this way, these principles work in concert to deliver *efficient* trade policy outcomes from the multilateral trading system - i.e., outcomes that do not distort trade more than if each government were motivated by domestic political-economy considerations only.⁸

Our theoretical analysis begins from such a politically efficient trade agreement between symmetric countries - i.e., an agreement that eliminates the trade restrictions associated to the terms-of-trade externality. While the trade agreement may not necessarily result in free trade - i.e. government preferences might be such that their "politically optimal" (efficient) trade policies in this Bagwell and Staiger framework are not zero - it is efficient in light of each government's potential political preferences.

Following the approach adopted in Bown (2002, 2004), we then introduce an unanticipated "political" shock that stimulates a desire by one of the governments - the respondent - to *change* the terms of the existing agreement. The intuition is simply that the political shock creates new preferences by changing the relative weights the government in the respondent faces vis-à-vis its various sectors therefore, its existing policies are no longer efficient. Because the nature of the shock we examine is "political," it leaves unaltered domestic demand and supply.⁹ A concrete example of this type of shock

⁸ As discussed in Bagwell, Mavroidis and Staiger (2002), the terms-of-trade rationale for trade agreements corresponds to the market access emphasis found in the WTO articles. An increased (reduced) export price, that is an improved (diminished) terms of trade, is just the price effect induced by the corresponding increase (reduction) in export volumes that augmented (restricted) market access implies.

⁹ This is certainly not the only type of shock that might trigger such a policy change, though it is perhaps most simple to use in the model to examine the questions of interest here. Nevertheless, we identify and discuss other types of shocks in section 5.

would be the election of a new government that weighs more heavily the producer interests of the import-competing sector, which creates an incentive for the government to move away from the trade policy commitments previously negotiated with its trading partner in an earlier round.

In section 3 we explore the most simple case of a government in the respondent reacting to this preference shock by imposing more import *restrictions* either directly via trade policy (e.g., tariffs, quotas or other non-tariff barriers) or by providing its domestic producers with a WTO-inconsistent subsidy that leads to a similar effect of limiting trade. The key from the WTO's perspective is that these policies all restrict market access and change the conditions of competition between domestic and foreign producers away from those that could have reasonably been expected based on earlier negotiated commitments. In section 4, we explore a second set of cases in which respondent policymakers react to preference shocks that cause them to expand export *promotion* activity – e.g., export subsidies – above WTO commitments.

Given the respondent country's change in policies, we then use the basic rules of the WTO's Dispute Settlement Understanding to examine how the setting plays out. I.e., after the respondent reacts to this "shock" by changing some policy that affects its WTO market access commitments, we assume that the adversely affected complainant country files a formal trade dispute. The parties then go through the DSU judicial process of legal argumentation, the respondent's policy is found by the panel and Appellate Body to be WTO-inconsistent, and we finally reach the stage of DSU arbitration. Assuming that the respondent has thus far refused to bring its measure into conformity with DSU rulings, it is the task of the arbitrators to define the limits of the complainant country's permissible retaliation as a response to the respondent country's initial WTO-inconsistent measure.

The DSU states that "the level of the suspension of concessions or other obligations authorized by the DSB shall be equivalent to the level of *nullification or impairment*" (GATT, 1994, Article 22:4, emphasis added). In each of the cases described below in sections 3 and 4 corresponding to a different WTO-inconsistent policy, our approach is to provide a simple graphical model to evaluate the level of nullification or impairment that arises. While there is not a single interpretation of the "proper" level of

nullification or impairment,¹⁰ we adopt the Bagwell and Staiger (2002) view that this level corresponds to the *suspension of trade that is designed to stabilize the value of export and imports trade volumes between countries*. For instance, in the case of a trade restrictive measure, the complainant's permissible retaliation is to reduce the volume of the exports by an amount equal to the respondent's reduction of imports, both measured at original export prices - i.e., before the breach of WTO commitments. We refer to this as the "reciprocity approach." Howse and Staiger (2005), for example, argue that this approach approximates a system of remedies that facilitates a form of "efficient breach" of the optimal trade treaty in presence of uncertainty.¹¹ Furthermore, they show that allowing the complainant to retaliate at a level equal to trade effects calculated at original export prices preserves the terms-of-trade and is close to an efficient response for "small" shocks.¹²

3 WTO Disputes and Retaliation over Import-Restricting Measures

In this section we study the process of arbitrator determination of countermeasures when the WTO-inconsistent policies are those that excessively restrict imports. We first describe the simple theoretical approach to this question and then examine how the arbitrators in the relevant DSU caseload have approached the question in practice. Our methodology relies on the Bagwell and Staiger interpretation of reciprocity to provide a theoretical framework to identifying the appropriate level of countermeasures. We then use this framework to identify three crucial elements to the arbitrators' decision-making process: i) the formula that they decide to adopt for evaluating appropriate countermeasures, ii) their political-legal-economic decision on a WTO-consistent counterfactual to use in the formula, and iii) the quantitative methods they choose to use to necessarily construct the (unobserved) WTO-consistent counterfactual.

¹⁰ For a discussion, see Pauwelyn (2008) in this volume.

¹¹ For a discussion of trade agreements as incomplete contracts and the analogy between the reciprocity approach to calculate appropriate trade sanctions and the concept of "expectation damages" in private contract law, see Sykes (2008) in this volume and the references therein.

¹² Nevertheless, there are also some limitations to such an approach that we also identify and describe in substantial detail below, especially when it comes to the question of *implementation* of such an approach in practice.

For illustrative purposes, we start our discussion of import-restricting measures with the case of tariffs. While none of the actual arbitration cases deals exclusively with this most simple trade policy measure, tariff analysis constitutes a valuable benchmark. Once we have established how the approach works to understand the basic tariff case, we then modify it appropriately to examine WTO-inconsistent quotas, which is relevant for five DSU arbitrations: the two *EC – Bananas* disputes (U.S. and Ecuador), the two *EC – Beef Hormones* disputes (U.S. and Canada), and the *U.S. – Internet Gambling* dispute. We then also extend the approach to consider the case of WTO-inconsistent domestic subsidies and other non-tariff measures, which are relevant for the arbitrations in *U.S. – Continuing Dumping and Subsidy Offset Act (Byrd Amendment)* and *U.S.-Antidumping Act of 1916*.

3.1 Import tariffs

In our benchmark case, we assume that governments have a single policy tool – import tariffs - at their disposal. At the initial WTO-type agreement between the two countries and before we introduce any shocks, the efficient level of the policies embedded in the agreement are given by τ^E, τ^{*E} , i.e., the efficient tariffs on imports of x (y) imposed by the respondent (complainant) country.

Panels a. and c. of figure 1 illustrate the demand (D_x and D_x^*) and supply (S_x and S_x^*) schedules for good x in the responding country and the complaining country respectively, while figure 1b. shows the export supply (X_x^*) and import demand (M_x) schedules in international markets. As we assume that the world is only composed of these two countries, export supply and import demand are entirely determined by the domestic conditions in the respondent's and the complainant's markets. In particular, notice that for the relevant price range, the complainant produces more of the good than it consumes and thus exports the rest, so that $X_x^* = S_x^* - D_x^*$, which is strictly positive for any price level larger than the equilibrium price in the complainant's market. On the other hand, the respondent consumes more than it produces and thus imports the rest, so that $M_x = D_x - S_x$, which is strictly positive for any

price lower than the respondent's equilibrium price under autarky. At the initial (efficient) tariff, the world price and the volume of trade are determined by the intersection of the export supply (X_x^*) and import demand (M_x^0) schedules at point E^0 in figure 1b., which we denote with $P_x^0 \equiv P_x(\tau^E)$ and $Q_x^0 \equiv Q_x(\tau^E)$.

Now assume that the respondent (R) country experiences a shock and unilaterally alters its policy from this initial level to some (non-prohibitive) level τ^1 . The introduction of a higher non-prohibitive tariff ($\tau^1 > \tau^E$) in country R increases its domestic price and lowers the price in the international market, as the reaction of exporters to the increased cost creates an excess demand for the good in the respondent's market and excess supply in the international market. Because of these price changes, producers in R supply more of the good and consumers demand less (see figure 1a.), while in country C producers supply less and consumers demand more (see figure 1c.). This implies a shift down in the import demand schedule in figure 1b. from its original position M_x^0 to the new level M_x^1 . In the new equilibrium (E^1), imports and exports are lower. The effect of the restrictive measure on the volume of trade corresponds to a fall from Q_x^0 to $Q_x^1 \equiv Q_x(\tau^1)$. The introduction of this new and more restrictive measure in country R will affect the price of good x which falls from its initial level $P_x^0(\tau^E)$ to the lower level $P_x^1(\tau^1)$.

We next turn to the key question facing WTO arbitrators: what is the level of retaliation to which the complainant is entitled? I.e., what is C's permitted retaliatory response via a change of its tariff policy τ^* on imports of y from the respondent?

We use the principle of reciprocity to determine the limits the arbitrators set for C's permissible retaliation. Under the reciprocity approach, the complainant is allowed to introduce a retaliatory policy measure (call it τ^{*Ret}) – i.e. a trade restrictive measure on the imports of good y from country R – such that the value of export and import trade volumes between the two countries is stabilized, that is:

$$P_x^0(\tau^E)[Q_x^0(\tau^E) - Q_x^1(\tau^1)] = P_y^0(\tau^{*E})[Q_y^0(\tau^{*E}) - Q_y^{\text{Ret}}(\tau^{*\text{Ret}})], \quad (1)$$

where $P_y^0(\tau^{*E})$ is the initial export price of good y , $Q_y^0(\tau^{*E})$ are initial imports and $Q_y^{\text{Ret}}(\tau^{*\text{Ret}})$ is the volume of imports under the more restrictive measure.¹³

Figure 1b provides a graphical interpretation of the level of retaliation that the arbitrators accord to the complainant under the reciprocity approach defined by equation (1). The reciprocal retaliatory response that would preserve the terms-of-trade between the respondent and the complainant corresponds to the volume of lost trade ($Q_x^0 - Q_x^1$) evaluated at the original export price (P_x^0) – i.e., the left-hand side of the reciprocity condition equation (1). The value of the trade-effect corresponds to the shaded area in Figure 1b. Not surprisingly, this area is equal to the sum of the shaded areas in figure 1a. (i.e., the value of loss imports at original export price) and the sum of shaded areas in figure 1c. (i.e., the value of loss exports at the original export price).

3.1.1 Actual DSU arbitrations over import tariffs

While no arbitrations to date have involved purely a WTO-inconsistent tariff restrictions, insights from this section will be important to helping us understand some elements of the two *EC – Beef Hormones* arbitrations described in section 3.2.1 below.

¹³ As in Bagwell and Staiger (2001a, p. 300), when introducing a numeraire good z , the general equilibrium condition for reciprocity can be defined as

$$P_x^0(\tau^E)[Q_x^0(\tau^E) - Q_x^1(\tau^1)] + Q_z^1(\tau^1, \tau^{*\text{Ret}}) - Q_z^0(\tau^E, \tau^{*E}) = P_y^0(\tau^{*E})[Q_y^0(\tau^{*E}) - Q_y^{\text{Ret}}(\tau^{*\text{Ret}})],$$

where Q_z denotes domestic country imports of the numeraire. It is easy to verify that condition (1) in the text continues to hold in this general equilibrium model for small shocks - i.e., for small effects of tariff changes on domestic imports of the numeraire good.

3.2 Import quotas

While none of the arbitrations we examine focused solely on the a breach of a tariff commitment, we can apply the logic just discussed to evaluate the level of nullification or impairment in the case of a WTO-inconsistent quota. Five out of ten arbitrations between 1995 and 2007 have dealt with this kind of trade restricting measure.

We begin our analysis of WTO-inconsistent quotas with all of the same modelling assumptions in subsection 3.1 – with the sole exception that the respondent country is now assumed to only have access to an import quota policy on good x instead of an import tariff. Again, we start from an politically efficient trade agreement reflecting the government’s politically-weighted objective function, which implies a trade restrictive quota binding in country R.¹⁴ This situation is depicted in figure 2a., which focuses only on the central panel of figure 1, illustrating the equilibrium in the international market. Differently from the tariff, the quota directly limits the amount of imports to the initial level Q_x^0 , which explains the kinked shape of the import demand function in figure 2a. The kink reflects the binding nature of the quota as, for prices lower than the initial export price P_x^0 , country R is willing to import larger quantities of the good, as in the dotted line, but this is prevented by the existence of the quota limit.

Suppose now that the respondent experiences the same sort of political shock and responds by changing its politically optimal quota from the WTO-consistent volume Q_x^0 to the more restrictive and WTO-inconsistent volume Q_x^1 . As a consequence of the imposition of this new measure, import demand from country R shifts in from M_x^0 to the new level M_x^1 . The effect of the lower quota is to increase the consumer price for the respondent to P_x^1 as the quantity demanded will exceed the quantity supplied by domestic and foreign producers. Furthermore, the price received by the complainant's exporters falls to P_x^2 .

¹⁴ We stress again that the quota is also "politically optimal" and is thus efficient in light of the government’s objective function.

Before we define the reciprocity condition used to determine the level of retaliation that the arbitrators accord to the complainant, we note one additional complication for the instances in which a quota is used in lieu of a tariff, due to the question of how the import quota licences are allocated. Because the quota limits competition in the respondent market, the price of good x in the respondent market is higher than the world price the exporters would receive for sales of the same good in other markets, and thus merely the right to export to this market – what we refer to as the quota licence – is something of value that can be bought and sold. Thus in order for the arbitrator to determine the complainant exporter’s received price for its sales of x in the respondent market, the arbitrator must know the form of the quota licence allocation regime as well as its WTO consistency. In figure 2a, the value of the quota licences – or what is frequently referred to as the ‘quota rent’ – is given by the cross-hatched rectangle.

Consider the range of extremes for potential WTO-consistent licensing schemes. First, if a party within the *complaining* country (e.g., exporting firms or their government) receives the quota licenses directly without payment and quota rent benefits, then the relevant original exporter price is P_x^0 , and thus, modifying equation (1), the reciprocity defined level of retaliation permitted to the complainant country is given by:

$$P_x^0 [Q_x^0 - Q_x^1] = P_y^0 (\tau^{*E}) [Q_y^0 (\tau^{*E}) - Q_y^{\text{Ret}} (\tau^{*\text{Ret}})]. \quad (2)$$

Graphically in figure 2a, the permitted level of retaliation corresponds to the combined shaded and the cross-hatched areas.

At the other extreme, if the WTO-consistent licensing regime allows only for *non-complaining* country parties to receive licences, then the effective foreign export price under the WTO-consistent quota is P_x^3 (and not P_x^0), since the foreign exporters would have to pay a price (equivalent to $P_x^0 - P_x^3$)

simply to acquire a licence, therefore driving down the effective price they receive for their exports. In this event, the modification to equation (1) results in a reciprocity condition given by

$$P_x^3 [Q_x^0 - Q_x^1] = P_y^0 (\tau^{*E}) [Q_y^0 (\tau^{*E}) - Q_y^{\text{Ret}} (\tau^{*Ret})]. \quad (2')$$

In this case, the appropriate level of nullification or impairment in figure 2a corresponds to the fraction of the shaded area below the price P_x^3 only.

These are the two extreme cases, and it is also possible to allocate some of the licences to foreign entities directly and some to non-foreign entities which the foreign exporter would then have to acquire through payment to export. In this instance a portion of the quota rent rectangle in figure 2a would be allocated to each group which increases the effective price received by foreign exporters above P_x^3 but still below P_x^0 . What is important to note is simply that information on the WTO-consistency of the quota licensing scheme itself is a necessary condition for determining the exporter's received price, an element necessary to implement the reciprocity formula of either equation (2) or (2').

Before turning to the actual DSU arbitrations involving quotas, we make a final remark on the relationship between quota licences, retaliation, and the reciprocity conditions of equations (2) and (2'). If the *only* WTO-inconsistency associated with a quantitative restriction is the way in which import licences under the quota were distributed, the reciprocity approach of equations (2) or (2') implies zero retaliation for the complainant country. This result is because there was no trade volume effect ($Q_x^0 - Q_x^1 = 0$) of the respondent's WTO-inconsistent measure.

3.2.1 Actual DSU arbitrations over import quotas: *EC – Bananas*, *EC – Beef Hormones*, and *U.S. – Internet Gambling*

In this section we use the methodological framework of section 3.2 to help interpret what the arbitrators have done in practice. Five out of the ten arbitrations that took place between 1995 and 2007 were challenges to WTO-inconsistent quantitative restrictions: the two *EC – Banana* disputes (U.S., Ecuador), the two *EC – Beef Hormones* disputes (U.S., Canada) and the *U.S. – Internet Gambling* dispute. As the model presented in figure 2 suggests, the arbitrators require three pieces of information to implement equation (2') if they seek guidance from the reciprocity approach to determining the level of countermeasures that the complainant parties can impose: the actual level of exports under the WTO-inconsistent regime (Q_x^1), the counterfactual level of exports under a WTO-consistent regime (Q_x^0), and the counterfactual exporter price under a WTO-consistent regime (e.g., P_x^3).

EC – Bananas

Consider first the initial *EC – Bananas* arbitration, in which the complainant was the United States.¹⁵ This is an interesting and precedential dispute in its own right as it was the first ever DSB case to proceed to the stage of arbitration. Since *EC – Bananas* dispute involving Ecuador as a complainant had the same arbitrators and process for determining the appropriate level of countermeasures, we focus our discussion on the U.S. arbitration.¹⁶

Evidence from the *EC – Bananas* arbitrators' report is broadly consistent with the idea that they followed a "reciprocity approach" formula analogous to equation (2') to determine the limit to

¹⁵ *European Communities - Regime for the Importation, Sale and Distribution of Bananas - Recourse to Arbitration by the European Communities Under Article 22.6 of the DSU - Decision By the Arbitrators*, WT/DS27/ARB, 9 April 1999. For the Ecuador arbitration, see *European Communities - Regime for the Importation, Sale and Distribution of Bananas - Recourse to Arbitration by the European Communities Under Article 22.6 of the DSU - Decision By the Arbitrators*, WT/DS27/ARB/ECU, 24 March 2000.

¹⁶ A separate and interesting issue for the Ecuador dispute was not on how the level of countermeasures was constructed, but the question of how Ecuador would have been authorized to implement them – i.e., via a potential withdrawal of TRIPs commitments, instead of via a withdrawal of tariff commitments under the GATT.

permissible U.S. countermeasures. First, the arbitrators determined the actual volume of U.S. banana exports under the WTO-inconsistent regime (Q_x^1) from data on wholesale services trade for bananas sold in the EC market, and the U.S. share of this EC import market derived from the U.S. share of allocated import licences to the overall EC banana market. Then, the arbitrators sought information on the counterfactual level of exports (Q_x^0) and exporter price (P_x^3) that would occur under a WTO-consistent policy.

However, even if the arbitrators follow the reciprocity approach, the politically and economically challenging part of the arbitrators' exercise is, of course, to construct the appropriate counterfactual to deduce information on Q_x^0 and P_x^3 .¹⁷ While the arbitrators' exact methodology and data used is not publicly available from their report, their logic appears to have been the following. First, to determine the relevant exporter price, they essentially assumed that a WTO-consistent regime would leave the overall volume of imports (from all foreign sources) unchanged, and that EC production would also remain unchanged. Under this set of assumptions, the exporter price under the counterfactual that would need to be known is the same as the current exporter price, which is a statistic available in the current year's data. In terms of figure 2a., this implies that in the relevant range the export supply schedule of the U.S. is flat (i.e., infinitely elastic) at the current export price (i.e., $P_x^3 = P_x^2$). Second, the arbitrators requested that the U.S. provide them with information on U.S. exports of bananas from four different counterfactual regimes that might be considered WTO-consistent. While it is unclear what caused the arbitrators to choose one of these proposed scenarios over the others, the arbitrators used those submissions to

¹⁷ The process was politically challenging in this instance as the arbitrators first had to decide on what would have been a WTO-consistent EC banana import policy – i.e., a policy itself that had never been in place. The process was also economically challenging as the arbitrators had to then take the WTO-consistent policy as given and then potentially use quantitative economic tools to determine the U.S. export response under such a policy. We do not comment here on whether their political or economic approaches were appropriate in this case, as the information provided in the report was not sufficient to allow us to form such an assessment.

construct their own measure for the counterfactual level of exports under a WTO-consistent regime, i.e.,

$$Q_x^0$$
¹⁸

A final item to note from this dispute is the role of quota licences, again with reference to figure 2a. As highlighted in the theoretical section, whenever a trade restriction is imposed as a quota, arbitrators subsequently require additional information on the WTO-consistent licence allocation scheme in order to determine the export price to implement the reciprocity formula. For instance, if a WTO-consistent scheme is such that quota licenses are attributed to the U.S. exporters, then the relevant counterfactual exporter price would be P_x^0 rather than P_x^3 . As shown in figure 2a. (the cross-hatched area), the maximum admissible retaliation in the quota cases crucially hinges on the appropriate counterfactual export price which, in turn, depends on the decision on the WTO-consistent licensing scheme. From the information available in the report, however, it is difficult to assess the arbitrators' decision on this issue.

EC – Beef Hormones

The next set of disputes involves the EC imposing WTO-inconsistent quantitative restrictions over hormone-treated beef imported from the United States and Canada.¹⁹ While we again find that the arbitrators' process of determining the U.S. and Canadian level of countermeasures is related to the reciprocity approach, the arbitrators deviated from the exact formulation along a number of dimensions. For space constraints, we focus here on the arbitrators' methodology in the U.S. case as the Canadian case was similar.

¹⁸ In order for the arbitrators to implement the reciprocity approach, they require information on the volume of U.S. exports under the counterfactual and not the value. Nevertheless, given their assumptions discussed above which led them to separately determine exporter prices under a WTO-consistent counterfactual regime, they could easily use those prices and the proposed value of exports to back out a volume number.

¹⁹ *European Communities – Measures Concerning Meat and Meat Products (Hormones) Original Complaint by the United States - Recourse to Arbitration by the European Communities Under Article 22.6 of the DSU - Decision By the Arbitrators*, WT/DS26/ARB, 12 July 1999; *European Communities – Measures Concerning Meat and Meat Products (Hormones) Original Complaint by Canada - Recourse to Arbitration by the European Communities Under Article 22.6 of the DSU - Decision By the Arbitrators*, WT/DS48/ARB, 12 July 1999.

As relevant background information, the dispute involved two differentiated products. The arbitrators necessarily separated the two products for the reason that each product faced its own counterfactual WTO-consistent regimes – i.e., one was a quantitative restriction and the other was a tariff. The first product is EC imports of high quality beef (HQB) that had been banned because it had been treated with hormones, but a product for which the WTO-consistent policy was for the EC to have a defined quota programme of 11,500 tonne limit per year. The second product was edible beef offal (EBO) also treated with hormones and to which the EC applied a ban, but in the absence of a ban would have faced an EC tariff and not a quota. The implication is that for the arbitrators, for one product (HQB) the approach would be based on the insights from section 3.2 and figure 2, and for the other product (EBO), the approach would be based on a combination of insights from this section and section 3.1 on tariffs and thus figure 1. Thus we follow the arbitrators and analyze the two products separately. After separately calculating retaliation limits associated with the ban of each product, the arbitrators then summed their total.

First consider HQB, for which the WTO-consistent regime was a quota, and the arbitrators' determination of the counterfactual prices and quantities that would have occurred under the WTO-consistent regime – once again referring to figure 2a. and equation (2'). Here, the volume (Q_x^0) was relatively easy to calculate as it was the U.S. share of a previously determined EC quota of 11,500 tonnes per year.²⁰ While the logic of the counterfactual price that would have occurred under a WTO-consistent regime (P_x^3) is not articulated in the report, the arbitrators accepted a U.S. proposed price of \$5,342 per tonne and thus found it straightforward to obtain.

²⁰ The arbitrators also did have to determine how much of the share of the EC's 11,500 tonne quota would be allocated to the U.S. versus Canada, and they relied on data on the relative size of U.S. and Canadian HQB exports to common third markets to determine shares within the quota had the ban not been in place – resulting in 92% for the U.S. and 8% for Canada. Second, the EC quota would have actually been implemented as a tariff rate quota and not a pure quota – i.e., the in quota tariff rate was 20% ad valorem, and the out of quota tariff rate was reportedly prohibitive. With respect to figure 2, the tariff rate quota grants the quota rents (cross-hatched rectangle) to the government via tariff revenue, and the price received by U.S. exporters would be P_x^3 .

Thus far, the arbitrators follow the reciprocity approach of equation (2') as modified to fit the facts for HQB. The potential deviation from this approach occurs in the arbitrators' determination of the *actual* volume of U.S. and Canadian beef exports under the WTO-inconsistent regime – i.e., Q_x^1 in figure 2a.²¹ Unlike the *EC - Bananas* case, the arbitrators deviated from equation (2') because they relied on an estimate of the current *value* of EC imports of HQB from the U.S., i.e., $P_x^2 * Q_x^1$ from figure 2b, and not the current *volume* (Q_x^1).²²

What are the implications to using this formulation of reciprocity that differs slightly from equation (2')? Instead of using the shaded area below P_x^3 on figure 2a and thus $P_x^3 * (Q_x^0 - Q_x^1)$, the arbitrators used a formula given by $P_x^3 * Q_x^0 - P_x^2 * Q_x^1$, which corresponds to the shaded area in figure 2b. As is clear from a comparison of the figures, this formula change allows for a *higher* level of countermeasures provided $P_x^2 < P_x^3$, i.e., the current price received by U.S. exporters was *lower* than the counterfactual exporter price that would be received under a WTO-consistent regime.

In the second case of the second beef product (EBO) the arbitrators were required to make a similar determination to what they had done for the HQB product retaliation, although in important ways the determination was more complex because the WTO-consistent regime was a tariff and not a quota. First, note that when it came to EBO, the arbitrators followed their own HQB formula and calculated the EBO retaliation limit given by the $P_x^3 * Q_x^0 - P_x^2 * Q_x^1$ formula instead of the reciprocity approach given

²¹ Calculation of this exercise was controversial in *EC – Beef Hormones*, although for reasons not central to our topic. The argument between the EC and U.S. focused on the degree to which the EC ban on hormone-treated had reduced current exports of HQB. The U.S. argued that it was effectively a ban and thus the value of imports should be zero, while the EC disagreed and presented information on imports from the U.S. of HQB that had been allowed entry into the EC because, after testing, they were found not to have been treated with hormones. The arbitrators chose some middle ground and determined the value of U.S. current exports of non-hormone treated HQB to be \$23,853,584. The issue is one that arguably could have been resolved and addressed using quantitative economic techniques that we discuss in more detail below.

²² See paragraphs 43 and 62 in the report. Interestingly, had the arbitrators adopted the approach taken in the U.S. submission, the value and volume of current would have been the same – i.e., zero – and thus the question of whether the arbitrators were using the appropriate price to precisely implement the reciprocity formula would not arise.

by $P_x^3 * (Q_x^0 - Q_x^1)$ and equation (2').²³ When it came time to implement this formula, the first item to note is that for the case of EBO, the arbitrators once again simply chose a counterfactual price, P_x^3 , that had been submitted to them by the parties. The choice received little discussion in the report and is a decision that raises the same economic questions as we identified above in our discussion of HQB, so we won't go into it further here.

Nevertheless, the interesting *differential* element worth highlighting is the quantitative techniques the arbitrators used to construct the values for Q_x^0 – i.e., the counterfactual volume of exports for EBO under a WTO-consistent regime. Because the counterfactual WTO-consistent regime for EBO was a tariff and not a quantitative restriction, the arbitrators would have to take some methodological approach to constructing their own value for Q_x^0 , since it would have been market-determined and not pre-determined by some negotiated quota limit as was the case for both HQB and *EC – Bananas*.

An economist would typically rely on knowledge of EBO producers' export supply response elasticities to construct the value for Q_x^0 that the arbitrators were forced to undertake in this exercise, even taking as given an acceptable value for P_x^3 – i.e., the counterfactual exporter-received price, perhaps under the assumption that the exporter is “small” and unable to affect world prices by changing their quantities supplied.²⁴ While the arbitrators were aware of the market forces that would affect the level of imports under the WTO-consistent counterfactual (see paragraph 70), there is no mention of such elasticities in the report. Instead the description of their approach suggests that arbitrators made their determination for Q_x^0 by simply relying on historical trends in the data and making adjustments for EC demand-side changes during this time period.

²³ See paragraph 72 in the report.

²⁴ See, for example, Francois and Reinert (1997). See also Armington (1969).

U.S. – Internet Gambling

The final DSU arbitration involving a WTO-inconsistent quota is the case Antigua and Barbuda brought against the U.S. import ban on internet gambling services.²⁵ Compared to the arbitrations discussed thus far, at least two additional items from this case are worth highlighting: the formula the arbitrators adopted and the empirical difficulty the arbitrators confronted in order to implement the formula in this application.²⁶

First, the arbitrators appear to have followed an approach that is quite close to the reciprocity formula and equation (2'). If the U.S. measure in question essentially resulted in a ban on internet gambling services from Antigua, the current volume of exports (Q_x^1) needed to implement the formula is equal to zero.²⁷ Next, the arbitrators then attempted to calculate the counterfactual value of exports ($P_x^3 Q_x^0$) under a WTO-consistent U.S. policy toward imports of internet gambling services from Antigua. When $Q_x^1 = 0$, calculation of equation (2') simply reduces to calculation of $P_x^3 Q_x^0$.

While the arbitrators' report in this dispute is particularly transparent in that makes clear the formula they were attempting to follow, the actual computation of $P_x^3 Q_x^0$ appears to have been extremely challenging – both for reasons of data availability and the need to implement relatively sophisticated quantitative economic techniques. First, it is a well known general problem that trade flow data on the provision of services are typically very poor and difficult to obtain – data collection agencies

²⁵ *United States - Measures Affecting the Cross-Border Supply of Gambling and Betting Services Recourse to Arbitration by the United States under Article 22.6 of the DSU – Decision by the Arbitrators*, WT/DS285/ARB, 21 December 2007.

²⁶ We do not comment on the question of the appropriateness of the arbitrator's choice of actual WTO-consistent counterfactual, but we simply focus on the formula for its determination and the quantitative techniques needed to employ it in practice. As we describe elsewhere, economics could potentially play a role in the arbitrator's step 2 decision of the WTO-consistent policy – for example, if there are multiple such WTO-consistent counterfactuals, economic techniques could be used to help the arbitrators rank (and choose between) them on efficiency grounds, equity grounds, etc. See also the Sebastian (2008) discussion in this volume.

²⁷ Indeed, in other potential cases in which the WTO-inconsistent policy is not a complete ban, it may be difficult to obtain Q_x^1 since services trade data are typically only reported in values (i.e., $P_x^2 Q_x^1$) and not volumes, which could result in the same sort of formula applied by the arbitrators in *EC – Beef Hormones* discussed above, with similar implications for the magnitude of the size of the retaliation vis-à-vis the formula of equation (2').

have not simply not devoted sufficient resources to track services flows at the same level of detail as is the case for goods trade. Thus, the arbitrators were constrained by the relatively poor data with which they were given to work. Second, even after the WTO-consistent counterfactual decision, determining an actual value for $P_x^3 Q_x^0$ relied on quantitative techniques in order to transform information on the most recently available and useful data (from the pre-2002 period) when Antigua had access to the U.S. gambling market, to a scenario accurately reflecting what Antigua's market access at the time of the arbitration would have been in the absence of the WTO-inconsistent U.S. measure.²⁸

3.3 Non-tariff measures on imports that violate national treatment

In addition to traditional trade policy tools, such as tariffs and quotas, governments may impose non-tariff measures (NTMs) that ultimately alter conditions of competition between domestic and foreign producers. Examples include the introduction of new laws and regulations that discriminate by increasing costs to foreign export suppliers vis-à-vis those facing domestic firms that produce like products, thus forming some violation of national treatment. While there are many examples of such DSU cases involving national treatment violations, *US-Antidumping Act of 1916* is an example of such a dispute that went to arbitration. The case involved a U.S. piece of legislation which potentially allowed dumped imports to be faced with treble damages, fines or imprisonment rather than tariffs authorized by the WTO's Antidumping Agreement. The EC argued that the U.S. law thus violated national treatment and caused a "chilling effect" on EC exports to the U.S.

To begin our theoretical analysis of such NTMs that violate national treatment, we again assume an efficient initial trade agreement between the countries. After receiving the political shock, we assume that the respondent country's only available policy tool is not a new tariff or quota, but a new domestic

²⁸ In order to determine the value of Antigua and Barbuda's internet gambling service exports at the time of the arbitration (2007), the arbitrators used quantitative economic techniques to address and control for market phenomenon such as i) changes in U.S. demand that had taken place since 2002, as well ii) supply-side changes that would have likely taken place given the evolution of the global market for such services such as new competition by other foreign competitors that would have likely eroded Antiguan market share, given the initial level of super-normal profits in the industry and low entry barriers.

legislation that increases the costs of exporting into the respondent's market. In the central panel in figure 3, which shows the respondent's import demand and the complainant's export supply, this is captured by an upward shift of the export supply curve (from X_x^{*0} to X_x^{*1}), as exporters at the original price are less willing to supply the respondent's market. In the new equilibrium (E^1) the volume of exports is lower compared to the original equilibrium (from Q_x^0 to Q_x^1), and the price that the exporters receive is now higher (from P_x^0 to P_x^2).

The formulaic reciprocity approach to determining the limit to the complainant's countermeasures is straightforward to apply, as equation (1) continues to hold. Under this formula, the arbitrators allow the complainant to retaliate up to the level of lost trade calculated at the original export prices, as shown in the shaded area in figure 3. Therefore, in order to implement the formula, the arbitrators again require information as to the current level of exports (Q_x^1), and the counterfactual level of exports (Q_x^0) and export price (P_x^0) under a WTO-consistent regime.

Nevertheless, an important practical implication arises in these kinds of cases, and is very similar to what we observed in the *EC – Beef Hormones* arbitration and the construction of a WTO-consistent counterfactual for edible beef offal (EBO) described above. The exact quantification of the effects of national treatment violations relies on an uncertain counterfactual – i.e., the inward movement of the complaining country's export supply curve. This fact makes the quantification of the appropriate response more complex than the analogous problem in presence of applied measures such as import tariffs. Here, the quantification requires information on the size of the non-tariff measure – i.e., how much the export supply curve shifts back – as well as information on the expected import demand elasticity response if that non-tariff measure were removed.

3.3.1 Actual DSU arbitrations over NTMs on imports that violate national treatment: U.S. – *Antidumping Act of 1916*

In this particular dispute, the United States was found to have a piece of domestic legislation – the Antidumping Act of 1916 – that permitted the imposition of penalties that were inconsistent with obligations set out in the WTO's Antidumping Agreement.²⁹ A DSU arbitration thus determined the appropriate level of countermeasures that the EC could impose, finding that it could retaliate up to the level of damages that U.S. courts had imposed on EC firms ("entities") under the 1916 Act as well as settlements agreed to by EC firms being prosecuted under the Act.³⁰

While such a retaliatory determination is unrelated to the reciprocity approach described in the last section, we do point to one particular element of the arbitration that is relevant to such an approach. In particular, the EC made the argument to the arbitrators that the U.S. Antidumping Act of 1916 legislation imposed a "chilling effect" on European exporting firms. In the context of our economic model and figure 3, such an effect can be represented as an extra cost facing foreign exporters that is not borne by domestic, import-competing firms in the U.S. Thus this piece of U.S. legislation shifts in the EC's export supply curve in figure 3b. From this theoretical perspective, it is possible for arbitrators to use the reciprocity formula approach to determine permissible EC retaliation for the trade effects illustrated there.

In practice, of course, it would have been extremely challenging for arbitrators to calculate the trade effects associated with the Antidumping Act of 1916 legislation. Quantification of the chilling effect requires determining the WTO-consistent counterfactual equilibrium E^0 , and thus the counterfactual export price (P_x^0) as well as level of exports (Q_x^0). An accurate assessment requires calculating the chilling effect on a product-by-product basis for all EC products that had had their exports diminished by

²⁹ *United States - Anti-Dumping Act of 1916 (Original Complaint by the European Communities) Recourse to Arbitration by the United States under Article 22.6 of the DSU – Decision by the Arbitrators*, WT/DS136/ARB, 24 February 2004.

³⁰ This led to zero retaliation in this instance as there had been no penalties imposed on EC firms, and neither party provided verifiable evidence of settlements involving EC firms that had been prosecuted under the Act. Nevertheless, the arbitrators did allow for future retaliation should such damages be incurred in the future before the U.S. brought the 1916 Act into WTO compliance.

the WTO-inconsistent policy. Individual calculations for thousands of such products may make such an approach infeasible to implement in practice, if we learn lessons from the *U.S. – Byrd Amendment* arbitration discussed below, which similarly failed to produce product-by-product calculations despite the fact that there were many fewer such products in that instance to assess. Nevertheless, it should be pointed out that a number that is difficult to calculate is not necessarily equivalent to zero, which is the amount both the arbitrators as well as the two parties quantitatively attached to the chilling effect in the actual arbitration in *U.S. – Antidumping Act of 1916*.

3.4 Domestic subsidies to import-competing firms

In this subsection we examine domestic production subsidies. Unlike the export subsidies that are the focus of section 4, domestic production subsidies are not, in principle, a trade-policy measure. However, such government transfers can affect expected market access to foreign firms that WTO commitments are designed to protect. We illustrate this case in figure 4.

Assume that the government in R departs from an efficient agreement by providing an illegal production subsidy, s , to its import-competing sector.³¹ As usual, a political shock such as the increased weight on producers' surplus may rationalize the underlying government decision to impose the new measure. Provided the domestic producers utilize at least part of the subsidy to expand domestic supply, as is the case for production subsidies by definition, then we expect an outward shift of the supply schedule in the respondent's market (from S_x^0 to S_x^1), depicted in figure 4a. As the respondent is a net importer of the good, increased domestic production leads to a reduction in import demand from M_x^0 to M_x^1 in figure 4b. In the new equilibrium (E^1), the export price falls from P_x^0 to P_x^1 , which is a terms-of-trade deterioration for the complainant, and the volume of imports falls from Q_x^0 to Q_x^1 .

³¹ An important point to note is our assumption that the subsidy to import-competing producers is tied to production. On the other hand, if the transfer is just redistributed lump-sum to share holders, we should not observe any relevant effect on production and trade. However, if domestic producers utilize at least part of the subsidy to expand domestic supply this will affect the import demand curve and reduce market access to the foreign exporting firms.

Figure 4b. illustrates how the impact of the WTO-inconsistent domestic production subsidy is analogous to an import restrictive measure such as the import tariff illustrated in figure 1 and described in section 3.1 - the volume of trade is lower than in the absence of such a measure. Under the reciprocity approach, the complainant is entitled to a level of retaliation equal to the shaded area in figure 4b, once again permitted to impose a retaliatory tariff that restricts its imports from the respondent under the formula given by equation (1).

3.4.1 Actual DSU arbitrations over domestic subsidies to import-competing firms: U.S. – *Continuing Dumping and Subsidy Offset Act (Byrd Amendment)*

The *U.S. –Byrd Amendment* case involved U.S. firms that had petitioned for antidumping and countervailing measures and subsequently received the revenue from the duties collected. We use the theoretical framework described in the last section to analyze the actual arbitration that took place.³²

Because the arbitrators' report clearly signals a preference for the methodology of the U.S. approach in the actual arbitration, we begin with a brief description of it. The U.S. approach broadly corresponds to the reciprocity formulation developed above and the shaded area in figure 4b., and it focused on three substantial points. First, the effect that the revenue remittances had on domestic production should be estimated at the product level. Second, the trade effect should be calculated by using estimates of the elasticities of the United State's export supply and of the complaining party's import demand at the product level. Third, the calculation of the appropriate limit for the retaliatory countermeasures would then need to result from the sum of these individual values. Based on this model, the U.S. concluded that the trade effect of the WTO-inconsistent measure is null, as the payments did not result in any increase in production. In terms of the figure 4a., this is equivalent to saying that the effect of

³² *United States – Continued Dumping and Subsidy Offset Act of 2000. Original Complaint by the European Communities. Recourse to Arbitration by the United States under Article 22.6 of the DSU. Decision by the Arbitrators, WT/DS217/ARB/EEC, 31 August 2004.*

the Byrd Amendment payments to U.S. firms led to no shift in the in the domestic supply curve (from S_x^0 to S_x^1).

While the arbitrators indicated sympathy to the U.S. proposed methodology for establishing the retaliation limits (paragraph 3.114), they ultimately disagreed with how the U.S. implemented the model and based their reasoning on two fundamental arguments. First, the arbitrators felt that the effect of the revenue remittances on domestic production would be generally different from zero. Second, the U.S. had chosen not to implement the model for a number of products covered by antidumping or countervailing duties that the arbitrators decided should have been part of the calculation. Therefore, while the arbitrators signalled in their report a preference to use an approach that appeared consistent with the reciprocity formula that would be implemented at the product-level, they were constrained to adopting a more aggregated approach that utilizes a less data-intensive methodology.

The arbitrator's actual approach relied on an "economically determined" coefficient (72%) that is then multiplied by the level of the subsidy (see figure 4a. under the assumption that –a fraction of- the remittances worked as a production subsidy) to provide an estimate of the value of loss trade (in figure 4b.). This coefficient is meant to capture the value of the trade effect of the WTO-inconsistent measure: each dollar paid to petitioning firms reduces the value of exports of the complainant by 72 cents. A key issue is, therefore, how such value was calculated. The broad idea is that the aggregate trade effect would be the product of three elements: the price reduction caused by the payment ("pass-through," in the language of the report), a substitution elasticity of imports and import penetration. Arbitrators used adjusted data provided by the parties to estimate an annual value of the trade-effect coefficient for each year between 2001 and 2003 and calculated the average for the period.

As an empirical matter, it is admittedly difficult to assess whether the actual level of retaliation proposed by the arbitrators is consistent with the reciprocity approach discussed in the previous section. The two levels in figures 4a. and 4b. are related, but they can be generally quite different when evaluated on a product by product basis. The coefficient attempts to average out these effects by providing a single

number and is an imperfect substitute for a more detailed and disaggregated approach. However, we do note that the aim of the arbitrators' approach in this case is quite clearly to utilize available data to evaluate the *trade effect* of the subsidy. As we discuss in the next section, this is not necessarily the case for WTO-inconsistent *export* subsidies.

4 WTO Disputes and Retaliation over Export-Promoting Measures

We now turn our attention to WTO-inconsistent policy measures that a respondent country R implements that have the effect of excessively promoting exports. Examples of such policies include government transfers to the export sector such as export and production subsidies. The theory of trade policy clearly documents how such measures have fundamentally different effects on trade volumes and the terms-of-trade when compared to import restraining policies. However, we show that, in a number of instances that are relevant for DSU cases and arbitrations, the logic of the reciprocity approach still delivers interesting insights. Namely, such instances rely on presence of an export market in a third country in which both the complainant and the respondent jointly sell their goods.³³

4.1 Export subsidies in a three-country model

We begin our investigation of the role for retaliation by looking at export subsidies. Bagwell and Staiger (2001b) show how a subsidy agreement that limits government payments and avoids subsidy escalation can be of value to governments of exporting firms. Without such an agreement, each government is tempted to subsidize its exporters so as to create a competitive advantage in a third market – i.e., a prisoners' dilemma problem.

Here we extend section 3's theoretical model that examined import-restricting measures in two important directions. First, we introduce a third good (that we call z) which both the complainant (C) and the respondent (R) export to a third country that we refer to as the rest of the world (ROW), again under

³³ Absent this assumption, as we discuss in a later section, it is unclear why export promoting policies are a problem in the first place, which suggests that we may need a different model to rationalize existing rules.

the assumption of competitive market conditions. Second, we allow the governments of countries R and C access to an export promoting policy tool (s) that affects good z , in addition to the tariff policies (τ, τ^*) that they can implement on one another's imports of x and y , respectively.³⁴ For simplicity, ROW does not use any policies to interfere with trade flows. This framework is a straightforward extension of Bagwell and Staiger (2001b). Furthermore, we begin from an efficient international agreement which binds the level of both import-restricting and export-promoting policy measures. We denote these levels with τ^E, τ^{*E} and s^E, s^{*E} , under the simplifying assumption that they are symmetric across countries and across goods.

Now assume that the government of the respondent country receives a political shock such as an increase to the political weight on exporters' interests so that it seeks to increase its export promoting policy for sector z to $s^1 > s^E$. The introduction of this new measure in country R will affect the volume of its export of good z to the rest of the world. As a result of excess export supply, the price of good z in international markets falls, thereby reducing country C's producers' market access in ROW as well as the price of their exports.

Figure 5a. illustrates this by focusing on the ROW import market for good z from the complainant country only, thus abstracting from the respondent. It portrays ROW's net import demand from the complainant (M_z^0) and the export supply from country C (X_z^*). Before the shock in R, the equilibrium is at point E^0 , which implies an export price $P_z^0(s^E, s^{*E})$ and a volume of trade between the complainant and the rest of the world equal to $Q_z^0(s^E, s^{*E})$. The effect of the subsidy in R is to shift downward ROW's net import demand curve toward products deriving from exporters in C. Intuitively, the export subsidy in R allows its exporters to supply goods in international markets at a lower price, which reduces the demand for exports from country C. In the new equilibrium, denoted with E^1 , the

³⁴ Note for clarity that this good z is different from the numeraire good introduced in the general equilibrium version of the Bagwell and Staiger (2001a) model discussed in footnote 13.

price received by C's exporters $P_z^1(s^1, s^{*E})$ is lower and the quantity of exports of the complainant into ROW market falls from Q_z^0 to $Q_z^1(s^1, s^{*E})$. This policy change in R hurts the exporting sector in C by lowering its market access in the rest of the world and worsening its terms-of-trade.

We adopt the reciprocity approach to determine the level of complainant retaliation in response to its loss of market access in ROW. Formally, under the reciprocity approach the complainant is allowed to introduce a retaliatory trade restrictive measure (τ^{*Ret}) on the imports of good y from country R that is equal to the value of lost trade volumes at original export prices, i.e.,

$$P_z^0(s^E, s^{*E})[Q_z^0(s^E, s^{*E}) - Q_z^1(s^1, s^{*E})] = P_y^0(\tau^{*E})[Q_y^0(\tau^E) - Q_y^{Ret}(\tau^{*Ret})]. \quad (3)$$

The retaliation that the complainant is entitled to under the reciprocity approach corresponds to the shaded area in figure 5a. The left-hand side of the reciprocity condition above is the volume of loss trade for the complainant ($Q_z^0 - Q_z^1$) evaluated at the original export price, i.e., $P_z^0(s^E, s^{*E})$. Similar to the case of import-restricting measures, the reciprocity approach allows for a level of retaliation which preserves a balance of concessions.

Finally, compare the effects of export-promoting policies with those of import-restricting measures analyzed in the previous section. While the higher export subsidy in R leads to a contraction in complainant trade volume with the rest of the world just as was the case with import-restricting measures, the *overall* effect of this subsidy policy on trade is to *expand* trade volumes. The subsidy thus *creates* more trade between R and ROW than is lost between C and ROW, and for this reason, the terms-of-trade improves for the consuming importers in the rest of the world.

4.1.1 Actual DSU arbitrations over export subsidies and third country effects: *Canada – Aircraft Subsidies, Brazil - Aircraft Subsidies, and U.S. – Foreign Sales Corporations (FSC)*

Before describing actual DSU arbitrations over export subsidies, it is worth using this economic model to make one additional point regarding GATT/WTO treatment of export subsidies. Under the countervailing duty provisions that have been part of the GATT/WTO since 1947, if a foreign government offers a subsidy to exporting firms that leads to injury in a domestic, import-competing industry, the government of the import-competing producers can unilaterally impose a countervailing duty. However, the magnitude of the response has been limited to *no larger than the amount of the subsidy*.³⁵

In the context of our earlier model, figure 5b now presents a second illustration of the ROW import market, but this time from the perspective of the respondent's export supply curves in the face of the respondent country's export subsidy (s^I) which shifts out the X_z^0 curve to X_z^1 .³⁶ Note that in the model, the value of the respondent's export subsidy is given by the cross-hatched area in figure 5b. It is clear from the figure that the size of the subsidy is related to its trade effect as a larger subsidy expands R's export supply schedule. However, it is not obvious that the size of the subsidy's value corresponds to the *trade effect* that we have been examining under the reciprocity formulation. The relationship between the sizes of shaded area in figure 5a. and the cross-hatched area in figure 5b. ultimately depends on the elasticities of ROW's import demand and R's export supply.

Naturally, one can make an argument, which may be relevant on practical grounds, that the size of the transfer may be easier to calculate than the value of the market access effect. Nevertheless, this is different from the reciprocity formula based on a theoretical approach to understanding the purpose of retaliation from a trade-balancing effect perspective (Bagwell and Staiger, 2002). We return to a discussion of this issue as it arises in the actual arbitrations on export subsidies discussed below.

³⁵ See, for example, the discussion in Sykes (2005).

³⁶ In this figure we abstract from the complainant's export supply curve, which is assumed to remain unchanged.

Canada– Aircraft Subsidies and Brazil - Aircraft Subsidies

The first two DSU arbitrations are the Canada (Bombardier) and Brazil (Embraer) aircraft subsidy cases.³⁷ These disputes fit the model as they relate to export subsidies given to firms that compete in third markets. In the first dispute that Canada brought against Brazil, Brazil was found to have provided WTO-inconsistent export subsidies via its export financing programme for Embraer regional jet aircraft that competed with Bombardier sales in third markets. In the second case, Canada was found to have implemented similar WTO-inconsistent policies – constructed as export credit and loan guarantees – to Bombardier's export sales of regional jets. In terms of timing, the Article 22.6 arbitration in the Brazil case was announced in August 2000, while the Canada case was announced in February 2003.

It is instructive to lump together the discussion of these cases for two reasons. First, they are clearly related in the sense of one country's WTO-inconsistent export subsidy scheme likely being in existence because of the other country's similar policy. Second, the arbitrators' logic in each dispute was similar. The arbitrators did not attempt to implement a reciprocity formula that would follow the trade effects approach that we introduced in the theoretical section. Instead, in each case, the arbitrators sought to establish a permissible level of retaliation simply commensurate with the size of the value of the export subsidy, i.e., the cross-hatched area of figure 5b given by $s^1 Q_z^1$.³⁸ As we have noted, the size of this area is not necessarily a good proxy for the size of the *trade effects* of the export subsidy – i.e., the volume of loss trade for the complainant ($Q_z^0 - Q_z^1$) evaluated at the original export price, i.e., $P_z^0(s^E, s^{*E})$. While there are a number of potential explanations behind why the arbitrators chose a different formula (the size

³⁷ See *Canada - Export Credits and Loan Guarantees for Regional Aircraft - Recourse by Canada to Article 22.6 of the DSU and Article 4.11 of the SCM Agreement - Decision by the Arbitrator*, WT/DS222/ARB, 17 February 2003; and *Brazil - Export Financing Programme for Aircraft - Recourse to Arbitration by Brazil under Article 22.6 of the DSU and Article 4.11 of the SCM Agreement - Decision by the Arbitrators*, WT/DS46/ARB, 28 August 2000.

³⁸ In the arbitration over Canadian subsidies in which Brazil was permitted to retaliate, the arbitrators added 20% to the size of the estimated Canadian subsidy under the argument that "the 'appropriate' level of countermeasures should reflect the specific purpose of countermeasures. Keeping this in mind, we are aware of the view that Canada's statement that, for the moment, it does not intend to withdraw the subsidy at issue suggests that in order to induce compliance in this case a higher level of countermeasures...would be necessary and appropriate." (paragraph 3.107, pp. 30-31).

of the export subsidy) than the reciprocity formula based on the trade impact of the measure,³⁹ it is also worth pointing out that the arbitrators discussed the trade impact of the subsidies and recognized that it might differ from the size of the actual subsidy itself.⁴⁰

Since the only WTO-consistent regime for export subsidies for these aircraft was zero, the only remaining task to implement the chosen formula is to use quantitative economics to compute the size of the subsidies. Computation of the size of the export subsidy in each of the arbitrations appears to have relied on standard techniques from financial economics. The arbitrators in each of the disputes took the basic approach of calculating the total discounted present value of the subsidy based on sales data and information on financing terms (interest rates) provided by the parties.

U.S. – Foreign Sales Corporations (FSC)

The final DSU arbitration that we consider is the retaliation the EC was authorized in response to U.S. imposition of WTO-inconsistent subsidies in the *U.S.- Foreign Sales Corporation (FSC)* dispute.⁴¹ An export subsidy such as that found in the *U.S. – FSC* case has the potential not only to have trade effects on exporting firms from complaining countries in third markets, but it is also quite possible that such a subsidy might also adversely affect the complaining countries' firms' sales in its own domestic market. In

³⁹ These would include arguments that the arbitrators pick the size of the subsidy in third market cases because 1) this is the analogue to the response under WTO permitted countervailing duty laws in two country models; 2) calculating trade effects in a third market model would require data and elasticities from third country markets (the importer) which do not face the same economic incentive to reign in the use of the subsidies since they benefit from lower import prices when they are in place; 3) for "lumpy" products such as aircraft, it may be difficult to precisely construct the trade impact of an export subsidy, 4) some of these subsidies may have dynamic (long run) effects, especially when they are allocated in markets with high fixed costs of entry.

⁴⁰ In the *Canada – Aircraft* case, the arbitrators indicated that "We agree in principle with Brazil that, in a market as competitive as the market for regional jets, even a limited difference in interest rates, if it allows a manufacturer to win a contract, may have a disproportionate impact, calculated on the basis of the trade impact, compared with the amount of subsidy granted." (paragraph 3.115, p. 32)

⁴¹ *United States - Tax Treatment for Foreign Sales Corporations - Recourse to Arbitration by the United States under Article 22.6 of the DSU and Article 4.11 of the SCM Agreement - Decision of the Arbitrator*, WT/DS108/ARB, 30 August 2002.

this section we limit discussion to the third-market effect and return to the latter effect after having introduced a two-country model of export subsidies in the next section.

Similar to the approach in the two aircraft subsidy disputes, the arbitrators' formula for establishing appropriate countermeasures was based on the size of the estimated subsidy that the U.S. gave its firms and not the trade effects embodied in the modified Bagwell and Staiger reciprocity formula.⁴² Nevertheless, the arbitrators in the *U.S. – FSC* dispute also did not rule out consideration of the trade effects approach, although nowhere in the report is there a description of either the parties or the arbitrators considering the formula, counterfactual, or quantitative techniques that would be needed to construct such a countermeasure limit in the same way that we observed and noted in *EC – Bananas*, *EC – Beef Hormones*, or *U.S. – Internet Gambling*, for instance.⁴³

In terms of implementing the formula once it has been decided, the choice of the WTO-consistent counterfactual was relatively straightforward in this dispute since the subsidy was prohibited. Thus, the remaining task for the arbitrators to use quantitative economic techniques to determine the size of the U.S. subsidy. In this particular case it was complicated by a number of factors – including the fact that, like the *U.S. – Byrd Amendment* and *U.S. – Antidumping Act of 1916* cases discussed above, the subsidy applied to many different firms, sectors, and products. Instead of doing a product-by-product approach to constructing the subsidy from the micro level and aggregating it upward, both of the parties relied on relatively aggregated models to construct estimates of the size of the subsidy – indeed, the EC even presented results based on a model used by the U.S. Treasury Department in an unrelated report it gave to the U.S. Congress in 1997 on the trade effects of the U.S. FSC policy. Nevertheless, in this particular instance, in order to make a decision on the size of the subsidy, the arbitrators were ultimately forced to

⁴² See also the discussion in Howse and Neven (2005).

⁴³ Indeed, the arbitrators state "We...do not rule out a priori that trade effects of the measure on the affected Member can enter into consideration in a particular case, as a relevant factor, in determining the 'appropriate' amount of countermeasures within the meaning of Article 4.10 of the SCM Agreement. Indeed, as we have previously noted, the expression 'appropriate countermeasures', in our view, would entitle the complaining Member to countermeasures which would at least counter the injurious effect of the persisting illegal measure on it." (paragraph 6.33, pp. 25-26).

confront and make assessments on a number of key inputs required to generate output from the models, including the parties' proposed values for "the reduction in the price of the good benefiting from the subsidy; the export response of producers benefiting from the subsidy; and the price elasticity of demand for U.S. exports" (footnote 90, pp. 27-28).

4.2 Export subsidies in a two-country model

Consider again the two-country model of section 3.1, but now assume that in addition to import tariffs, governments have another policy tool in their arsenal in the form of export subsidies. The initial situation corresponds, as before, to an efficient agreement and, in response to a political shock, the government in R increases its export subsidy to domestic producers of good y to the new politically optimal level. We study the effect of this policy change on the volume of trade and on the price, and use this to infer the appropriate level of retaliation under the reciprocity approach.

Figure 6 illustrates the consequences of increased export subsidies in R. The central panel illustrates the equilibrium in the international market. This figure portrays the export supply schedule of the respondent and the import demand schedule of the complainant. Both curves can be obtained (*mutatis mutandis*) with the same methodology described above for the tariff analysis.

The effect of the increased export subsidy is to create incentives for producers in R to export more for any given price, thus shifting downward the export supply schedule in figure 6b from X_y^0 to X_y^1 . As a result, an excess-supply is created in the international (and the complainant's) market and an excess-demand in country R which causes the price to fall in the international and the complainant's market (from P_y^0 to P_y^1) and to increase in the domestic market of the respondent (from P_y^0 to P_y^2), which in turn implies a higher quantity of exports (from Q_y^0 to Q_y^1).⁴⁴

⁴⁴ Even if in our notation (both in the text and in the figure) we do not show functional arguments, the reader should keep in mind that, relative to section 3, prices and quantities are now function of both tariffs *and* subsidies.

The fundamental implication of the policy change is that the respondent *increases* its market access in the international market (i.e., in country C's import market) at the expense of producers in the complainant country. Figure 6b. illustrates the reciprocity formula's level of retaliation as equal to the volume of trade distorted relative to the initial agreement ($Q_y^1 - Q_y^0$) calculated at original export price (P_y^0). This area is shaded in figure 6b. and is equal to each of the shaded areas in figures 6a. and 6c. Note finally in figure 6b. how, similar to the three country model export subsidy case derived in the last section, there is not necessarily an equivalence between the size of the value of the export subsidy (the cross-hatched rectangle) and the trade effect under reciprocity (the shaded rectangle).

While the intuition of the reciprocity approach remains unaltered in this model of export subsidies vis-à-vis the model with import-restraining policies – i.e., the retaliation is one that stabilizes the value of exports and imports between countries – this theoretical case also identifies an important limitation. Here we have a major departure from the previous subsection, in which the complainant experienced a *negative* terms-of-trade effect as a consequence of the higher export subsidy in the respondent. In this example of a two country model, the complainant experiences a *positive* terms-of-trade effect. From perspective of pure social welfare, it is well understood that the subsidy lowers welfare for the respondent and increases welfare for importing country C. From an aggregate welfare sense, the complainant should have little to complain about.

4.2.1 Actual and potential DSU arbitrations over export subsidies in a two-country model: U.S. – Foreign Sales Corporations (FSC)

This discussion on WTO-inconsistent subsidies in two-country models suggests a novel reflection on the U.S. – FSC case. As observed in section 4.1.1 and shown above, this form of export subsidy has the potential to adversely affect the complaining countries' firms' sales in its own domestic market in addition to any third-market effect. For example, if these are multi-product firms that produce different varieties, an export subsidy by the respondent may affect the complainants' sales in a third country export market as

well as its own domestic market. Thus, while the theoretical case in this section is often thought to be most easily and efficiently dealt with outside of a DSU case via the use of (WTO-permitted) countervailing measures, in the case that export subsidies have a trade effect in both third markets and domestic markets, there may be some efficiency arguments for considering all these elements together in one DSU proceeding.

5 Other Issues

In this section we briefly discuss issues that are also potentially important in light of specific DSU cases but that we could not address with the theoretical models presented thus far.

5.1 Imperfectly competitive markets: strategic trade policy

Each of the models introduced thus far has assumed that firms trade in perfectly competitive markets. Given that the two arbitrations over export subsidies between Canada and Brazil clearly involve aircraft-producing firms (Bombardier and Embraer) that compete in imperfectly competitive markets, here we present a simple refinement of the underlying model to check on the sensitivity of our results.

As discussed in the strategic trade policy literature, when export markets are not competitive, an export subsidy can be appealing to the exporting firm's government for reasons that are independent of any political economy motive. The classic example is Brander and Spencer (1985), who present a model with many of the same characteristics of the three-country model of section 4. Brander and Spencer's primary departure from section 4's model is that there are only two firms - i.e., one in the respondent and one in the complainant - and the exporting market in ROW where producers compete is thus not competitive, but is assumed to have a Cournot oligopolistic market structure. Notwithstanding these differences, the effects of an export subsidy in this environment are remarkably similar. A key insight is that such subsidies can represent a means through which a government can give to its exporters an advantage. If only one government uses such a subsidy, it can change the nature of the game to one in which its subsidy policy credibly commits its firms to a production level that effectively give it a first-

mover (Stackelberg leadership) advantage. Of course, if both governments have access to such subsidies, both may implement them and the result is a prisoner's dilemma outcome – i.e., while both would be better off removing the subsidies, neither country has a unilateral incentive to do so. Hence from these two countries' perspective, there is an incentive to craft a subsidy limitation agreement to help them jointly escape the prisoner's dilemma outcome.

Therefore, assume we begin with such a (bilaterally) "efficient" export subsidy agreement and that government R suddenly increases the subsidy to its firm. What are the effects on the trade volume between country C and the rest of the world? What is the appropriate level of retaliation that an arbitrator should allow under the reciprocity approach? Similar to the earlier export subsidy model of perfect competition, the effect of a subsidy is to reduce the effective import demand of the ROW faced by the producer in C. As depicted in figure 5, the downward shift of import demand in world markets leads to a contraction of export volumes for the complainant's firm. Under the reciprocity condition, the level of retaliation corresponds to the shaded area in figure 5. Independently of the mode of competition in export markets, export subsidies in one country distort trade flows against exporters in the other country that results in a negative terms-of-trade effect for the complainant.

Nevertheless, it is still the case that the overall outcome of export subsidies is an increase in trade volume and a terms-of-trade (and welfare) improvement for the importing country, ROW. This positive effect is particularly strong in the case of oligopolistic markets where, notably, firms have an incentive to keep the level of production inefficiently low to increase profits. In this set of models, export subsidies may therefore lead to a welfare improvement for the world as a whole. This reinforces the idea expressed elsewhere that we may require a different theoretical framework to analyze agreements that limit export subsidies altogether.⁴⁵

⁴⁵ See the discussions in Bagwell and Staiger (2006, 2001b). Furthermore, see Ossa (2008) who presents an alternative theory of trade agreements when markets are imperfectly competitive.

5.2 Non-political shocks

In this subsection we alter a second assumption of the model by considering how our analysis would change if the respondent experienced such as a technology or a demand shock instead of the “political” shock we have used thus far. The main question that we need to address is whether the evaluation of the appropriate retaliation under the reciprocity approach would be substantially different in presence of other types of shocks.⁴⁶

To illustrate this case we use our graphs that represent the market for good x in the two-country model with import tariffs discussed in section 3.1. Figure 7 depicts the case of a negative technology shock to the import sector in country R. We start from an efficient trade agreement in which tariffs are initially bound at τ^E, τ^{*E} , which implies an equilibrium in international markets in figure b. at E^0 , where the export price is P_x^0 and the corresponding volume of trade is Q_x^0 . The negative technology shock in R causes a reduction in domestic supply and thus an inward shift of the supply curve from S_x^0 to S_x^1 . This leads to a flatter respondent import demand curve (from M_x^0 to M_x^1) in the international market. The post-shock equilibrium in figure 7b. is denoted with E^1 and corresponds to a higher export price P_x^1 and volume of trade Q_x^1 . Intuitively, the negative technology shock reduces domestic supply in country R and thus creates an excess demand of the good in the international market, which results in a higher price and larger imports.

In the context of this model and our discussion thus far, the supply shock has not resulted in anything that would result in a WTO disputes, as we have assumed that R's government did not make any policy changes in response to the shock. With no government policy response, there would be no dispute, as country C's market access and its terms-of-trade have improved in the face of the shock. However, there are important reasons to believe that the government in R may respond to an adverse technology

⁴⁶ Note that a similar analysis could be done for the equally important case of foreign (positive) technology shocks which expand market access but may, at the same time, endogenously induce the imposition of new trade barriers to in response. The question of the permissible level of retaliation in the face of these two events (foreign shock and new domestic trade barrier) will also arise in such a setting.

shock. One possibility is that the import-competing producers of good x negatively affected by the shock increase lobbying pressure on the government, which responds by increasing its politically optimal tariff from the WTO binding of τ^E to some level τ^1 that, while non-prohibitive, violates its WTO commitments.⁴⁷ Notice that this is not a political shock, as the preferences of the government (i.e., the weights on producers' surplus versus consumer welfare) have not changed. Absent the supply shock, the policymaker would not have changed its policy. However, the practical effect of such a shock is not different, as both a political and a technology shock may well result in an increase of a trade-restricting measure. In what follows, we first study the effects of the higher tariff on market access in the context of a negative technology shock and then discuss the issue of appropriate retaliation.

A new (and higher) tariff in country R causes a contraction of market access and a negative terms-of-trade effect for the complainant that is similar to what we observed in figure 1 and discussed in section 3.1. More precisely, the higher tariff increases the domestic price of the good in R and reduces R's import demand from M_x^1 to M_x^2 in figure 7b. In the new equilibrium E^2 , imports fall from Q_x^1 to Q_x^2 and the export price is at the lower level P_x^2 . In the figure, market access for the complainant is not only reduced compared to equilibrium in the absence of the tariff increase in the respondent, but also relative to the pre-shock situation.⁴⁸

What is the level of retaliation under the reciprocity approach in this instance? As the answer to this question is not trivial, we do not attempt to be exhaustive and instead limit our consideration to the two extreme cases that establish a range of possibilities. A first option is to consider only the effect of the tariff, which is equivalent to what we examined in the case of a political shock. Here the value of lost trade evaluated at initial export price corresponds to the rectangle $P_x^1(Q_x^1 - Q_x^2)$ in figure 7b. This neglects the fact that the tariff increase was triggered by a negative supply shock in R which increased

⁴⁷ For a formal political economy model that shows why declining industries can be particularly effective in receiving protection from the government, see Baldwin and Robert-Nicoud (2007).

⁴⁸ This is not necessarily the case as there is also a special case in which the new equilibrium falls between the pre and the post-shock equilibrium.

market access for producers in country C and thus may *overestimate* the prejudice to the complainant. A second possibility is the pre-shock equilibrium and assessing the value of lost trade induced by a higher tariff relative to that counterfactual. This would suggest a smaller permissible retaliation for the complainant equal to the area $P_x^0(Q_x^0 - Q_x^2)$ - i.e., the shaded area in figure 7b. In this special case in which the new equilibrium falls in between the pre and the post-shock levels, the permissible retaliation for the complainant would be zero. Hence, the risk here may be to *underestimate* the prejudice caused by WTO-inconsistent policy actions.

6 Conclusions

The Dispute Settlement Understanding (DSU) gives WTO arbitrators the mandate to establish the permissible retaliation limits that aggrieved complainant countries can implement in response. Arbitrators therefore set the retaliation limits that ultimately serve to enforce the overall WTO agreement. We examine how WTO arbitrators have used theoretical and quantitative economic analysis in this stage of the DSU process for the ten disputes that reached the stage of arbitration between 1995 and 2007. Our approach also illustrates a template for many additional types of arbitrations likely to take place under the DSU going forward, in a number of different areas.

We organize the analysis by adopting the Bagwell and Staiger interpretation of the WTO principle of reciprocity to provide a theoretical framework that arbitrators can apply to identify the maximum level of retaliatory countermeasures. We identify, characterize, and categorize the major classes of disputes – e.g., those affecting import protection versus export promotion – that typically occur under the WTO and the implications of the Bagwell and Staiger approach for each type of likely dispute. Our framework also allows us to identify three crucial elements to the arbitrators' decision-making process for each case: i) the formula that they decide to adopt for identifying appropriate countermeasures, ii) their political-legal-economic decision on a WTO-consistent counterfactual to use to implement the formula, and iii) the quantitative methods they use to necessarily construct the

(unobserved) WTO-consistent counterfactual. We then analyze each of the ten DSU arbitrations taking place between 1995 and 2007 by comparing the arbitrators' actual approach with the theory.

In many of the DSU cases that we examine, such as the arbitrations over WTO-inconsistent quantitative restrictions that limit imports, the arbitrators' actual approach appears quite consistent with the Bagwell and Staiger reciprocity formulation theory. Furthermore, in a number of other cases, the arbitrators' report explicitly signals their preference to use such an approach despite the practical inability to do so for procedural, computational, or data limitation reasons related to the quantitative methods they are forced to employ in practice. Even in the arbitrations over WTO-inconsistent subsidies in which the arbitrators have departed from the trade effects approach to establishing retaliation limits in favour of a number that is arguably easier to calculate (i.e., the size of the subsidy), using theory to analyze the retaliation determination question allows us to compare the arbitrators' actual approach to one that might occur under this particular formulation of reciprocity. Finally, in the disputes in which this reciprocity approach has not been used, we identify procedural difficulties that arbitrators confront thus highlighting the constraints that hinder their use of economic analysis in practice.

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Table 1: WTO DSU Article 22.6 Arbitrations, 1995-2007

Case Title	Agreements/Provisions Infringed	Award by the Arbitrators	Discussed in Section
<i>Import-restricting measures</i>			
<i>EC—Bananas (U.S.)</i>	GATT Art. XIII	\$191.4 million	3.2
<i>EC-Bananas (Ecuador)</i>	GATT Art. XIII	\$201.6 million	3.2
<i>EC-Hormones (U.S.)</i>	SPS Agreement	\$116.8million	3.2
<i>EC-Hormones (Canada)</i>	SPS Agreement	C\$11.3 million	3.2
<i>U.S.- Antidumping Act of 1916 (EC)</i>	GATT Art. VI, Antidumping Agreement	no specific amount	3.3
<i>U.S.-Continuing Dumping and Subsidy Offset Act (Byrd Amendment) (Brazil, Canada, Chile, EC, India, Japan, Korea, Mexico)</i>	GATT Art. VI, Antidumping Agreement, SCM Agreement	0.72 * value of payments	3.4
<i>U.S.- Internet Gambling (Antigua and Barbuda)</i>	GATS Art. XVI	\$21 million	3.2
<i>Export-promoting measures</i>			
<i>Brazil-Aircraft Subsidies (Canada)</i>	SCM Agreement	\$344.2 million	4.1 and 5.1
<i>Canada-Aircraft Subsidies (Brazil)</i>	SCM Agreement	C\$247.796 million	4.1 and 5.1
<i>U.S.-Foreign Sales Corporations (FSC) (EC)</i>	SCM Agreement	\$4.043 billion	4.1 and 4.2

Figure 1. Reciprocity Compensation when the Respondent Implements a WTO-Inconsistent Tariff

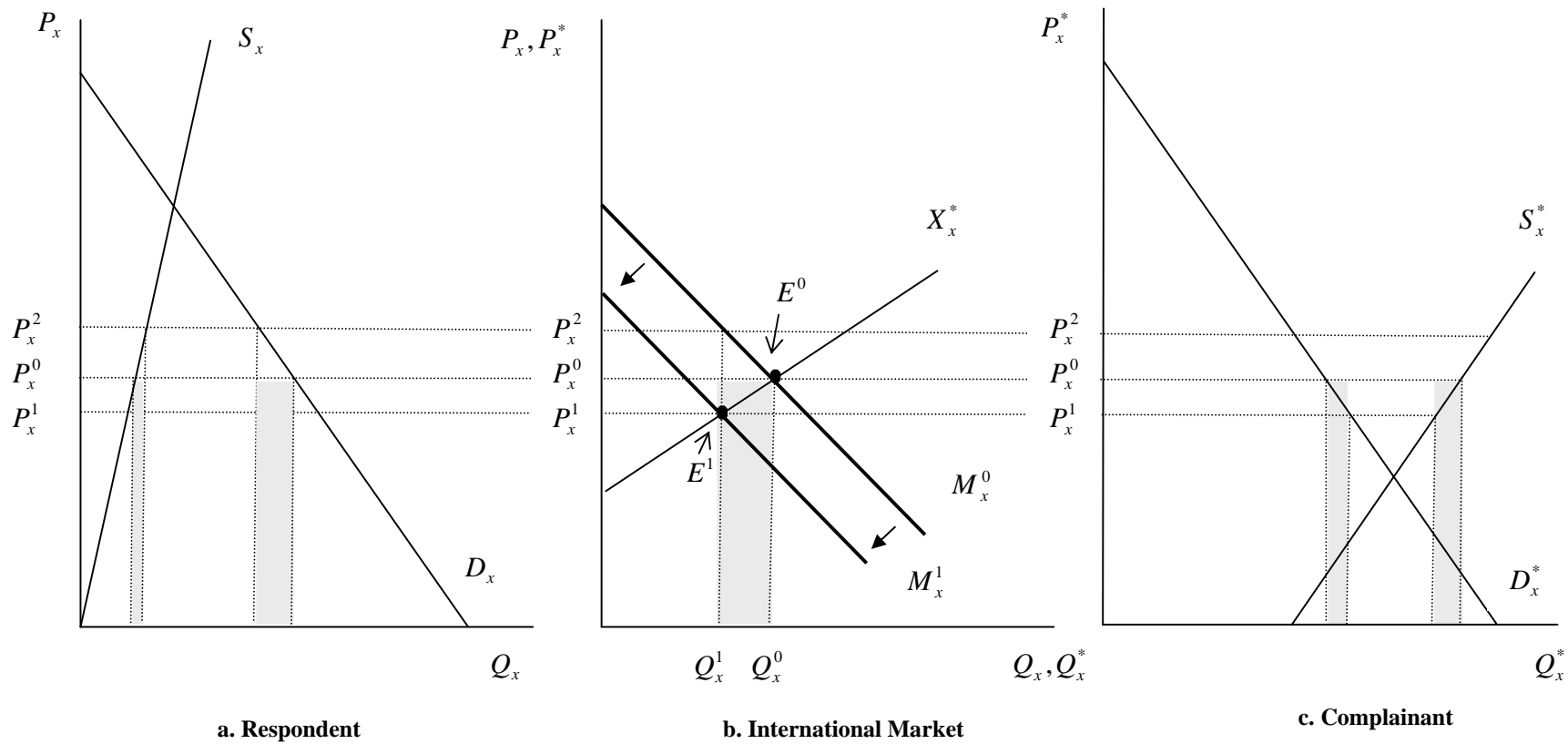
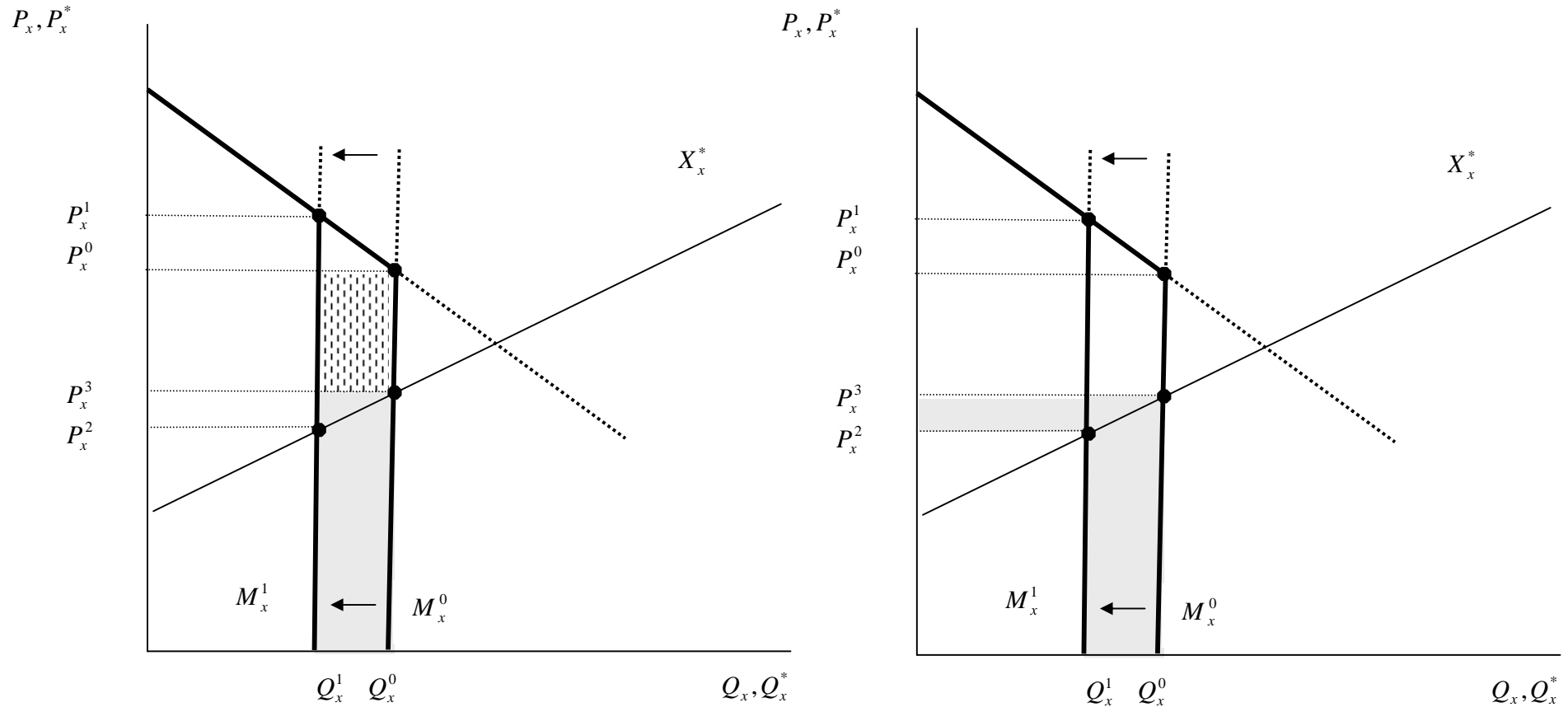


Figure 2. Reciprocity Compensation when the Respondent Implements a WTO-Inconsistent Quota and/or Implements Inconsistent Licensing Scheme



a. International Market

b. International Market in EC - Beef Hormones

Figure 3. Reciprocity Compensation when the Respondent Imposes a WTO-Inconsistent Non-Tariff Measure on a Trading Partner's Exports (e.g., Violating National Treatment)

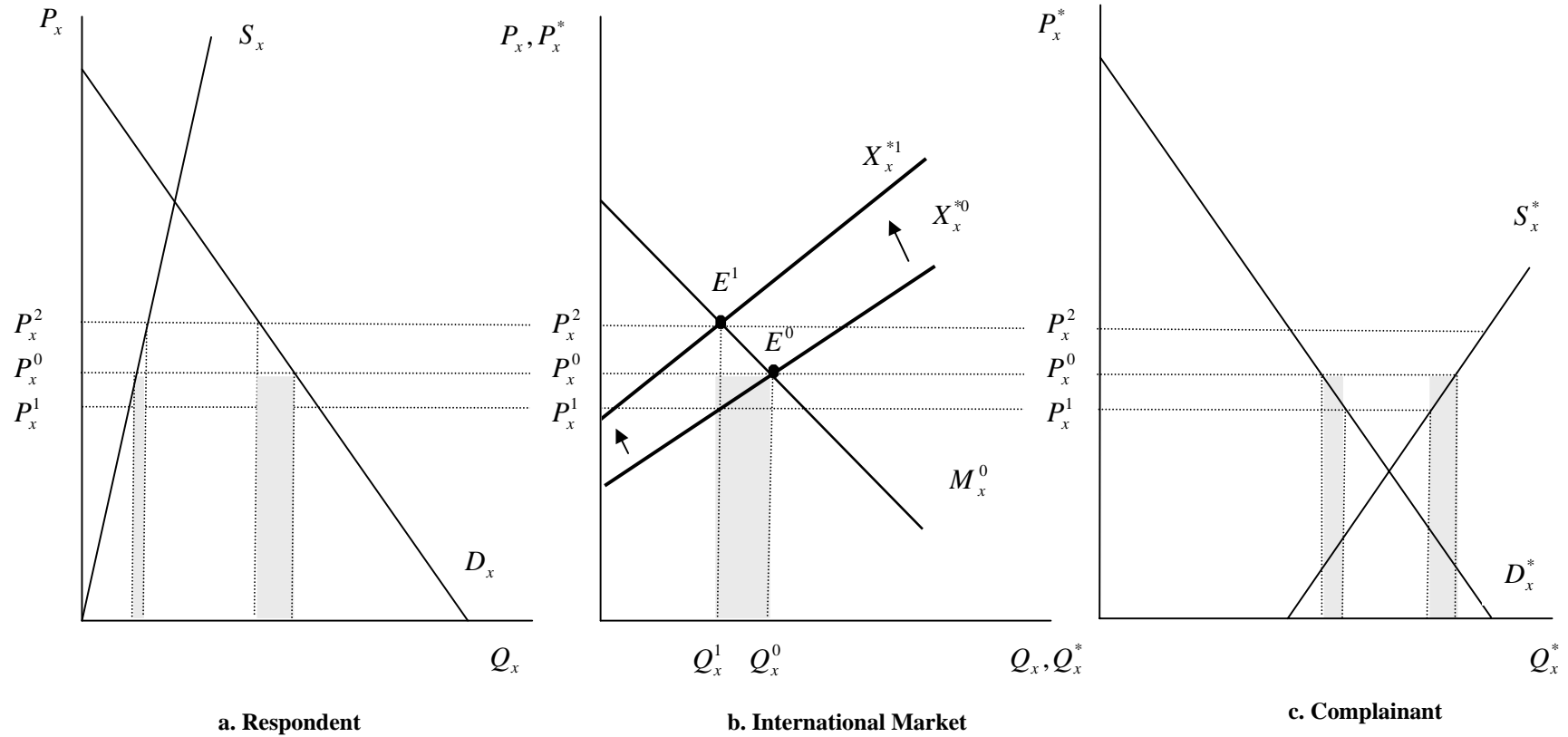


Figure 4. Reciprocity Compensation when the Respondent Implements a WTO-Inconsistent Production Subsidy to an Import-Competing Industry

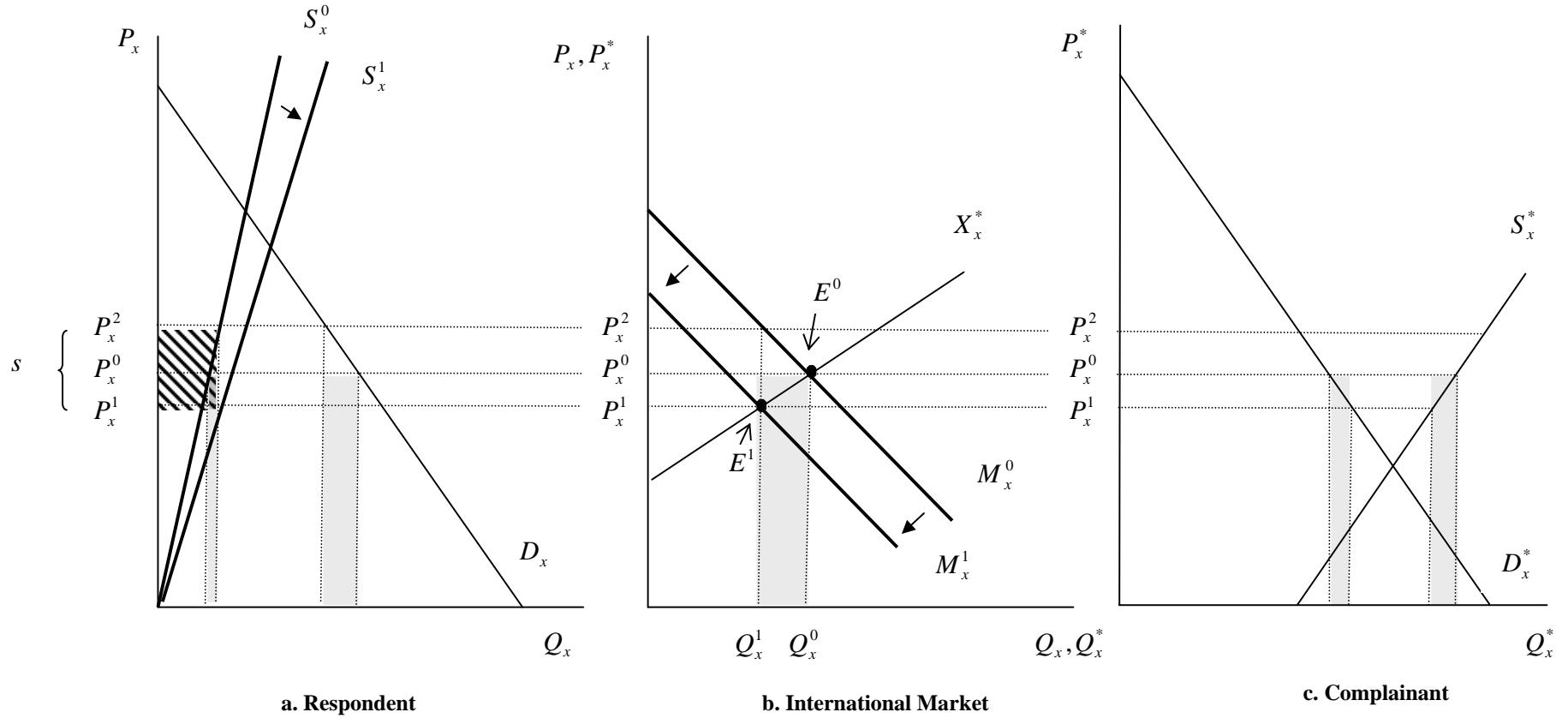
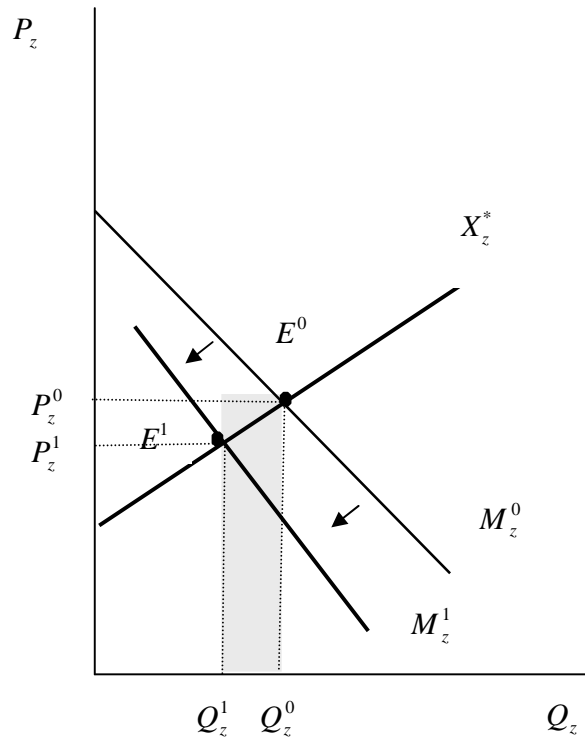
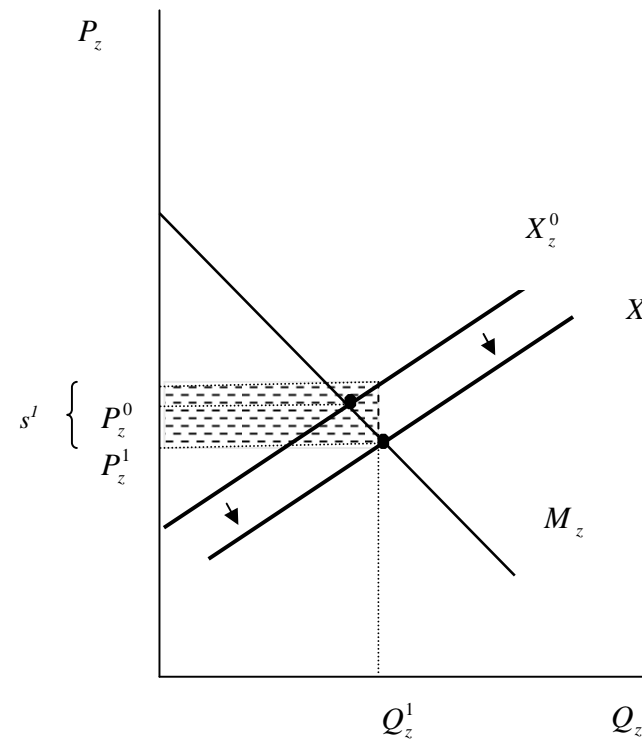


Figure 5. Reciprocity Compensation when the Respondent Imposes a WTO-Inconsistent Export Subsidy (Three-Country Model)



**a. International Market –
ROW Imports from Complainant in
face of Respondent subsidy**



**b. International Market –
ROW Imports from
subsidizing Respondent**

Figure 6. Reciprocity Compensation when the Respondent Imposes a WTO-Inconsistent Export Subsidy (Two-Country Model)

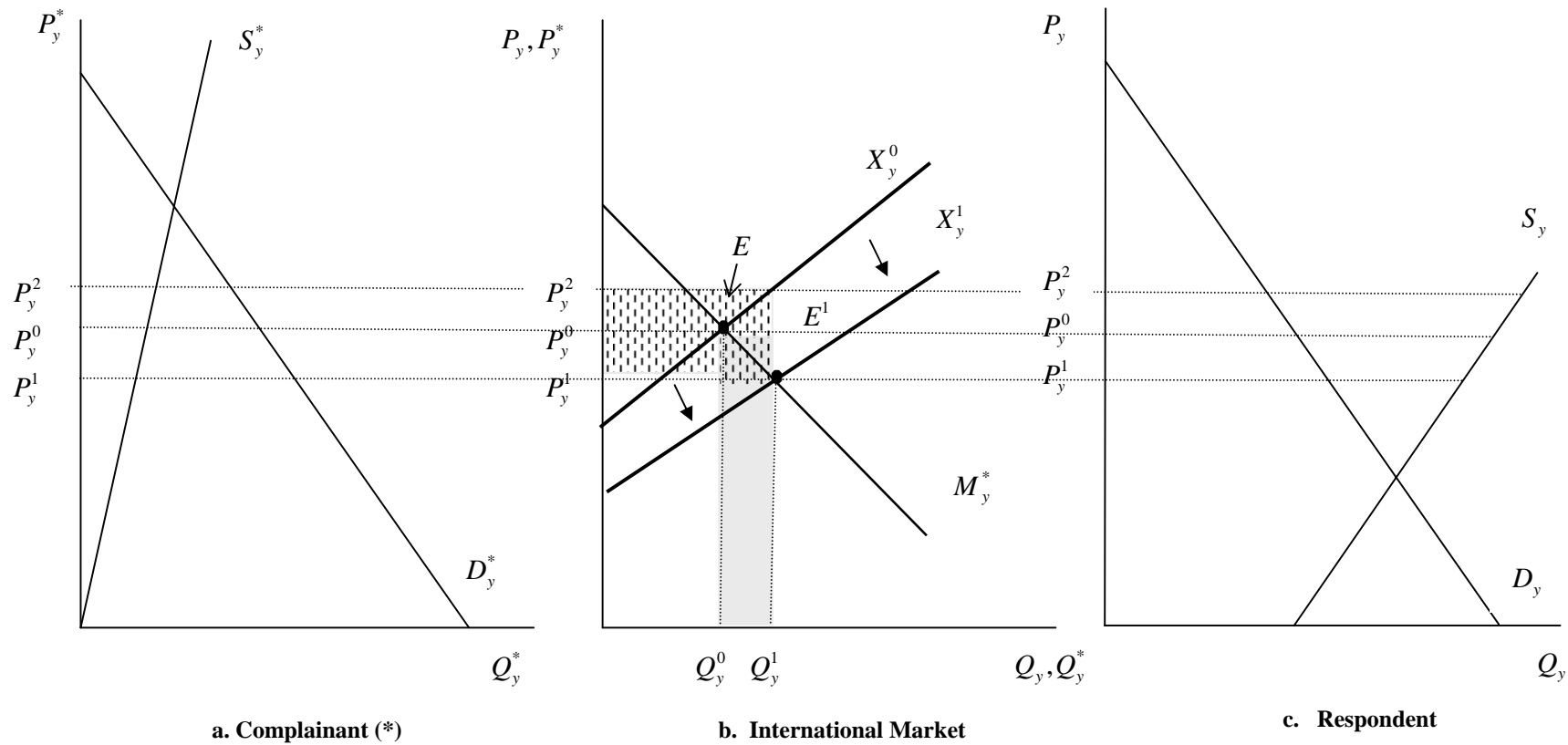


Figure 7. Reciprocity Compensation when the Respondent Implements a WTO-Inconsistent Tariff After a Supply Shock

