The Evolution of International Subsidy Rules

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Abstract

Why did countries achieve a consensus to impose explicit restrictions on trade-distorting subsidies when the WTO was formed in 1995, but not decades earlier under the GATT? This paper rationalizes the historical pattern of subsidy rules. Politically-motivated governments benefit from international subsidy restraints only after achieving sufficient cooperation in restraining tariffs. Once tariffs fall, as they did in the 1950s and 1960s, governments prefer to protect domestic sales through international subsidy restraints rather than to allow consumers to benefit from unfettered subsidization. The theory explains why the WTO contains subsidy rules with trade-reducing consequences.

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1 Introduction

The expanded restrictions on manufacturing subsidies in the World Trade Organization (WTO) since 1995 are a significant departure from the 1947 General Agreement on Tariffs and Trade. Export subsidies are prohibited in the WTO, and domestic subsidies that increase exports can be disputed.[1] Government consternation over export subsidies puzzles trade lawyers and economists because export subsidies improve the terms of trade for importing countries and increase trade.[2] When the only cross-border effect of export subsidies is the terms-of-trade improvement of the importing country, then the export subsidies are like a gift from abroad, and there is no reason for countries to restrict each other from using them. Limits on domestic subsidies can be harmful because domestic subsidies are the best instrument governments can use to address domestic distortions.[3] According to Bagwell and Staiger (2006), the WTO subsidy rules serve no purpose, even for politically motivated governments. Moreover, the rules could "completely undermine" the GATT, because countries could be forced to eliminate socially beneficial subsidies as a consequence of committing to low tariffs. For all these reasons, Mavroidis, Messerlin, and Wauters (2008) denounce the subsidy agreement as "one of the least economics-informed agreements in the WTO." The potential drawbacks of the WTO subsidy rules call for a better understanding of why the rules were adopted. Why were the WTO subsidy rules adopted? Why were they not implemented sooner?

To address these questions, this paper proposes the following model. There are two governments who each choose a domestic subsidy, an ad valorem import tariff and an ad valorem export subsidy. The two symmetric countries each have two sectors: a freely traded outside sector and a monopolistically-competitive, differentiated sector with costly trade. Firm entry in the differentiated sector requires the employment of capital factor while production requires labor in each sector. The government's domestic subsidy reduces the cost of firm entry and fully determines the number of firms in each country. Firm profits accrue to capital owners and government objectives give greater weight to profits than to other forms of national income.

This paper establishes the novel result that countries could achieve a global consensus to impose limits on both export subsidies and export-promoting domestic subsidies, as in the

[1] See Sykes (2005) and Wouters and Coppens (2010). Actionable domestic subsidies must also be specific to a particular firm or industry and cause "serious prejudice" to the interests of a trading partner.

[2] For example, Janow and Staiger (2003) argue that the export subsidy prohibition runs against the GATT's fundamental purpose of increasing trade from inefficiently low levels.

[3] The theory of distortions and welfare dates back to Bhagwati and Ramaswami (1963). More recently, Stiglitz (2006) and Rodrik (2011) argue that the WTO subsidy rules are particularly damaging for developing countries where market imperfections are more prevalent.

WTO.[4] Consider a country, foreign, choosing subsidies unilaterally, subject to the GATT constraint that ensures foreign's subsidies do not reduce the access another country, home, has to foreign's market.[5] Despite the GATT constraint, foreign does not consider three effects of higher subsidies on home: a decrease in home's domestic profits, an increase in home's consumer surplus from the subsidized sector, and an increase in home's import tariff revenue. The net cross-border effect of the foreign subsidy on home can be negative, provided that home places a sufficiently large weight on profits in the subsidized sector and home's import tariffs are sufficiently small. A net negative cross-border effect implies that the two countries' unilateral subsidy choices are too high. A Pareto superior outcome for the two governments can be achieved by an agreement limiting subsidies.

The paper further shows that regardless of the weight governments place on domestic profits, countries cannot benefit from the WTO's limits on subsidies when import tariffs are close to noncooperative levels, as when GATT was formed. The net effect of a foreign subsidy on home welfare cannot be negative at unilateral tariff choices, because the positive effect of the foreign subsidy on home import tariff revenue dominates any net negative effect of the foreign subsidy on home domestic profits and home consumer surplus. Imposing limits on subsidies cannot be Pareto-improving until governments achieve sufficient cooperation in reducing tariffs. Hence, the second main result of the paper is that the WTO's subsidy rules were desirable only after several successive rounds of tariff reductions in the GATT.

A previous formal analysis of whether political motives can rationalize the WTO subsidy rules, Bagwell and Staiger (2006), found no rationale.[6] The same three cross-border effects of foreign subsidies in the current paper can exist in their model, but a difference arises because subsidies to foreign's export sector influence all three effects solely through changes in terms of trade in their model. In their framework, the sum of the three effects is positive whenever two symmetric countries choose noncooperative import tariffs or pursue a symmetric liberalization path to lower efficient tariffs. At any point along such a symmetric liberalization path, the assumption that countries benefit from receiving a pure transfer in either good—equivalent to a terms-of-trade gain holding local prices fixed—ultimately implies that

[4]The consensus distinguishes the theory from prior work. Brander and Spencer (1985) and Bagwell and Staiger (2001b) each provide theories of why two countries would limit export subsidies at the expense of a third country who only imports.

[5]The constraint is a consequence of Article XXIII in the GATT. Bagwell and Staiger (2001a, 2006) model the GATT in similar fashion.

[6]Many other papers explain international subsidy limits but focus on subsidies to import-competing industries, which are restrained by GATT Article XXIII. Such papers include Horn, Maggi, and Staiger (2010), Brou and Ruta (2009), Sauré (2010), and Lee (2011). The current paper and Bagwell and Staiger (2006) take as given that Article XXIII is perfectly functional.

countries must benefit from a foreign subsidy that improves home's terms of trade.[7] In the current paper, countries benefit, all else equal, from a terms-of-trade gain—a pure transfer between treasuries in the outside good. But because foreign export subsidies influence home apart from changes in terms of trade, the sign of cross-border foreign subsidy effects along the liberalization path is not pinned down by the assumption that countries always benefit, all else equal, from a terms-of-trade gain.

In a closely related paper, Bagwell and Staiger (2011) provide an alternative explanation for the evolution of export subsidy rules using a model with linear Cournot competition. A unique property of international Cournot competition is that a foreign increase in export subsidy or reduction in export tariff gives home a terms-of-trade loss.[8] In their model, nations would unilaterally deviate from an efficient, free-trade equilibrium using export subsidies, so export subsidy bans are desirable at free trade.[9] Yet at the equilibrium where both import and export policies are chosen noncooperatively, countries choose both import and export taxes and countries benefit when they exchange small reductions in these taxes. An important difference between their paper and the current paper is theirs does not consider domestic subsidies. By providing a theory for the WTO's limits on domestic subsidies, the current paper addresses a broader debate over the appropriate scope of the WTO in regulating domestic policies.[10] Moreover, the WTO's limits on domestic subsidies have not been made consistent with the theory that the GATT's fundamental purpose is to increase trade volumes from inefficiently low levels. By rationalizing these policies, the current paper implies that the WTO has addressed a wider range of international externalities than the standard theory, given the absence of alternative explanations.[11]

[7] Along the liberalization path, countries benefit from a fall in the domestic price of the imported good, all else equal, as in Bagwell and Staiger (2002, p. 60-61). When a foreign subsidy increase improves home's terms-of-trade, home benefits from both the fall in domestic price and the direct effect of the terms-of-trade improvement.

[8] In perfect competition (Bagwell and Staiger 1999), monopolistic competition (Bagwell and Staiger 2009b), or Cournot competition without free entry (Bagwell and Staiger 2009a), the export subsidy at free trade worsens the terms of trade. The current paper shows that the rationale for export subsidy constraints need not depend on the Cournot framework.

[9] Venables (1985) was the first to identify that a country would unilaterally deviate from free trade with an export subsidy in such a Cournot trade model.

[10] Examples include Bagwell, Mavroidis and Staiger (2002), Staiger and Sykes (2009), and Bagwell and Mavroidis (2010). Bhagwati (1996) defends the GATT's capability of handling labor and environmental issues. Bhagwati defends the GATT approach to domestic policies in his concluding remarks of a 2010 *Economist* debate on fair trade vs. free trade.

[11] Cross-border externalities that arise under imperfect competition can rationalize the GATT/WTO principles of reciprocity and nondiscrimination, as shown in Ossa (2011) and Mrazova (2011), but both principles can also be explained by the terms-of-trade theory. The current paper is distinct in explaining a WTO rule that has not been explained by the terms-of-trade theory.

2 Government Objectives and Externalities

The model builds on Section 7.3 of Helpman and Krugman (1989) by adding an export subsidy and a domestic entry subsidy.[12] We further simplify by assuming symmetric technology, endowments, and preferences across the two large countries, home and foreign. The economy has two sectors: a monopolistically competitive sector of symmetric firms producing differentiated products and a quasilinear freely traded numeraire good. There are two factors: a labor factor mobile between the two sectors and a specific factor necessary for entry in the differentiated sector. The factors are owned by consumers who take prices and government policies as given and maximize utility. Firms take government policy and the consumer price index as given and maximize profits. Individual firms and consumers are too small to behave strategically. The remainder of the paper focuses on the strategic behavior between the two governments.

After laying out the model, this section determines the governments' objectives as a function of home and foreign policy choices. The objectives allow us to derive the *cross-border externalities* of government policies. Here externalities refer to the cross-border effects of policies that a government does not internalize when it chooses policies unilaterally. We formally model the GATT rules, and we define what it means to improve upon the GATT. The GATT rules can manage some cross-border effects, but not all of them. The third section of the paper focuses on the balance of the remaining externalities.

2.1 Baseline Model

Government: The home government chooses an ad valorem import tariff τ, an export subsidy s, and a subsidy to entry e. The foreign government chooses a corresponding set of policies τ^*, s^*, and e^*. A negative import tariff indicates an import subsidy, and a negative export subsidy indicates an export tax, but we will primarily focus on situations when governments choose import tariffs and export subsidies. Nondistortionary transfers between government and consumers balance any budget deficit or surplus.

Government objectives assign a weight 1 to consumer surplus and a weight α to the rents accruing to the specific factor (e.g. producer surplus) Microfoundations for such government objectives come from the Grossman and Helpman (1994) model of lobbying, and Chang

[12] Related contributions are Flan and Helpman (1987) and Venables (1987), who consider unilateral trade and domestic policies in two-country models with monopolistically competitive firms. Ossa (2011) and Bagwell and Staiger (2009b) consider trade agreements under monopolistic competition, but do not consider domestic policies. All four papers use a single-factor model, while the current paper uses a two-factor model.

(2005) extends the results to a framework with monopolistic competition.[13]

For the existence of noncooperative and cooperative equilibria, we require $\alpha < \sigma$, where σ is the elasticity of substitution between differentiated products. If the political economy weight α were greater than σ, countries would give boundless export subsidies to their producers.

Consumption: Consumers in each country all have income large enough to ensure consumption Y of the numeraire good. The utility functions are

$$\begin{aligned} U &= \frac{1}{\theta}(D)^{\theta} + Y, \text{ and} \\ U^* &= \frac{1}{\theta}(D^*)^{\theta} + Y^*. \end{aligned} \tag{1}$$

The utility functions imply an elasticity of substitution $\varepsilon = \frac{1}{1-\theta}$ between sectors. D is a CES composite good over n_h symmetric home products and n_f symmetric foreign products. Imposing symmetry on the consumption of goods for each product, we have

$$\begin{aligned} D &= \left(n_h c_h^{\frac{\sigma-1}{\sigma}} + n_f c_f^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}, \text{ and} \\ D^* &= \left(n_h c_h^{*\frac{\sigma-1}{\sigma}} + n_f c_f^{*\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}. \end{aligned} \tag{2}$$

The elasticities of substitution satisfy $\sigma > \varepsilon > 1$. For consumption variables c, subscripts h and f denote location of origin, while the superscript "*" indicates location of consumption, so c_f is home imports and c_h^* is foreign imports.

Marginal Production: The good Y has a unit labor requirement and is freely traded between sectors. The differentiated products have marginal labor requirement m. To ship one unit abroad requires an iceberg trade cost, additional production of the good that "melts" in transit. The trade cost is $\phi \geq 0$.

Firm Entry: Countries each have a capital endowment K specific for entry into the differentiated sector. Some consumers own capital and some do not, ensuring a motive for capital lobbying. Governments can reduce the capital requirement with an entry subsidy. The government subsidizes entry in the differentiated sector by hiring labor to produce a public good specific to the differentiated sector. The capital requirement is given by the

[13]The additional weight on producer profits is motivated by Hufbauer and Erb (1984, p. 8) and Baldwin (1980, p. 86), who argue that producers' sense of entitlement to their domestic markets has always been central to subsidy rules. Mavroidis, Messerlin, and Wauters (2008) observe the WTO subsidy rules are focused on producer interests.

function $k(e)$, such that k is strictly decreasing in the government subsidy e. Firm profits accrue to the owners of the specific factor. The domestic entry subsidies e and e^* determine the number of firms n_h and n_f in each country:

$$n_h = \frac{K}{k(e)}, \text{ and } n_f = \frac{K}{k(e^*)}. \tag{3}$$

The function k can be inverted to express the cost to the government of having a given number of firms, as if governments were directly choosing the number of firms:

$$\begin{aligned} e &= k^{-1}(\frac{K}{n_h}) \equiv f(n_h), \text{ and} \\ e^* &= k^{-1}(\frac{K}{n_f}) \equiv f(n_f). \end{aligned} \tag{4}$$

A simple feasible functional form is $k(e) = \frac{K\beta}{e+\mu}$ for a scale parameter β and a shift parameter μ. Such a function $k(e)$ yields $f(n) = \beta n - \mu$ for $n \geq \frac{\mu}{\beta}$, and $\frac{\mu}{\beta}$ is the number of firms absent any entry subsidy. The model could conceivably admit a more general functional form for k, as long as entry subsidy costs are sufficiently convex to prevent governments from achieving boundless utility.[14] We require a restriction on the shift parameter μ that ensures countries offer positive entry subsidies at all equilibria under consideration.[15] The scale parameter for $k(e)$ is subject to an additional restriction to ensure there is a cooperative equilibrium with zero tariffs. Discussion of the restriction is postponed to Subsection 2.5.

The structure here allows us to consider, in a simple way, government ability to influence the extensive margin of firm entry, while at the same time not allowing free entry to eliminate any lobbying motive for firms, as would be the case in a single-factor model.[16] Consideration of fixed cost subsidies is also empirically justified.[17] A richer model would allow owners of capital to hire more labor in response to profit opportunities. Such a model would fall in between the extremes of this paper's model and a single-factor free entry model.

[14] Formally, we require that $\lim_{n\to\infty} \frac{n^{(\frac{\varepsilon-1}{\sigma-1})}}{k^{-1}(\frac{K}{n})} = \frac{n^{(\frac{\varepsilon-1}{\sigma-1})}}{f(n)} = 0$.

[15] A decrease in μ lowers the number of firms with no entry subsidies. Being a constant in $f(n)$, μ has no effect on first-order conditions and second-order conditions that determine noncooperative and constrained choices of n_h and n_f.

[16] Models with single-factor free entry are derived in the appendix. The idea that such free entry can eliminate strategic trade motives has been well understood since Horstmann and Markusen (1986).

[17] Marvel and Rey (1995) find that many subsidies are nonrecurring. Grossman and Mavroidis (2001, 2003) argue WTO panels failed to regulate fixed cost subsidies appropriately, hence their title, "Recurring Misunderstanding of Non-Recurring Subsidies." The Boeing-Airbus dispute involves "launch aid," subsidies for financing new varieties of aircraft. Baylis (2009) notes the strategic trade policy literature is lacking on motives for fixed cost subsidies.

The simplification that government effectively chooses the number of firms has precedent in the international competition policy literature.[18] In the current paper, the approach offers tractability for studying interactions between domestic policy choices and trade policies, and such interactions have received little attention apart from Bagwell and Staiger (2001a, 2006).

2.2 Determining Government Objectives

To evaluate the government objectives, we find the equilibrium consumption and production taking government policies as given.

Freely mobile labor implies wages are equal across sectors, and profit maximization implies the wage equals the price of the homogeneous good. Free trade in the homogeneous good implies the prices of the homogeneous good and wages are equal across countries. The wage and price of the quasilinear good are defined to be the numeraire.

Utility maximization implies demand for the composite good $D = P^{-\varepsilon}$, where P is the price index for the composite good and PD is the total expenditure on differentiated products. Indirect utilities V and V^* are decreasing in own price index and increasing in income I:

$$\begin{aligned} V &= \frac{1}{\varepsilon - 1} PD + I = \frac{1}{\varepsilon - 1} P^{1-\varepsilon} + I, \text{ and} \\ V^* &= \frac{1}{\varepsilon - 1} P^* D^* + I^* = \frac{1}{\varepsilon - 1} P^{*1-\varepsilon} + I^*. \end{aligned} \tag{5}$$

The notation for prices p_h, p_f, p_h^*, and p_f^* matches the consumption variables c_h, c_f, c_h^*, and c_f^*. The price index P is standard following Dixit and Stiglitz (1977) under symmetric firms:

$$\begin{aligned} P &= \left(n_h p_h^{1-\sigma} + n_f p_f^{1-\sigma}\right)^{\frac{1}{1-\sigma}}, \text{ and} \\ P^* &= \left(n_f p_f^{*1-\sigma} + n_h p_h^{*1-\sigma}\right)^{\frac{1}{1-\sigma}}. \end{aligned} \tag{6}$$

Market demand x_h for a home product is the sum of domestic demand and foreign demand, plus the iceberg transport costs:

[18] Dixit (1984), Horn and Levinsohn (2001), and Bagwell and Staiger (2002, Ch. 9) each consider a domestic competition policy (e.g. antritrust policy) that directly determines the number of domestic firms in a Cournot market. Only Bagwell and Staiger (2002, Ch. 9) consider whether there is an additional rationale for a domestic policy agreement beyond the GATT, and they conclude the answer is no.

$$\begin{aligned} x_h &= c_h + (1+\phi)c_h^*, \text{ and} \\ x_f &= c_f^* + (1+\phi)c_f. \end{aligned} \tag{7}$$

Consumer maximization implies the total demands for individual products are

$$\begin{aligned} x_h &= p_h^{-\sigma} P^{\sigma-\varepsilon} + (1+\phi)p_h^{*-\sigma} P^{*\sigma-\varepsilon}, \text{ and} \\ x_f &= p_f^{*-\sigma} P^{*\sigma-\varepsilon} + (1+\phi)p_f^{-\sigma} P^{\sigma-\varepsilon}. \end{aligned} \tag{8}$$

Because markets are integrated, imports are marked up from domestic prices based on total net cross-border costs:

$$\begin{aligned} p_h^* &= (1+\phi+\tau^*-s)p_h, \text{ and} \\ p_f &= (1+\phi+\tau-s^*)p_f^*. \end{aligned} \tag{9}$$

Since demand functions have a constant price elasticity, profit-maximization implies a constant local price for domestic varieties p_h and p_f^*:

$$p_h = p_f^* = \frac{\sigma}{\sigma-1} m \equiv p. \tag{10}$$

The prices do not depend on tariffs, as emphasized in Ossa (2011), or on firm entry, as emphasized here. World prices p_h^w and p_f^w are the prices of home and foreign exports between borders. They depend only on the export subsidy:

$$\begin{aligned} p_h^w &= (1-s)p_h, \text{ and} \\ p_f^w &= (1-s^*)p_f^*. \end{aligned} \tag{11}$$

The per unit markup $p - m = \frac{p}{\sigma}$ determines home and foreign domestic per firm profits π and total profits Π:

$$\begin{aligned} \pi_h &= (\frac{p}{\sigma})x, \; \pi_f = (\frac{p}{\sigma})x_f, \\ \Pi_h &= n_h \pi_h, \text{ and } \Pi_f = n_f \pi_f. \end{aligned} \tag{12}$$

Home government objectives can be decomposed as follows:

- Profits (with political economy weight α) $\equiv \alpha\Pi_h$
  - Domestic profits $\equiv \alpha(\frac{p}{\sigma})n_h c_h = \alpha(\frac{c_h}{x_h})\Pi_h$
  - Export profits $\equiv \alpha(\frac{p}{\sigma})(1+\phi)n_h c_h^* = \alpha(1-\frac{c_h}{x_h})\Pi_h$
- Consumption
  - Consumer surplus $\equiv \frac{1}{\varepsilon-1}PD$
  - Import tariff revenue $\equiv \tau p n_f c_f$
  - Export subsidy cost $\equiv -spn_h c_h^*$
  - Entry subsidy cost $\equiv -f(n_h)$
  - Wage income $\equiv L$

A corresponding decomposition holds for foreign. The government objectives G and G^* are then

$$\begin{aligned} G &= \alpha\Pi_h + \frac{1}{\varepsilon-1}PD + \tau p n_f c_f - spn_h c_h^* - f(n_h) + L, \text{ and} \\ G^* &= \alpha\Pi_f + \frac{1}{\varepsilon-1}P^*D^* + \tau^* p n_h c_h^* - s^* p n_f c_f - f(n_f) + L. \end{aligned} \tag{13}$$

For cooperative policies, the government joint objective $W \equiv G + G^*$, and

$$W = \alpha(\Pi_h+\Pi_f)+\frac{1}{\varepsilon-1}(PD+P^*D^*)+(\tau-s^*)pn_f c_f+(\tau^*-s)pn_h c_h^*-f(n_h)-f(n_f)+2L. \tag{14}$$

The sum of the two objectives is justified here because we consider symmetric choices throughout. W can be written in terms of net trade taxes, which we define as $t_f \equiv (\tau - s^*)$ for foreign-produced goods and $t_h \equiv (\tau^* - s)$ for home-produced goods.

2.3 Import Tariff Results

This section considers noncooperative and cooperative tariffs. We introduce an unobjectionable assumption that ensures the standard result that countries' noncooperative import tariffs are larger than their cooperative import tariffs.

At the noncooperative equilibrium in trade policies, each country's import and export subsidy choice is unilaterally optimal. At the cooperative equilibrium, each country's total trade barriers are picked to maximize world welfare. The cooperative equilibrium depends only on total trade barriers because W only depends on total trade barriers.

First we establish that net trade taxes are higher at noncooperative trade policies than cooperative trade policies, so noncooperative trade policy choices result in too little trade.[19]

All lemmas are proven in Appendix A.2.

Lemma 1 *Consider countries with symmetric policies* $\bar{e}$, $\bar{\tau}^N$, *and* $\bar{s}^N$, *such that* $\frac{dG}{d\tau} = \frac{dG^*}{d\tau^*} = \frac{dG}{ds} = \frac{dG^*}{ds^*} = 0$. *Consider an additional set of countries with total trade barriers* $\bar{t}^c$ *such that* $\frac{dW}{d\tau} = \frac{dW}{d\tau^*} = \frac{dW}{ds} = \frac{dW}{ds^*} = 0$. *Then* $\bar{\tau}^N$, $\bar{s}^N$, $\bar{t}^c$ *do not depend on* $\bar{e}$, $\bar{\tau}^N > 0$, *and* $\bar{t}^N > \bar{t}^C$.

The lack of dependence of the noncooperative trade policies $\bar{\tau}^N$ and $\bar{s}^N$, and fully cooperative trade barriers $\bar{t}^c$ on the level of entry subsidies (and hence the number of firms) is a consequence of CES preferences and the symmetry between countries. The policies maximizing the joint objective W involve subsidizing trade as a second-best attempt to correct the monopoly distortion, so countries would benefit when moving from noncooperative policies to policies with zero net trade taxes.[20]

Many trade policy models suffer the difficulty that cooperative trade policies could arise from either reducing import tariffs or increasing export subsidies, while we observe GATT members reducing tariffs.[21] One typical way to avoid the problem is to assume away export subsidies, but such an approach is not feasible here because we want to study the motivation for the ban on export subsidies. Instead we build on the following lemma which argues that countries will unilaterally choose subsidies below a certain bound.

Lemma 2 *Consider arbitrary import tariff policies and entry subsidies, and export subsidy choices* s *and* s^* *satisfying* $\frac{dG}{ds} = \frac{dG^*}{ds^*} = 0$ *Then* $s \leq \frac{\alpha}{\sigma}$ *and* $s^* \leq \frac{\alpha}{\sigma}$.

[19] A related question of interest is whether noncooperative entry subsidies are too high or too low given noncooperative trade policies. The result ultimately depends on parameters, and there is no international inefficiency in entry subsidy choices for a knife-edge case. Such a result does not necessarily imply that there is no fundamental problem with international entry subsidy choices, since correcting the problem with import tariff choices in this model can result in inefficiencies in noncooperative entry subsidy choices.

[20] The joint objectives are also maximized with trade subsidies in the monopolistic competition model of Bagwell and Staiger (2009b). Other trade policy models (e.g. Bagwell and Staiger 1999) allow the possibility that political preferences result in positive cooperative net trade barriers. The appendix considers an extension with two differentiated sectors that can generate positive net trade barriers due to a distributional conflict.

[21] See Maggi and Rodridguez-Clare (2005) for more focus on this feature of trade policy models and an approach to resolving the issue.

The $\frac{\alpha}{\sigma}$ is the value to governments of an additional unit of firm output. When subsidies are greater than $\frac{\alpha}{\sigma}$, the increase in subsidy costs cannot possibly be worth the increase in output.[22]

Lemma 2 implies that countries would not choose export subsidies above these bounds unless either they were constrained to do so, or if choosing an export subsidy above $\frac{\alpha}{\sigma}$ allowed them to choose a more desirable import policy or entry subsidy policy against some constraint. We do not consider any such constraints in this paper, so throughout we assume $s \leq \frac{\alpha}{\sigma}$ and $s^* \leq \frac{\alpha}{\sigma}$. The assumption allows us to derive later results without concern for suboptimal subsidy choices.

Ruling out the possibility of high subsidies yields an empirically sensible result on import tariffs.

Lemma 3 *Import tariffs always cause negative cross-border externalities on their trading partners ($\frac{dG^*}{d\tau} < 0$ and $\frac{dG}{d\tau^*} < 0$). If home and foreign choose noncooperative import tariffs to maximize their objectives, holding other policies fixed, then the noncooperative import tariffs are higher than the cooperative import tariffs that maximize W.*

A foreign import tariff raises the equilibrium price of home exports in the foreign market, and the higher price leads to lower exports for home. Provided that export subsidies do not violate the bound suggested by Lemma 2, such that the subsidy is larger than the government's valuation of export profits, then the import tariffs always exert negative cross-border externalities. The persistent negative externalities ensure that countries' unilateral tariff choices are too high.

2.4 Foreign Firm Entry Externalities

All policies create international externalities. We focus here on the externalities of a foreign entry subsidy policy on home and postpone the discussion of trade policy externalities. We show that foreign entry improves home differentiated sector consumption but worsens home domestic and foreign profits. Foreign entry improves home's net trade revenue when home uses import tariffs and export subsidies. The balance of concerns determines the effect of foreign entry on welfare.

[22] The export subsidy increase consists of both an increase in the subsidy cost on the inframarginal export volume, and the total subsidy cost on the marginal export units. The former has a negative effect on the government objective. When the subsidy is greater than $\frac{\alpha}{\sigma}$, the latter more than offsets the value to governments of the marginal unit of output. The export subsidy has no effect on the domestic market. Consequently, countries cannot unilaterally benefit from subsidies greater than $\frac{\alpha}{\sigma}$.

Foreign entry lowers the price indices of the variety-loving consumers everywhere. An elasticity of substitution σ closer to 1 implies a larger effect. We express results as log derivatives: $\frac{\widehat{y}}{\widehat{x}} \equiv \frac{d\ln y}{d\ln x} = \frac{dy}{dx}\frac{x}{y}$, the elasticity of y with respect to x.

$$\text{Consumer surplus effect} \equiv -\frac{\widehat{P}}{\widehat{n_f}} = \frac{(1-S)}{(\sigma-1)} > 0. \tag{15}$$

Here $S \equiv \frac{n_h p c_h}{n_h p c_h + n_f p_f c_f}$, home's ratio of domestic expenditure on differentiated products to total expenditure on differentiated products. S^* is foreign's ratio. Since consumer surplus is inversely proportional to the price indices, the increase implies an increase in home consumer surplus from consuming differentiated products. The foreign price index increase is $\frac{\widehat{P^*}}{\widehat{n_f}} = \frac{-S^*}{(\sigma-1)} < 0$.

Foreign entry unambiguously lowers home total and per-firm profits, both domestically and abroad. A larger elasticity of substitution σ implies a larger business-stealing effect.

$$\text{Domestic profit effect} \equiv \frac{\widehat{\alpha(\frac{c_h}{x_h})\Pi_h}}{\widehat{n_f}} = \frac{\widehat{c_h}}{\widehat{n_f}} = \frac{\widehat{P}}{\widehat{n_f}}(\sigma-\varepsilon) = -\frac{(1-S)}{(\sigma-1)}(\sigma-\varepsilon) < 0. \tag{16}$$

$$\text{Export profit effect} \equiv \frac{\widehat{\alpha(1-\frac{c_h}{x_h})\Pi_h}}{\widehat{n_f}} = \frac{\widehat{c_h^*}}{\widehat{n_f}} = \frac{\widehat{P^*}}{\widehat{n_f}}(\sigma-\varepsilon) = -\frac{S^*}{(\sigma-1)}(\sigma-\varepsilon) < 0. \tag{17}$$

Foreign entry increases the total home import volume (but decreases the imports per-firm). Foreign entry decreases the home export volume M^* and c_h^*. A larger elasticity of substitution implies a larger decrease in per firm volumes. Throughout when describing the effects, we assume $\tau > 0$ and $s > 0$.

$$\text{Import tariff revenue effect} \equiv \frac{\widehat{\tau p n_f c_f}}{\widehat{n_f}} = 1 + \frac{\widehat{c_f}}{\widehat{n_f}} = 1 - \frac{(\sigma-\varepsilon)}{(\sigma-1)}(1-S) > 0. \tag{18}$$

$$\text{Export subsidy cost effect} \equiv \frac{\widehat{-s p n_h c_h^*}}{\widehat{n_f}} = -\frac{\widehat{c_h^*}}{\widehat{n_f}} = \frac{(\sigma-\varepsilon)}{(\sigma-1)}(S^*) > 0. \tag{19}$$

The foreign firm entry has no external effect on the home domestic entry subsidy costs and labor income.

To summarize, the signs of the various effects of foreign firm entry on the home government's objective are:

- Domestic profits decrease $(-)$

- Export profits decrease $(-)$
- Export subsidy costs decrease $(+)$
- Import tariff revenue increases $(+)$
- Consumer surplus increases $(+)$

Whether home benefits from foreign entry depends on the balance of the various externalities.

2.5 GATT Domestic Policy Rules

This subsection formalizes the GATT domestic policy rules and the question of whether further subsidy rules can offer an improvement. We consider whether the GATT approach to international regulation of domestic policies[23] succeeds in eliminating any domestic policy externalities derived in the previous subsection. We would expect the GATT approach to eliminate at least some domestic policy externalities, since the GATT eliminates all domestic cross-border externalities in Bagwell and Staiger (2001a). We generalize their stylized model of the GATT Article XXIII nonviolation complaint. Such a constraint "ensures that the level of market access commitments implied by tariff negotiations is not eroded by subsequent changes in domestic policies" (545). The nonviolation complaint enables home to demand a rebalancing of foreign's policies if foreign's domestic policy choices undermine the benefit of tariff reductions to home. Foreign would have to grant an additional tariff cut to home in order to abide by Article XXIII.

We use the following definition to model Article XXIII:

Definition 4 *A foreign policy mix* (τ^*, s^*, e^*) *is* ***market-access preserving*** *relative to baseline policies* $(\bar{\tau}, \bar{s}, \bar{e}, \bar{\tau}^*, \bar{s}^*, \bar{e}^*)$ *if and only if the new foreign policy mix yields equal or greater home export volume relative to the baseline policies.*

The definition must be different from Bagwell and Staiger (2001a) because theirs is not well-defined in our framework. When Bagwell and Staiger (2001a) formalize their market access constraint (p. 547), they require that foreign policies would preserve or increase home exports at a particular baseline world price. Their definition specifies nothing with respect to home's policies, because home's export volume does not depend on home's policies apart from the world price of home's exports, whereas in our framework the home export volume

[23] There are also other domestic policy rules in GATT that we abstract from, such as National Treatment, considered by Horn, Maggi, and Staiger (2010).

also depends on the home entry subsidy.[24] Foreign policies satisfying our definition do not erode home export volume, holding the home entry subsidy and both world prices fixed, so policies satisfying our definition satisfy their definition augmented by the requirement that the home entry subsidy is fixed at the baseline level.

Building on our definition of market-access preserving, we have our model of the GATT.

Definition 5 *Define a* ***GATT equilibrium*** *to be a set of policies* $(\hat{\tau},\hat{s},\hat{e},\hat{\tau}^*,\hat{s}^*,\hat{e}^*)$ *such that each country is choosing unilaterally optimal policies subject to the* ***market access constraint*** *defined in the program below. The home and foreign constraints that imply a GATT equilibrium are known as a* ***GATT Agreement****. Formally, the foreign policies satisfy*

$$(\hat{\tau}^*, \hat{s}^*, \hat{e}^*) = \arg \max_{\tau^*, s^*, e^*} \; G^*(\hat{\tau}, \hat{s}, \hat{e}, \tau^*, s^*, e^*)$$

$$\textit{subject to } c_h^*(\hat{\tau}, \hat{s}, \hat{e}, \tau^*, s^*, e^*) \geq c_h^*(\hat{\tau}, \hat{s}, \hat{e}, \hat{\tau}^*, \hat{s}^*, \hat{e}^*)$$

The set of GATT equilibria includes potential outcomes under GATT rules. For a given equilibrium, foreign cannot reduce home's exports. One GATT equilibrium is at the fully noncooperative trade policies. Tariff reductions under GATT are a movement between GATT equilibria**.**

To be consistent with reality, we need to ensure that if countries transition from one GATT equilibrium to a second GATT equilibrium with constraints requiring greater market access, then the second GATT equilibrium will have lower import tariffs then the first. In other words, countries will lower tariffs as part of granting each other greater market access. Countries could conceivably expand market access by reducing the entry subsidy and leaving tariffs fixed. In particular, we want to consider a GATT equilibrium with zero import tariffs, because we derive results at a zero-tariff GATT equilibrium in Section 3. We require the following lemma:

Lemma 6 *There exists a set* B *of scale parameters* β *for the function* $k(e)$*, such that there exists a GATT equilibrium at zero import tariffs when* $\beta \in B$*.*

We assume throughout that $\beta \in B$ so a zero-tariff GATT equilibrium exists. The assumption ensures that a sufficient expansion of market access under GATT rules eliminates import tariffs.

Our stylized model of GATT perfectly enforcing Article XXIII is unrealistic, but appropriate for our purposes. The early history of the GATT provides strong support for such

[24] The home import tariff does not matter for home export volume, and the home export subsidy does not have any effect on home export volume apart from the world price.

a model, in the sense that countries understood that Article XXIII could be used to prevent nations from undermining the market access granted by tariff cuts.[25] Later rounds of negotiations suggest that Article XXIII was not as successful as GATT drafters originally had hoped, and the number of successful Article XXIII complaints was limited.[26] When the Uruguay Round subsidy negotiations began in 1987, among the subsidies that were considered "hardly enforceable" were domestic subsidies to import-competing industries that Article XXIII could have addressed.[27] The focus of the current paper, however, is on why limits on subsidies were extended to trade-promoting subsidies not limited by Article XXIII, so we take an ideal version of Article XXIII as given.

With our definition of a GATT agreement, we can consider formally whether an agreement would benefit from further subsidy restrictions.

Definition 7 *Subsidy limits* $e \leq \tilde{e}$ *and* $e^* \leq \tilde{e}^*$ *or* $s \leq \tilde{s}$ *and* $s^* \leq \tilde{s}^*$ ***improve*** *a GATT equilibrium if Nash equilibrium government choices subject to both the market access constraints and subsidy limits yield a superior joint government outcome relative to Nash equilibrium choices subject only to the market access constraints.*

The paper only considers two possible forms of agreements: market access constraints and subsidy limits. The market access constraints alone can ensure efficiency in the two-good perfectly competitive frameworks of Bagwell and Staiger (2001a, 2006), so in their papers, subsidy limits never improve an agreement.[28]

We next consider whether the GATT eliminates all domestic policy externalities. Consider a GATT equilibrium. The GATT market access constraint binds, because otherwise it would not prevent countries from choosing unilateral import tariffs. Subsidy limits improve the GATT equilibrium if there exists a combination of entry subsidy decreases and tariff

[25] From GATT document L/334 (1955): "The Working Party considered many proposals for strengthening the present provisions of the Agreement with respect to the use of subsidies. So far as domestic subsidies are concerned, it was agreed that a contracting party which has negotiated a [tariff concession] may be assumed, for the purpose of Article XXIII, to have a reasonable expectation, failing evidence to the contrary, that the value of the concession will not be nullified or impaired by the contracting party which granted the concession by the subsequent introduction of a domestic subsidy on the product concerned."

[26] See Roessler and Gappah (2005) for a critique of the Article XXIII nonviolation complaint and a summary of its case history.

[27] See GATT document W-4 (1987).

[28] The limits on contract type in the current paper differ from a literature that focuses on efficient points achieved when countries act as if they do not value their ability to manipulate their terms-of-trade. Bagwell and Staiger (2009b) determine an efficient point in a monopolistically competitive framework that involves high export subsidies and noncooperative import tariffs. Such a point is an infeasible outcome in the current paper's contracting environment, because countries would unilaterally deviate by cutting their export subsidies. Contracting over a minimum export subsidy level would allow the point to be maintained, but no such policy exists in the GATT/WTO.

increases along the market access constraint such that both countries are better off. Formally, such a combination exists when $\frac{dG}{dn_f}|_{dc_h^*=0} < 0$, such that an increase in foreign firms (dn_f) combined with a foreign tariff decrease keeps home exports constant ($dc_h^* = 0$).[29] Foreign's constrained maximization implies $\frac{dG^*}{dn_f}|_{dc_h^*=0} = 0$, so the change in the joint objective is $\frac{dW}{dn_f}|_{dc_h^*=0} < 0$.

Among the foreign firm entry externalities from Subsection 2.4, the first-order effect of foreign firm entry on home exports and export subsidy costs are zeroed out by the tariff change required to preserve home exports. GATT effectively eliminates the home export effect and the export subsidy cost effect. Three other cross-border effects of foreign firm entry remain:

- Domestic profits (−)
- Consumer surplus (+)
- Import tariff revenue (+)

Which of the three effects above dominate depends on the parameters and trade policies in later sections. The complexity here contrasts with Bagwell and Staiger (2001a), where all three effects are a function of the terms-of-trade, and countries prefer terms-of-trade gains by assumption.[30]

To interpret the result, notice that the foreign entry subsidy promotes both exports and import competition, the former trade-promoting and the latter trade-reducing. The GATT market access constraint eliminates the trade-reducing and import-competing effects of the subsidy and leaves only the trade-promoting effects. The remaining externalities are similar to the externalities of export subsidies, derived in the Appendix, which are pure trade-promoting instruments. Proposition 1 summarizes the result:

Proposition 1 *Subsidy limits improve a GATT equilibrium if the sum of the domestic profit effect, the import tariff revenue effect, and the consumer surplus effect is negative.*

3 Model of Subsidy Rule Evolution

We model subsidy rule evolution by applying the Section 2 framework. When tariffs are close to zero at a GATT equilibrium (as in Definition 5), then the equilibrium could

[29] The foreign tariff decrease that keeps home export constant is $-d\tau \frac{dc_h^*/d\tau}{dc_h^*/dn_f}$.

[30] The model suggests that an "extended" market access rule could address the additional externalities. If a country increasing its entry subsidy voluntarily chose not to export any of the resulting varieties, then there would be no additional externalities from the entry subsidy. But voluntary export restraints have never been tied directly to subsidies by world trading rules.

be improved by adding subsidy limits (as in Definition 7). Three characteristics that motivate subsidy limits are a high government weight on domestic profits, a high substitutability between home and foreign goods, and a large share of differentiated goods consumed domestically. When tariffs are close to noncooperative tariff levels, the agreement cannot be improved by adding subsidy limits. While the first two subsections establish the evolution results for the domestic subsidy policy, the third subsection extends the results to the export subsidy. The results link the evolution of subsidy rules to tariff reductions.

This section takes the choice among the GATT equilibria to be exogenous. The paper does not provide a theory explaining why countries chose a GATT equilibrium with higher tariffs in the 1940s and progressed to Pareto superior GATT equilibria with progressively lower tariffs, but there is already a large literature on theories of gradual tariff reductions.[31]

3.1 Subsidy Limits at Zero Tariffs

This subsection first establishes the possibility that subsidy limits could improve a GATT equilibrium in the simplest case when import tariffs are zero. We then establish a more general set of parameters such that subsidy limits improve the GATT equilibrium.

Consider a GATT equilibrium such that the resulting policies are zero import tariffs $\hat{\tau} = \hat{\tau}^* = 0$. Such an agreement exists (Lemma 6). If a unilateral increase in entry subsidies and decrease in import tariffs, holding the trading partner's export volume fixed, still results in a negative net cross-border externality, then constraining subsidies would improve the GATT equilibrium. The negative net cross-border externality results if the negative effect on domestic profits outweighs the positive effect on consumers (Proposition 1), given that there is no tariff revenue. We evaluate the externality on home for the foreign policy change:

$$\frac{dG}{dn_f}\Big|_{\substack{dc_h^*=0 \\ \tau=\tau^*=0}} = \left(\overbrace{-PD\frac{\widehat{P}}{\widehat{n_f}}}^{\text{Consumer Surplus Effect}} + \overbrace{\alpha\left(\frac{p}{\sigma}\right) n_h c_h \frac{\widehat{c_h}}{\widehat{n_f}}}^{\text{Domestic Profit Effect}} \right) \frac{1}{n_f}. \tag{20}$$

Using our results from subsection 2.4, we have

[31] See Bagwell and Staiger (2002, p. 106-107) and Bagwell and Staiger (2010) for surveys.

$$\begin{aligned}
\frac{dG}{dn_f}|_{\substack{dc_h^*=0 \\ \tau=\tau^*=0}} &= \left(-PD\frac{\widehat{P}}{\widehat{n_f}} + \alpha\left(\frac{p}{\sigma}\right)n_h c_h \frac{\widehat{P}}{\widehat{n_f}}(\sigma-\varepsilon)\right)\frac{1}{n_f} \qquad (21)\\
&= \left(PD - \alpha\left(\frac{p}{\sigma}\right)n_h c_h(\sigma-\varepsilon)\right)\left(-\frac{\widehat{P}}{\widehat{n_f}}\right)\frac{1}{n_f}\\
&= \left[1-\alpha S(1-\frac{\varepsilon}{\sigma})\right]\left(\frac{(1-S)}{(\sigma-1)}\right)\frac{PD}{n_f}.
\end{aligned}$$

The sign of $\frac{dG}{dn_f}|_{dc_h^*=0}$ is the same as the bracketed expression. Foreign entry decreases the home price index. The price index change leads to an increase in consumer surplus (with unit elasticity) and fall in domestic profits (with elasticity $(\sigma-\varepsilon)$). For a government maximizing national income with $\alpha = 1$, the home price index decrease from foreign home entry is always desirable. If government weighs domestic profits heavily (high α), the price index decrease is undesirable:

$$\alpha > \frac{1}{S}\left(\frac{1}{1-\frac{\varepsilon}{\sigma}}\right) \Longrightarrow \frac{dG}{dn_f}|_{\substack{dc_h^*=0 \\ \tau=\tau^*=0}} < 0. \qquad (22)$$

Though S is endogenous, for symmetric policies and zero tariffs the market share depends only on parameters: $S = \frac{c_h}{c_h+(1+\phi)c_f} = \frac{1}{1+(1+\phi)^{1-\sigma}}$. We then have an expression for the existence of trade-rules in terms of parameters.

Proposition 2 *For $\alpha > \frac{1+(1+\phi)^{1-\sigma}}{1-\frac{\varepsilon}{\sigma}}$ there exists a GATT equilibrium at sufficiently low import tariffs that can be improved by limits on domestic entry subsidies.*

The theory implies three considerations that can motivate a GATT equilibrium limiting entry subsidies:

1. high political economy weight on profits (high α), which raises subsidies' cross-border externality on profits,

2. high domestic share of consumption (high S and high ϕ), which increases the relative importance of domestic profits compared to consumer surplus, and

3. high substitutability between differentiated goods relative to the outside good (low $\frac{\varepsilon}{\sigma}$), which increases the effects of competition from foreign entrants.

The proposition implies subsidy limits can improve a GATT equilibrium given reasonable parameter values. If $\frac{\varepsilon}{\sigma} = \frac{1}{3}$, the ratio of elasticities of substitution between the highest and

lowest categories of goods in Table IV of Broda and Weinstein (2006), and the share of differentiated consumption is 75%, then we require $a > 2$, which implies governments give more weight to lobbying contributions than national welfare.[32]

3.2 No Subsidy Limits at Higher Tariffs

This subsection establishes that when countries choose noncooperative tariffs, subsidy limits cannot improve a GATT equilibrium. The domestic profit consideration that motivates countries to use subsidy limits also motivates higher unilateral tariffs. Parameters that would imply subsidy limits also imply higher tariffs, so high that subsidy limits could not possibly improve a GATT equilibrium. The theory then provides a link between the import tariff reductions of the 1950s and 1960s under the GATT and the addition of subsidy limits on domestic trade-promoting subsidies under the WTO.[33]

Consider a GATT equilibrium at noncooperative tariffs $\bar{\tau}^N$, the Nash equilibrium where all policies are set unilaterally. The cross-border externality of a rise in foreign firms and fall in tariffs along the market access constraint, holding home exports fixed, is

$$\frac{dG}{dn_f}\Big|_{\substack{dc_h^*=0 \\ \tau=\tau^*=\tau^N}} = \left(\overbrace{-PD\frac{\widehat{P}}{\widehat{n_f}}}^{\text{Consumer Surplus Effect}} + \overbrace{\alpha\left(\frac{p}{\sigma}\right) n_h c_h \frac{\widehat{c_h}}{\widehat{n_f}}}^{\text{Domestic Profit Effect}} + \overbrace{\tau^N p n_f c_f \left(1 + \frac{\widehat{c_f}}{\widehat{n_f}}\right)}^{\text{Import Tariff Revenue Effect}} \right) \frac{1}{n_f}. \quad (23)$$

The connection between the motive to limit subsidies and the motive to raise tariffs is evident when comparing the external effects of foreign firm entry to home's unilateral tariff condition, $\frac{dG}{d\tau} = 0$:

$$\alpha\left(\frac{p}{\sigma}\right) n_h c_h \frac{\widehat{c_h}}{\widehat{p_f}} + \tau^N p n_f c_f \frac{\widehat{c_f}}{\widehat{p_f}} = 0. \quad (24)$$

Hidden within the unilateral tariff condition is the result that the fall in consumer surplus from an increased tariff is perfectly offset by the first-order increase in tariff revenue. Unilateral tariffs are always positive: a foreign price increase raises home per firm sales ($\frac{\widehat{c_h}}{\widehat{p_f}} > 0$) and lowers foreign import sales ($\frac{\widehat{c_f}}{\widehat{p_f}} < 0$) A higher political economy motivation (higher α)

[32] For a formal estimation of government weights on profits, Mitra, Thomakos, and Ulubasoglu (2006) find close to equal weight on contributions and consumer welfare, while the earliest studies found little weight on contributions (Goldberg and Maggi 1999, Gawande and Bandyopadhyay 2000). The estimates are for a different model (Grossman and Helpman 1994) with perfectly competitive sectors.

[33] The relevance of the result does not rest on the claim that the GATT actually represented a fall from noncooperative tariffs to zero import tariffs, since the respective results for zero and noncooperative import tariffs each hold for some neighborhood around the respective tariff choices.

motives higher import tariffs.

To connect the unilateral import tariff equation to the cross-border externality expression, we require a relationship between the effect of foreign prices on domestic consumption and the effect of foreign entry on domestic consumption. Log differentiating the demand equation (8) and price index equation (6) establishes the relationship. A one percent foreign price increase has the same impact on home's price index as a $(\sigma - 1)$ percent decrease in foreign firms: $(1-\sigma)\frac{\widehat{P}}{\widehat{n_f}} = \frac{\widehat{P}}{\widehat{p_f}}$. Consequently, the impact of a one percent foreign firm increase on expenditure of either home or foreign goods is the same as the impact of a $(\sigma - 1)$ percent decrease in foreign firms: $\frac{\widehat{n_f p_f c_f}}{\widehat{n_f}} = (1-\sigma)\frac{\widehat{n_f p_f c_f}}{\widehat{p_f}}$ and $\frac{\widehat{n_h p c_h}}{\widehat{n_f}} = (1-\sigma)\frac{\widehat{n_h p c_h}}{\widehat{p_f}}$. The expressions can equivalently be written as $\frac{\widehat{c_h}}{\widehat{n_f}} = (1-\sigma)\frac{\widehat{c_h}}{\widehat{p_f}}$ and $\left(1 + \frac{\widehat{c_f}}{\widehat{n_f}}\right) = (1-\sigma)\left(1 + \frac{\widehat{c_f}}{\widehat{p_f}}\right)$.

The relationship between foreign price and firm increases allows us to substitute the import tariff Nash condition (24) into the foreign firm externality equation (23). The import tariff effect can be rewritten as

$$\tau^N p n_f c_f \left(1 + \frac{\widehat{c_f}}{\widehat{n_f}}\right) = \alpha \left(\frac{p}{\sigma}\right) n_h c_h \frac{\widehat{c_h}}{\widehat{n_f}} \left(-1/\frac{\widehat{c_f}}{\widehat{p_f}} - 1\right) > 0. \tag{25}$$

To check that the effect is positive, the elasticity of foreign firm entry $\frac{\widehat{c_h}}{\widehat{n_f}} < 0$ and the price elasticity of import demand $-\frac{\widehat{c_f}}{\widehat{p_f}} > \sigma - (\sigma - \varepsilon)(1 - S^N) = \varepsilon + (\sigma - \varepsilon)S^N > 1$ since $\sigma > \varepsilon$ and $\varepsilon > 1$. Here S^N is the domestic expenditure share at the Nash equilibrium. The effect of foreign firm entry subject to the GATT constraint at Nash tariffs is then

$$\frac{dG}{dn_f}\Big|_{\substack{dc_h^*=0 \\ \tau=\tau^*=\tau^N}} = \left(-PD\frac{\widehat{P}}{\widehat{n_f}} + \alpha\left(\frac{p}{\sigma}\right) n_h c_h \frac{\widehat{c_h}}{\widehat{n_f}} / \left(-\frac{\widehat{c_f}}{\widehat{p_f}}\right)\right) \frac{1}{n_f}. \tag{26}$$

The Nash import tariff neatly scales down the domestic profit effect by the price elasticity of import demand $-\frac{\widehat{c_f}}{\widehat{p_f}}$. Using a similar derivation as (21), we have

$$\frac{dG}{dn_f}\Big|_{\substack{dc_h^*=0 \\ \tau=\tau^*=0}} = \left[1 - \frac{\alpha S^N (1 - \frac{\varepsilon}{\sigma})}{\sigma - (\sigma - \varepsilon)(1 - S^N)}\right] \left(\frac{(1 - S^N)}{(\sigma - 1)}\right) \frac{PD}{n_f}. \tag{27}$$

For the foreign firm entry externality to be negative, and the subsidy limits to be desirable, the bracketed expression must be negative. Solving the inequality for α we have

$$\frac{dG}{dn_f}\Big|_{\substack{dc_h^*=0 \\ \tau=\tau^*=0}} < 0 \Longrightarrow \alpha > \sigma\left(1 + \frac{\varepsilon}{(\sigma - \varepsilon)S^N}\right) > \sigma. \tag{28}$$

But our parameter restriction requires $\alpha < \sigma$. The parameter restriction was necessary because without it, governments would achieve an arbitrarily high joint objective by providing boundless export subsidies to their firms. The import tariff removes any motive to constrain subsidies beyond the GATT.

Proposition 3 *The GATT equilibrium at noncooperative tariffs cannot be improved by subsidy limits on domestic policies.*

Recall in the previous subsection that aside from high political economy motives, a large domestic expenditure share (S) and a large relative substitutability of goods (low $\frac{\varepsilon}{\sigma}$) push the motive for subsidy limits. But higher S and higher $\sigma - \varepsilon$ also imply a larger tariff revenue effect due to firm entry (reflected in the larger price elasticity of import demand). So the parameters that would yield subsidy limits at zero tariffs do not result in subsidy limits at noncooperative tariffs.

3.3 Extending Results to Export Subsidies

This subsection extends the results of the previous two subsections on entry-promoting subsidies to export subsidies affecting marginal cost of production. We desire such an extension to explain why there was a consensus to limit both domestic policies and export subsidies in the WTO.[34]

The effect of a foreign export subsidy increase on home can be written as

$$\frac{dG}{ds^*} = \left(\overbrace{PD\frac{\widehat{P}}{\widehat{p_f}}}^{\text{Consumer Surplus Effect}} - \overbrace{\alpha\left(\frac{p}{\sigma}\right) n_h c_h \frac{\widehat{c_h}}{\widehat{p_f}}}^{\text{Domestic Profit Effect}} - \overbrace{\tau p n_f c_f \left(\frac{\widehat{c_f}}{\widehat{p_f}}\right)}^{\text{Import Tariff Revenue Effect}} \right) \frac{1}{1+\phi+\tau+s^*}. \tag{29}$$

Notice the similarities between the expression, (20), and (23). We do not require notation to indicate the effects of a GATT equilibrium because the GATT equilibrium does not constrain export subsidies. Because $\frac{dG}{ds} = 0$ at the GATT equilibrium, $\frac{dG}{ds^*} = \frac{dW}{ds^*}$, so it is sufficient to show that $\frac{dG}{ds^*} < 0$ to establish that export subsidies are inefficiently high and countries would benefit from export subsidy limits.

The condition for the domestic profit effect to dominate the consumer surplus here is equivalent to the condition for domestic entry subsidies at zero tariffs in Subsection 3.1. The conditions are equivalent because of the close relationship between foreign price effects and foreign firm entry effects: $(1-\sigma)\frac{\widehat{P}}{\widehat{n_f}} = \frac{\widehat{P}}{\widehat{p_f}}$ and $\frac{\widehat{c_h}}{\widehat{n_f}} = (1-\sigma)\frac{\widehat{c_h}}{\widehat{p_f}}$. Consequently, the motive for subsidy limits at zero tariffs holds for either kind of trade-promoting subsidy.

At Nash import tariffs, the import tariff revenue effect precisely offsets the domestic profit effect, as evident from (24), and all that remains is the consumer surplus benefit for

[34]Several developed countries also began to limit export subsidies on manufacturing in 1962, to the detriment of manufacturing importers. Export subsidy agreements lacking a consensus are outside the scope of this paper, but they can be explained by the Brander and Spencer (1985) model.

the falling foreign price. The result that $\frac{dG}{ds^*}_{\tau=\tau^*=\tau^N} > 0$ at the Nash equilibrium implies that international inefficiency results from too little subsidization at the Nash equilibrium:

$$\frac{dG}{ds^*}_{\tau=\tau^*=\tau^N} = \left(PD\frac{\widehat{P}}{\widehat{p_f}}\right)\frac{1}{1+\phi+\tau+s^*} > 0. \tag{30}$$

Proposition 4 *Propositions 2 and 3 extend to export subsidies.*

Proposition 4 completes our explanation for why the rationale for subsidy limits and their evolution applies to both domestic entry subsidies and export subsidies.

4 Conclusion

This paper counters the claim that the WTO subsidy rules have no economic rationale whatsoever. It resolves the puzzle of why countries would seek to constrain trade-reducing policies at the time of the GATT, yet implement barriers to trade-promoting policies 40 years later. The model is highly stylized, but it is important to provide a simple theory for understanding the WTO subsidy rules, when such a large body of literature argues the subsidy rules are nonsensical. Much of the trade literature argues that the GATT struck the right balance in regulating both trade policies and domestic policies, but the current paper argues that the world trading system has faced problems that the GATT could not address.

The model provides a positive theory for the WTO subsidy rules. From the normative perspective that countries should maximize national income, the model does not provide a result distinct from prior work, since there is no motive for subsidy rules absent political economy motives. The positive theory is still valuable in explaining why countries form sub-optimal agreements. If there are additional reasons why governments should value domestic production outside the scope of the model, then this paper is a step towards a model of how such considerations would be important in motivating subsidy rules.

Another puzzle in the subsidy agreement literature is why the WTO permits countries to respond to subsidies with higher import tariffs, known as countervailing duties, as an alternative to filing a dispute to enforce the new subsidy limits. The countervailing duties are puzzling because they seem to respond to inefficiency in subsidy choices by creating more inefficiency in trade barriers.[35] The model here could be extended to consider a limited contracting environment, such that countries set tariffs under GATT negotiations as usual, but the costs of enforcing the WTO subsidy limits are exogenously large. In such an environment, countries would optimally choose cooperative tariffs to allow some subsidy

[35] See Sykes (1989, 2005) and WTO (2009) for the legal and economic background on countervailing duties.

inefficiency and some trade barrier inefficiency.[36] The extension then provides a rationale for the WTO allowing countries to continue use of countervailing duties, for industries in which the subsidy limits are costly to enforce.

While we have mainly considered the history of domestic policies in manufacturing trade to validate the theory, the negotiations over services provide an additional potential application. As Francois and Hoekman (2010) observe, a puzzle in the services trade literature is that trade liberalization has tended to be unilateral and not driven by trade agreements—actual services policies are more liberal than negotiated policy bounds. The authors remark, "Much more work is also required to understand the political economy of services policies and reform... It is not clear that for international transactions that involve factor movement (i.e. trade in service) the standard explanations in the literature—first and foremost the terms of trade rationale—necessarily apply." Another defining feature of services trade is that domestic regulations rather than border measures are what matter for market access, so the framework developed here is promising for the analysis of such trade barriers. The theory can explain why services liberalization would be unilateral in some industries but require coordination in others.

This paper improves our positive understanding of the international coordination of subsidies, but the actual decision-making process to file subsidy disputes and countervailing duties is more complex than in the model. How does the political process map the winners and losers from subsidization into the actual decision-making? To what extent do bureaucrats have the necessary information to make appropriate decisions about subsidies? More research is necessary to understand how international coordination of subsidies could be improved, and whether international subsidy rules should be eliminated altogether, as Sykes (2010) proposes.

A Appendix

A.1 Preliminaries

Before presenting the proofs of the lemmas, we provide some background on the comparative statics for the government policy choices and existence proofs.

[36] Countries would not choose the efficient import policies with subsidy limits, because at such policies there is a first-order benefit from raising tariffs to address the subsidy inefficiency, and no first-order effect of raising tariffs on the trade barrier inefficiency. Similarly, countries would not choose to set import tariffs high enough to fully eliminate the subsidy inefficiency because there would be a first-order benefit from lowering tariffs to address the trade barrier inefficiency.

A.1.1 Demand Comparative Statics

Before presenting proofs and extensions, we consider comparative statics of government policies. Totally log-differentiating the price index equations and the demand equations yield all the comparative statics for prices and firms:

$$\begin{bmatrix} \hat{P} \\ \hat{P}^* \end{bmatrix} = \frac{1}{1-\sigma} \begin{bmatrix} S & 1-S \\ 1-S^* & S^* \end{bmatrix} \begin{bmatrix} \hat{n}_h \\ \hat{n}_f \end{bmatrix} + \begin{bmatrix} (1-S_h)\hat{p}_f \\ (1-S_f^*)\hat{p}_h^* \end{bmatrix}, \tag{31}$$

$$\begin{aligned} \hat{x}_h &= \frac{c_h}{x_h}\hat{c}_h + (1-\frac{c_h}{x_h})\hat{c}_h^*, \\ \hat{x}_f &= (1-\frac{c_f}{x_f})\hat{c}_f + \frac{c_f}{x_f}\hat{c}_f^*, \text{ and} \end{aligned} \tag{32}$$

$$\begin{bmatrix} \hat{x}_h \\ \hat{x}_f \end{bmatrix} = (\sigma-\varepsilon) \begin{bmatrix} \frac{c_h}{x_h} & 1-\frac{c_h}{x_h} \\ (1-\frac{c_f}{x_f}) & \frac{c_f}{x_f} \end{bmatrix} \begin{bmatrix} \hat{P} \\ \hat{P}^* \end{bmatrix} - \sigma \begin{bmatrix} (1-\frac{c_h}{x_h})\hat{p}_h^* \\ (1-\frac{c_f}{x_f})\hat{p}_f \end{bmatrix}. \tag{33}$$

Here $\hat{a} = d\log a = da/a$.

The entry subsidies e and e^* singly determine the firm counts n_h and n_f, respectively. The connection between the trade policy instruments and prices is that each trade policy instrument affects only one price. Totally differentiating the traded price equations yields

$$\begin{aligned} dp_f &= p(d\tau_h + d\tau_f), \text{ and} \\ dp_h^* &= p(d\tau_h^* + d\tau_f^*). \end{aligned} \tag{34}$$

To see a connection between the effects of foreign entry and foreign export subsidies, notice that log changes in one have proportional effects to log changes in the other, for the home price index, home domestic sales, and expenditure shares: $(1-\sigma)\frac{\widehat{P}}{\widehat{n_f}} = \frac{\widehat{P}}{\widehat{p_f}}$, $(1-\sigma)\frac{\widehat{c_h}}{\widehat{n_f}} = \frac{\widehat{c_h}}{\widehat{p_f}}$, and $(1-\sigma)\frac{\widehat{p_f n_f c_f}}{\widehat{n_f}} = \frac{\widehat{p_f n_f c_f}}{\widehat{p_f}}$.

Foreign price increases always raise home sales and lower foreign sales:

$$\begin{aligned} \frac{\widehat{c_h}}{\widehat{p_f}} &= (\sigma-\varepsilon)(1-S) > 0, \text{ and} \\ \frac{\widehat{c_f}}{\widehat{p_f}} &= \sigma - (\sigma-\varepsilon)(1-S) > 1. \end{aligned} \tag{35}$$

A.1.2 Government Comparative Statics

We provide here comparative statics for changes in home or foreign government policies on home welfare. Symmetric results hold for foreign.

The effect of a foreign tariff increase on home is

$$\frac{dG}{d\tau^*} = \frac{(\frac{\alpha}{\sigma} - s)pn_h c_h^* \frac{\widehat{c_h^*}}{\widehat{p_h^*}}}{(1 + \phi + \tau^* - s)}. \tag{36}$$

The effect of an increase in home's own export subsidy is

$$\frac{dG}{ds} = \frac{(s - \frac{\alpha}{\sigma})pn_h c_h^* \frac{\widehat{c_h^*}}{\widehat{p_h^*}} - p_h^* n_h c_h^*}{(1 + \phi + \tau^* - s)}. \tag{37}$$

The effect of an increase in foreign export subsidies on home is

$$\frac{dG}{ds^*} = \frac{p_f n_f c_f - \alpha(\frac{p}{\sigma})n_h c_h \frac{\widehat{c_h}}{\widehat{p_f}} - \tau p n_f c_f \frac{\widehat{c_f}}{\widehat{p_f}}}{(1 + \phi + \tau - s^*)}. \tag{38}$$

The effect of an increase in home's own tariff is

$$\frac{dG}{d\tau} = \frac{\alpha(\frac{p}{\sigma})n_h c_h \frac{\widehat{c_h}}{\widehat{p_f}} + \tau p n_f c_f \frac{\widehat{c_f}}{\widehat{p_f}}}{(1 + \phi + \tau - s^*)} = 0. \tag{39}$$

The effect increase in trade barriers $t = \tau - s^* = \tau^* - s$ on world welfare is

$$\frac{(1 + t + \phi)}{2}\frac{dW}{dt} = \alpha\frac{p}{\sigma}n(\left[c_h(\frac{\widehat{c_h}}{\widehat{p_f}}) + (1 + \phi)c_h^*(\frac{\widehat{c_h^*}}{\widehat{p_h^*}})\right] + tp\bar{M}(\frac{\widehat{c_h^*}}{\widehat{p_h^*}}). \tag{40}$$

A.1.3 Firm Entry Externalities Compared to Export Subsidy Externalities

Foreign firm entry has the following effect on home welfare, if foreign tariffs fall to preserve home exports to foreign. This expression could also be thought of as the trade-promoting effect of the foreign firm entry:

$$\frac{dG}{dn_f}|_{dc_h^*=0} = \left(-PD\frac{\widehat{P}}{\widehat{n_f}} + \alpha\left(\frac{p}{\sigma}\right)n_h c_h \frac{\widehat{c_h}}{\widehat{n_f}} + \tau p n_f c_f\left(1 + \frac{\widehat{c_f}}{\widehat{n_f}}\right)\right)\frac{1}{n_f}. \tag{41}$$

The foreign firm entry effect can be rewritten in terms of price changes:

$$\frac{dG}{dn_f}|_{dc_h^*=0} = \left(PD\frac{\widehat{P}}{\widehat{p_f}} - \alpha\left(\frac{p}{\sigma}\right)n_h c_h \frac{\widehat{c_h}}{\widehat{p_f}} - \tau p n_f c_f\left(1 + \frac{\widehat{c_f}}{\widehat{p_f}}\right)\right)\frac{1}{(\sigma - 1)n_f}. \tag{42}$$

The results imply a relationship between the trade-promoting effect of the foreign firm entry and the export subsidy externality:

$$\frac{dG}{dn_f}|_{dc_h^*=0} = \left((1+\phi+\tau-s^*)\frac{dG}{ds^*} - \tau p n_f c_f\right)\frac{1}{(\sigma-1)n_f}. \tag{43}$$

It immediately follows that if $\tau > 0$ and $\frac{dG}{ds^*} = 0$ (no export policy externalities), then $\frac{dG}{ds^*} < 0$. If $\tau > 0$ and $\frac{dG}{dn_f}|_{dc_h^*=0} = 0$, then $\frac{dG}{ds^*} > 0$ (if export policies are chosen unilaterally such that $\frac{dG}{ds^*} = 0$, then export subsidies are inefficiently low from the perspective of maximizing world objective W).

A.1.4 Existence of Efficient Policies

We prove here that the restriction $\alpha < \sigma$ ensures that trade policies which maximize W exist.

We derive the symmetric and efficient level of trade barriers that satisfy the trade policy efficiency conditions in the baseline model. In each country, profits are $\bar{\Pi}$ and import volume is $\bar{M}$. The trade elasticity with respect to prices is the same for both trade volumes $-\frac{\widehat{c_h^*}}{\widehat{p_h^*}} = -\frac{\widehat{c_f}}{\widehat{p_f}} \equiv \zeta = \sigma - (\sigma-\varepsilon)(1-\bar{S}) > 1$. The import price elasticity of domestic demand is $\frac{\widehat{c_f^*}}{\widehat{p_h^*}} = \frac{\widehat{c_h}}{\widehat{p_f}} = (\sigma-\varepsilon)(1-\bar{S}) = \sigma - \zeta > 0$. Define production share $\bar{X} = \frac{c_h}{x_h} = \frac{c_f^*}{x_f}$.

The net trade barrier first-order condition for maximizing world welfare is

$$\frac{\bar{\iota}}{2}\frac{dW}{dt} = \alpha\bar{\Pi}\big(\big[\bar{X}(\sigma-\zeta) + (1-\bar{X})(-\zeta)\big] + tp\bar{M}(-\zeta) = 0.$$

As in Bagwell and Staiger (2009b), the world welfare condition is the sum of the unilateral import tax condition (39) and export tax condition (37), less the terms-of-trade effects of the export tariff ($p_f M$). The efficiency condition does not depend on the individual trade barriers chosen independent of the total trade barriers t.

The first-order condition implicitly defines the solution for t:

$$\alpha\bar{X} - \zeta\left(\frac{\alpha}{\sigma} + \frac{(1-\bar{X})}{(1+\phi)}t\right) = 0.$$

The number of firms and output divide out of the first-order condition—a consequence of the CES assumption and symmetry. Solving for the optimal firm count is not necessary to characterize the efficient policies.

The first order condition reflects the tradeoff between correcting the imperfectly competitive distortion in traded goods and distorting the balance of consumption between home and foreign goods. Recall that $\bar{X}$, the share of production spent at home, depends on t, as

does ζ.

We show that the efficient level of trade subsidies falls between zero and the subsidy that fully corrects the foreign distortion. First, we can rule out positive net trade barriers ($t > 0$) as optima, as these further distort the marginal cost of consumption away from the marginal benefit abroad—there is no redistribution motive in the baseline model that would lead positive trade taxes to be efficient. We can establish existence by showing that $g(t) \equiv \alpha\bar{X}(t) - \frac{\zeta(t)}{\sigma}(\alpha + \frac{(1-\bar{X}(t))}{(1+\phi)}t)$ is negative at free trade and positive at the subsidy that yields first-best consumption in traded goods. There exist ϕ and α sufficiently high such that $g'(t)$ is increasing at free trade, so we cannot rely on global concavity to prove existence and uniqueness.

At free trade, $g(0) = -\frac{\alpha\varepsilon}{\sigma}\left(\frac{(1+\phi)^{2-\sigma}}{1+(1+\phi)^{1-\sigma}}\right) < 0$. The negative sign of this expression reflects that countries optimally make some attempt to correct the monopoly distortion in traded goods.

Consider the tariff t^* that establishes the first-best output for traded goods, such that $\frac{\alpha}{\sigma} + \frac{(1-\bar{X}(t^*))}{(1+\phi)}t^* = 0$. Such a $t^* < 0$ much exist because the continuous function $h(t) = \frac{\alpha}{\sigma} + \frac{(1-\bar{X}(t^*))}{(1+\phi)}t^*$ satisfies $h(0) > 0$, and as $t \to -1-\phi$, $h(t) \to \frac{\alpha}{\sigma} - 1 < 0$. At t^*, $g(t^*) = \alpha\bar{X}(t^*) > 0$. The result reflects that countries would not subsidize to ensure first-best consumption in traded goods, since it would excessively distort consumption away from domestic goods.

Since $g(t)$ is continuous and differentiable, and we have shown that $g(0) < 0$ and $g(t^*) > 0$, then there must exist an optimum t^{eff} in $(t^*, 0)$ such that $g(t^{eff}) = 0$ and $g'(t^{eff}) < 0$.

To establish uniqueness, suppose the conditions $g(t^{eff}) = 0$, $g'(t^{eff}) < 0$, and $t^{eff} < 0$ are not uniquely satisfied. Let t^{eff} be the point closest to zero satisfying the conditions, so there are no optima in the interval $(t^{eff}, 0]$. We can establish that for all $t < t^{eff}$, $g'(t) < 0$: expanding the derivative of $g'(t)$, all the positive terms receive weight S or X and become smaller as subsidies increase (domestic consumption becomes smaller), while all the negative terms receive weight $(1 - X)$ and become larger as subsidies increase (foreign consumption becomes larger). Consequently, $g(t) > 0$ for all $t < t^{eff}$. and since there were no equilibrium in $(t^{eff}, 0)$ by assumption, t^{eff} is the unique equilibrium.

A.2 Proofs

Lemma 1 *Consider countries with symmetric policies $\bar{e}$, $\bar{\tau}^N$, and $\bar{s}^N$, such that $\frac{dG}{d\tau} = \frac{dG^*}{d\tau^*} = \frac{dG}{ds} = \frac{dG^*}{ds^*} = 0$. Consider an additional set of countries with total trade barriers $\bar{t}^c$ such that $\frac{dW}{d\tau} = \frac{dW}{d\tau^*} = \frac{dW}{ds} = \frac{dW}{ds^*} = 0$. Then $\bar{\tau}^N$, $\bar{s}^N$, $\bar{t}^c$ do not depend on $\bar{e}$, $\bar{\tau}^N > 0$, and $\bar{t}^N > \bar{t}^C$.*

Proof. $\bar{\tau}^N$, $\bar{s}^N$, and $\bar{t}^c$ do not depend on $\bar{e}$ because under symmetric policies, firm counts are the same, and drop out of all the first-order conditions.

$\tau^N > 0$**:** Define $\bar{\tau}^N$ to be the Nash tariff and denote other symmetric policies similarly. $\bar{\tau}^N = -\frac{\alpha}{\sigma}\frac{c_h}{c_f}\frac{\widehat{c_h}}{\widehat{p_f}}/\frac{\widehat{c_f}}{\widehat{p_f}} > 0$, because $\frac{\widehat{c_h}}{\widehat{p_f}} > 0$ and $\frac{\widehat{c_f}}{\widehat{p_f}} < 0$ (a foreign price increase improves home's sales and lowers home's imports).

$\bar{t}^N > \bar{t}^C$: Substituting the Nash policy conditions ($\frac{dG}{ds} = 0$) and ($\frac{dG}{dt} = 0$) into the externality equations we get $\frac{dG}{ds^*} > 0$ and $\frac{dG}{d\tau^*} < 0$ (see A.1.2), which implies countries can benefit from reducing trade barriers from Nash policies. ■

Lemma 2 *Consider arbitrary import tariff policies and entry subsidies, and export subsidy choices s and s^* satisfying $\frac{dG}{ds} = \frac{dG^*}{ds^*} = 0$ Then $s \leq \frac{\alpha}{\sigma}$ and $s^* \leq \frac{\alpha}{\sigma}$.*

Proof. The export subsidy first-order condition (setting equation 37 to 0) implies $\bar{s} = \frac{\alpha}{\sigma} + \frac{p_h^*}{p}/\frac{\widehat{c_h^*}}{\widehat{p_h^*}}$. Since $\frac{\widehat{c_h^*}}{\widehat{p_h^*}} < 0$, $\bar{s} < \frac{\alpha}{\sigma}$. ■

Lemma 3 *Import tariffs always cause negative cross-border externalities on their trading partners ($\frac{dG^*}{d\tau} < 0$ and $\frac{dG}{d\tau^*} < 0$). If home and foreign choose noncooperative import tariffs to maximize their objectives, holding other policies fixed, then the noncooperative import tariffs are higher than the cooperative import tariffs that maximize W.*

Proof. The import tariff externality expression (36) implies the externality has the same sign as $s - \frac{\alpha}{\sigma}$, but Lemma 2 implies $s < \frac{\alpha}{\sigma}$, and $\frac{dG^*}{d\tau} < 0$ *and* $\frac{dG}{d\tau^*} < 0$ follows. For the Nash policies to maximize W, it must also be true that $\frac{dG}{d\tau} + \frac{dG^*}{d\tau} = 0$, so $\frac{dG}{d\tau} > 0$. $\frac{dG}{d\tau} = 0$ at the Nash tariff, and sign($\frac{dG}{d\tau}$)=sign($\alpha(\frac{p}{\sigma})c_h\frac{\widehat{c_h}}{\widehat{p_f}} + \tau p c_f \frac{\widehat{c_f}}{\widehat{p_f}}$). $\alpha(\frac{p}{\sigma})c_h\frac{\widehat{c_h}}{\widehat{p_f}} > 0$ and $pc_f\frac{\widehat{c_f}}{\widehat{p_f}} < 0$, so a lower tariff than the Nash tariff is necessary to induce a positive $\frac{dG}{d\tau}$. ■

Lemma 6: *There exists a set B of scale parameters β for the function $k(e)$, such that there exists a GATT equilibrium at zero import tariffs when $\beta \in B$.*

Proof. Let $\bar{M} > \bar{M}^N$ be a symmetric export volume greater than the export volume at Nash policies. We show we can find a β such that there is a GATT equilibrium at zero import tariffs with export volume $\bar{M}$, and by varying $\bar{M}$, this maps out the set B of β values such that we know a zero-tariff GATT equilibrium exists. Let $\bar{\tau}, \bar{s}$,and $\bar{e}$ be the policies countries choose at the GATT equilibrium with export volume $\bar{M}$. We can scale the function $k(e)$ so that countries choose zero import tariffs. Write $k(e) = \beta_k\kappa(e)$ for some $\beta_k > 0$ yet to be determined, and κ is a function that satisfies our restrictions for k from Subsection 2.2, and let κ have scale parameter β_κ. The condition for the constrained optimal choice of e can then be written as $F(\bar{\tau}, \bar{s}, \bar{e}) = \beta_k$,for some function $F(\bar{\tau}, \bar{s}, \bar{e})$, which is strictly positive because κ is positive, and both consumer welfare and total profits are increasing in the entry subsidy. The market access constraint gives us e as a function of $\bar{\tau}$ and the unilateral export condition

gives us $\bar{s}(\bar{\tau}, \bar{e}(\bar{\tau}))$. If we choose $\beta_k = F(0, \bar{s}(0, \bar{e}(0)), \bar{e}(0))$, then the resulting function k has scale parameter $\beta = \beta_k \beta_\kappa$, the choices of s and e are optimal subject to the market constraint, and the policies $(0, \bar{s}(0, \bar{e}(0)), \bar{e}(0))$ determine a GATT equilibrium with zero tariffs. ■

A.3 Extensions

A.3.1 Model with No Domestic Consumers

A common simplification in the strategic trade literature is that countries have no domestic market for their products. The baseline model of Brander and Spencer (1985) and the three-country model of Bagwell and Staiger (2009a) make such an assumption. The assumption eliminates the results of the current paper. Observe the efficient trade policy condition without domestic consumers:

$$\alpha \left(\frac{p}{\sigma}\right) (\bar{M})(-\zeta) + \tau p \bar{M}(-\zeta) = 0.$$

Countries set export subsidies to $\tau = \frac{-\alpha}{\sigma}$ and eliminate the monopoly and political economy distortions. The foreign firm entry externality under such policies is

$$\left(\alpha \left(\frac{p}{\sigma}\right) + \tau p\right) \frac{\widehat{M}}{\widehat{n_f}} = 0.$$

The efficient trade policies eliminate any foreign firm externality and there is no role for trade agreements to coordinate entry-promoting policies.

A.3.2 Mirror Image Economy

The efficient policies in the baseline economy involve negative net trade barriers, regardless of the political economy weight. The result contrasts with Bagwell and Staiger (1999), where political economy motives can lead countries to agree on positive tariffs. The lack of distributive motives arises because the economy has a single factor. One way to address this is to add a second factor to the economy. A simpler way to add a distributional motive is to have mirror image imperfectly competitive sectors in each country, much like the two-industry economy of Krugman (1980).

Total number of firms is the same in each country: $n_h = n_f = n$. A share $\chi > .5$ firms produce in industry a in home, and b abroad, so

$$\begin{aligned} n_{ha} &= n_{fb} = \chi n, \text{ and} \\ n_{hb} &= n_{fa} = (1-\chi)n. \end{aligned}$$

Preferences are such that the elasticity of substitution is σ between goods within an industry, but the elasticity of substitution is ω between the composite goods of each industry, where $\omega \in (\varepsilon, \sigma)$. The preferences yield the following demands:

$$\begin{aligned} x_{h\alpha} &= p^{-\sigma} P_{\alpha}^{\sigma-\omega} P^{\omega-\varepsilon} + (1+\phi) p_h^{*-\sigma} P_{\alpha}^{*\sigma-\omega} P^{*\omega-\varepsilon}, \\ x_{hb} &= p^{-\sigma} P_{b}^{\sigma-\omega} P^{\omega-\varepsilon} + (1+\phi) p_h^{*-\sigma} P_{b}^{*\sigma-\omega} P^{*\omega-\varepsilon}, \\ x_{f\alpha} &= p^{-\sigma} P_{\alpha}^{*\sigma-\omega} P^{*\omega-\varepsilon} + (1+\phi) p_f^{-\sigma} P_{\alpha}^{\sigma-\omega} P^{\omega-\varepsilon}, \text{ and} \\ x_{fb} &= p^{-\sigma} P_{b}^{*\sigma-\omega} P^{*\omega-\varepsilon} + (1+\phi) p_f^{-\sigma} P_{b}^{\sigma-\omega} P^{\omega-\varepsilon}. \end{aligned}$$

The relevant price indices are

$$\begin{aligned} P &= (P_a^{1-\omega} + P_b^{1-\omega})^{\frac{1}{1-\omega}}, \quad P^* = (P_{\sigma}^{*1-\omega} + P_{\beta}^{*1-\omega})^{\frac{1}{1-\omega}}, \\ P_a &= (n_{\alpha h} p^{1-\sigma} + n_{\alpha f} p_f^{1-\sigma})^{\frac{1}{1-\sigma}}, \quad P_{\alpha}^* = (n_{\alpha f} p^{1-\sigma} + n_{\alpha h} p_f^{1-\sigma})^{\frac{1}{1-\sigma}}, \\ P_b &= (n_{bh} p^{1-\sigma} + n_{bf} p_f^{1-\sigma})^{\frac{1}{1-\sigma}}, \text{ and } P_b^* = (n_{bf} p^{1-\sigma} + n_{bh} p_f^{1-\sigma})^{\frac{1}{1-\sigma}}. \end{aligned}$$

Under symmetry we have $P = P^*$, $P_a = P_b^*$, and $P_b = P_a^*$.

The demand equations imply the home country's expenditure shares on goods a and b are

$$S_a = \frac{1}{1 + \left(\frac{P_b}{P_a}\right)^{1-\omega}}, \text{ and } S_b = \frac{1}{1 + \left(\frac{P_a}{P_b}\right)^{1-\omega}}.$$

Define S_a^* and S_b^* similarly for foreign consumers' expenditure share. Notice that $S_a > S_b$, $S_a = S_b^*$, $S_b = S_a^*$, and $S_a + S_b = 1$.

Define S_{ha} to be the share of a goods home purchases domestically:

$$S_{ha} = \frac{1}{1 + \frac{n_{\alpha f}}{n_{\alpha h}} \iota^{1-\sigma}} = \frac{1}{1 + \frac{1-\chi}{\chi} \iota^{1-\sigma}}.$$

Define similar shares for foreign production and consumption. The subscript denotes location of production while the superscript denotes the location of consumption. Notice that $S_{ha} =$

$S^*_{fb} > .5$, $S^*_{fa} = S_{hb}$, $S^*_{hb} = S_{fa} < .5$, and $S_{fb} = S^*_{ha}$.

A tariff increase by both countries has the following effects on the price indices:

$$\begin{aligned} \hat{P} &= S_a \hat{P}_\alpha + S_b \hat{P}_\beta = \left(S_a(1 - S_{ha}) + S_b(1 - S_{hb})\right) \hat{p}_f, \text{ and} \\ \hat{P}^* &= S^*_a \hat{P}^*_\alpha + S^*_b \hat{P}^*_\beta = \left(S^*_a(1 - S^*_{fa}) + S^*_b(1 - S^*_{fb})\right) \hat{p}^*_h. \end{aligned}$$

Since $S_b(1 - S_{hb}) > S_a(1 - S_{ha})$, the tariff has a much larger benefit for the minority good in each country, which creates the motive for redistribution. The motive allows for the possibility of positive tariffs in a cooperative equilibrium, if the minority industry in each country receives a political economy weight sufficiently larger than the weight of the majority industry.

A.3.3 Single Factor Economy

We consider here how the paper's results hold up in a model like Ossa (2011) where there is a single labor factor for both the fixed cost and marginal cost of production. As in the current paper's framework, the wage is constant for all factors in both countries.

Consider governments which choose a trade policy and a subsidy for the fixed cost of production. A consequence of such an environment is that there are no profits in equilibrium and firm production is $\frac{f_h}{m}(\sigma - 1)$, regardless of foreign policy changes.

The market clearing condition for home firms can be written as

$$n_h c_h + (1 + \phi) n_h c^*_h = n_h x_h.$$

Consider a change in foreign policy mix that lowers fixed costs and raises tariffs to preserve home's export volume to foreign. The policy change increases foreign firms, naturally, and home firms exit due to the tougher competition. Such a policy change has no effect on home prices or output or exports, so the log differential of the market clearing condition is

$$X_h(\hat{n}_h + \hat{c}_h) = \hat{n}_h.$$

And since $\hat{c}_h = (\sigma - 1)\hat{P}$:[37]

$$\hat{P} = \frac{(1 - X_h)}{X_h(\sigma - 1)} \hat{n}_h < 0.$$

[37] Ossa uses a Cobb-Douglas utility function for the outside sector and differentiated sector instead of a quasilinear function, so the elasticity of consumption with respect to the price index is $(\sigma - 1)$ instead of $(\sigma - \varepsilon)$.

The fall in home firms implies a lower home price index which increases home welfare. Intuitively, if home firms exit when a zero-profit condition is in place, the home firms must be selling less to domestic consumers, which can only happen if consumers are better off from the change in foreign policy mix. Furthermore, if home is subsidizing entry, home's subsidy costs fall, providing an additional benefit.

The model can be augmented with mobility frictions that give home workers benefit to having production at home, but such an extension just moves the model closer to the current paper's specific factor baseline model, which is a much simpler though more extreme approach. The result suggests that such frictions are central to the existence of the WTO subsidy rules.

A.3.4 Single Sector Economy

Consider a Krugman (1980) model without any outside sector (also studied by Gros 1987 and Ch. 7.1-7.2 of Helpman and Krugman 1989). Here there is no outside sector to pin down the wages, and a change in foreign policy mix has no effect on the number of firms or output at home.

The market clearing condition is $c_h + (1+\phi)c_h^* = x_h$. A change in foreign policy mix which preserves foreign exports has no effect on the entry and production levels of home firms, so it must also preserve home consumption and the real wage of home consumers $\frac{w}{P}$. The result would hold true even if there were specific factors for the fixed requirement of production. The result suggests that having multiple sectors of the economy is crucial to the results, but the model is still reasonable because trade negotiations often take place over sectors that are small relative to the rest of the economy.

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