A Firm Delocation Theory of WTO Subsidy Rules

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Abstract

I construct a theory of trade agreements in which nations negotiate over both domestic policies and trade policies in a monopolistically competitve setting. My theory contributes to two trade policy questions: first, what problems do trade agreements solve? Second, what explains the evolution of domestic subsidy rules between the GATT and the WTO? I show that trade agreements must solve a firm-delocation problem – a prisoners' dilemma arising when nations use domestic subsidies to attract firm entry within their borders. This problem persists even when nations have both import and export policies at their disposal. GATT nonviolation complaints, designed to prevent domestic policies that undermine market access commitments, do not support efficient agreements when countries have sufficiently strong political economic motivations. This inefficiency leaves a role for additional remedies against subsidies, such as countervailing duties and WTO disputes forcing removal of "trade-distorting" subsidies.

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1 Introduction

Stricter rules on manufacturing subsidies are among the most salient differences between the World Trade Organization (WTO) and its precursor, the General Agreement on Tariffs and Trade (GATT). WTO rules on manufacturing subsidies allow governments to force the removal of any subsidy perceived to be trade-distorting, while GATT rules limit subsidies only to the extent they undermine the benefits of prior tariff commitments.[1]. Subsidy rules were among the most contentious issues of the Tokyo Round (1973-1979) and Uruguay Round (1986-1994) of trade negotiations.[2] Disputes under the WTO subsidy rules have resulted in some of the WTO's most high-profile cases and largest settlements.[3] Understanding international subsidy rules is therefore important for understanding the WTO.

I make two novel theoretical contributions towards understanding the WTO. First, I show that if nations can use domestic policies to affect the entry of differentiated producers, then nations *must* solve a "firm-delocation" problem – a prisoners' dilemma arising when nations use industrial policy to attract firm entry within their borders. Second, I show that GATT rules aimed to prevent subsidies that undermine market access commitments are not generally sufficient to maintain efficiency under monopolistic competition. These results suggest a role for additional subsidy rules in guiding nations towards the efficiency frontier in trade relations.

The importance of the firm delocation problem here contrasts with a wide range of theories in which the only problem a trade agreement needs to solve is terms-of-trade manipulation – the ability of nations to pass the costs of trade policy onto their trading partners.[4] Nations do not need trade agreements to solve externalities that arise under imperfect competition, because these externalities travel through local prices of traded goods, and nations can handle these through their import and export policy choices. In my theory, further discipline on domestic subsidies is necessary to solve the firm delocation problem.

I show that international agreements must solve a firm-delocation problem in a two-country model with monopolistically competitive industries, CES preferences over differentiated products, linear production functions, and iceberg trade costs. An advantage of

[1] See Bagwell and Staiger (2006) for more details on this interpretation of GATT and WTO rules.

[2] Stewart (1993), Sykes (2005, 2009), Wouters and Coppens (2010) discuss the history of GATT/WTO subsidy rule negotiations.

[3] For further discussion of the importance of subsidy cases, see WTO (2006, 2009).

[4] This result holds in the first formal treatment of the terms-of-trade problem by Johnson (1953-54), who studied a perfectly competitive economy with countries maximizing national income. The result has been generalized to political economic preferences under perfect competition (Grossman and Helpman 1995, Bagwell and Staiger 1999), domestic policies under perfect competition (Bagwell and Staiger 2001a, 2001b), and import and export policies under various forms of imperfect competition (Bagwell and Staiger 2009a,b,c). See Bagwell and Staiger (2010) for a review of this literature.

this framework is that its trade policy implications are well-studied. Venables (1987) first establishes the firm delocation effect, and Ossa (2009) shows that the WTO principles of reciprocity and nondiscrimination guide countries towards cooperative choices of import tariffs, though Bagwell and Staiger (2009a) show this firm delocation problem does not persist when nations can choose both import and export trade taxes and subsidies.[5] This prior literature on monopolistic competition does not consider trade agreements covering domestic policies.[6]

The firm-delocation problem caused by domestic subsidies is most transparent when the domestic policy affects only the fixed cost of entry. Such a subsidy by a home country has no price or terms-of-trade effects,[7] but it leads to entry at home and exit abroad. Even if countries signed a trade agreement such that they did not value terms-of-trade manipulation, the outcome would still be inefficient.

I argue that the firm-delocation problem is not merely a theoretical curiosity, but rather its practical relevance is supported by the existence of disciplines for subsidies distinct from the traditional GATT principles of reciprocity, nondiscrimination, and market access exchange. In my theory, these principles lead to efficiency when nations maximize national income, but not when nations have political economic preferences. Only these principles are necessary to ensure an efficient agreement when terms-of-trade manipulation is the only problem, as in Bagwell and Staiger (1999, 2001, 2006) – even allowing for domestic policy choices and political economic preferences. This theory has inspired a large legal and policy literature arguing that additional disciplines on domestic policies are unnecessary.[8] My theory offers a political economic argument for why trading nations have not complied with this literature.

The GATT remedy that prevents nations from using domestic policies to undermine market access granted by tariff negotiations – the Article XXIII non-violation complaint – has rarely been used, and my theory offer a novel economic argument for why such complaints have been unpopular.[9] I show that a nation can increase subsidies and decrease tariffs in

[5]The Ossa (2009) analysis is the first to establish that firm delocation effects (also known as production relocation externalities) create an important problem for trade agreements when export subsidies are prohibited, as in the WTO.

[6]Campolmi, Fadinger, and Forlati (2010) do consider optimal unilateral policy for domestic marginal cost subsidies.

[7]Throughout I follow the Ossa (2009) and Bagwell and Staiger (2009a) definition of terms-of-trade, because only this definition has been used to derive the conclusion that terms-of-trade is the only problem for a trade agreement to solve.

[8]Examples include Bagwell and Staiger (2001b), Bagwell, Mavroidis and Stagier (2001), Staiger (2006), Staiger and Sykes (2009), and Bagwell and Mavroidis (2010).

[9]See Roessler and Gappah (2005) and Staiger and Sykes (2009) for a legal history of NV complaints, and some legal arguments for their rarity.

a manner that preserves its trading partner's market access, yet impairs the competitive position of the trading partner in its home market. The trading partner maintains consumer welfare but loses firms and market share in its home market. This suggests why the trading partner would consider the non-violation complaint to be an unsatisfactory remedy.

My paper's focus on fixed cost subsidies in differentiated-product industries matches well with prominent features of GATT/WTO subsidy disputes that have been neglected by the current trade agreement literature.[10]. The most popular GATT/WTO-legal remedy against subsidies has been countervailing duties (CVDs). In an empirical study of CVDs, Marvel and Ray (1995) document that "many of the subsidies in question appear to have covered fixed costs." Grossman and Mavroidis (2001,2003) argue WTO panels have failed to follow the intentions of WTO founders in regulating these subsidies, hence their title choice, "Recurring Misunderstanding of Non-Recurring Subsidies."[11] In the prominent Boeing-Airbus case, Boeing (2010) has challenged European Union "launch aid,"[12] because it allowed Airbus to develop new aircraft varieties that cut into Boeing's market share.[13]

My paper's contributions are similar to Antras and Staiger (2010). They argue the rise of offshoring – trade in intermediate goods whose prices are determined by bilateral bargaining – will lead to increasing difficulties for traditional GATT/WTO concepts. My paper shows such complications arise even with trade under standard market-clearing conditions, and I suggest remedies like CVDs and the WTO subsidy rules are evidence that these problems matter. Their paper depends on a three-country model,[14] and they leave any specific connections between their problem and WTO rules to future work.

Horn, Maggi, and Staiger (2010) also consider subsidy constraints, and they argue that more costly contracting over subsidies became desirable as trade volumes increased through the first five decades of GATT. However, their argument considers a baseline regime of no subsidy restrictions, with no possibility for non-violation complaints, which would provide

[10] Baylis (2009), surveying the countervailing duty and strategic trade policy literature, notes the need for theory on strategic motivations for fixed cost subsidies.

[11] Grossman and Mavroidis (2001, 2003) provide a theoretical argument for CVD use, but these models do not consider whether CVDs are necessary in the presence of other remedies such as GATT Article XXIII nonviolation complaints.

[12] The Boeing-Airbus case suggests my model of domestic fixed costs subsidies is also relevant in explaining export subsidy prohibitions. Export subsidies are traditionally modeled as per unit, but they could also be fixed cost subsidies contigent on exporting. Rodrik (2007) argues that attaching export contigency to fixed cost subsidies is a valuable incentive prohibited by the WTO.

[13] Of course, there are several complications of the aircraft industry not captured by model: the firms are multi-product duopolists who both offshore production and sell products to other countries. But fixed cost subsidies leading to new varieties is the core feature of the dispute.

[14] In Antras and Staiger (2010), the final good importer lacks a trade policy instrument for influencing trade between the final good exporter and the intermediate good exporter. Their new problem would disappear if the final good importer was also the intermediate good exporter.

efficient constraints of subsidies in their model.[15] My paper can then provide a rational for why subsidy rules became more strict even in the presence of non-violation complaints, which have existed since the founding of GATT.

Brou and Ruta (2009) provide an argument complementary to mine for constraints on subsidies, according to the commitment theory of trade agreements (Maggi and Rodriguez-Clare 1998). The commitment theory considers governments who use trade agreements to tie their hands in response to political pressures.[16]

Finally, subsidies and CVDs have also been well-studied by the strategic trade policy literature of the 1980s.[17] This literature's focus was on normative trade policy, while my main focus is on the positive theory of the GATT/WTO.

The rest of this paper proceeds as follows. Section 2 develops the benchmark model taking trade policies as given, and establishes the firm delocation problem in domestic policy choices. Section 3 solves for the Nash equilibrium and socially optimal policies when nations maximize national income. Counter to empirical reality, nations desire subsidy floors not ceilings.[18] Section 4 introduces general political-economic preferences into the benchmark model and establishes conditions under which nations desire subsidy ceilings, and NV complaints do not lead to efficiency. Section 5 discusses the robustness of the results. Section 6 concludes.

2 Benchmark Economy

I consider a two-country model in which each country chooses a domestic policy which affects the fixed cost of production. I add this feature to the monopolistic competition model of Bagwell and Staiger (2009a),[19] in which countries also choose both import and export trade taxes or subsidies. In the underlying economy, firms are monopolistically competitive in integrated markets with free entry, and they use an increasing-returns linear production technology to produce differentiated goods using a single factor of production. Consumers

[15] Bagwell and Staiger (2001, 2006) show that GATT rules lead to efficient outcomes when terms-of-trade manipulation is the only problem for a trade agreement to solve, which is indeed the case in the Horn, Maggi, and Staiger (2010) framework.

[16] See Bagwell and Staiger (2010) for discussion of this literature. In contrast to the terms-of-trade theory, the commitment theory has not attempted to interpret the key design features of the GATT/WTO such as reciprocity and nondiscrimination.

[17] See Brander (1995), Staiger (1995), and WTO (2006, 2009) for relevant surveys. Dixit and Kyle (1985) is the most closely related paper in analyzing subsidies for the cost of entry.

[18] It is common for national-income maximizing preferences to lead to unrealistic results. In the perfectly competitive benchmark, export taxes are always optimal. In the benchmark Antras and Staiger (2010) model, import subsidies are optimal. In Brander and Spencer (1985), export subsidy floors are globally efficient even though exporting countries benefit from a ceiling.

[19] Bagwell and Staiger (2009a) added export policy choices to a variant of Venables (1987) in Helpman and Krugman (1989).

have CES preferences over these goods, which are shipped using iceberg transport costs. There is also a freely traded, homogenous outside good produced with constant-returns technology which enters quasilinearly into utility. Endowments are large enough for this good to be consumed.

Domestic fixed-costs subsidies lead to firm entry at home and firm exit abroad. Countries can use these to policies to lower their price index, while raising their trading partner's. These cross-border externalities result in a firm-delocation problem. A distinctive feature of my model is that there are cross-border externalities not transmitted through either local, foreign, or world prices. Such externalities are not considered in existing models in which terms-of-trade manipulation is the only problem for a trade agreement to solve.[20]

2.1 The Model

This section discusses government, consumer, and firm behavior. Consumers take prices and government policies as given and maximize utility. Firms take government policy as given and maximize profits. Governments maximize the indirect utility of consumers. Discussion of unilateral and cooperative government behavior is left to Section 3.

2.1.1 Government Policies

There are two symmetric countries, home and foreign. The home and foreign ad valorem policy on domestic fixed costs F are denoted by s_h and s_f, respectively. For trade policies τ, the subscripts h and f indicate the nation imposing the policy, while the superscript "*" indicates the destination of the good affected by the policy. Thus, τ_h and τ_f are home's import policy and foreign's export policy, respectively, on home's imports. A positive (negative) policy denotes a (tax) subsidy.

I exogenously impose a constraint against governments choosing export taxes and import subsidies, while permitting export subsidies and import tariffs. This limits trade policies to the most commonly observed set of trade policies, and does not limit the scope of total trade barriers over which countries can negotiate. For symmetric countries in this framework, only the total trade barriers are relevant in evaluating the efficiency of trade policy.

[20] In Bagwell and Staiger (1999), trade policies affect other nations solely through world prices. The same is true for trade policies and domestic policies in Bagwell and Staiger (2001, 2006). In Bagwell and Staiger (2009a) and Ossa (2009), trade policies affect other nations through world prices and local prices.

2.1.2 Consumer and Firm Behavior

Home and foreign each have endowments of labor L large enough to ensure consumption of the homogenous good C_Y. Consumers receive (finance) any government surplus (deficit) in lump-sum, nondistortionary fashion. Utility is

$$\begin{aligned} U &= \frac{\varepsilon}{\varepsilon-1}(C_D)^{\frac{\varepsilon-1}{\varepsilon}} + C_Y \\ U^* &= \frac{\varepsilon}{\varepsilon-1}(C_D^*)^{\frac{\varepsilon-1}{\varepsilon}} + C_Y^* \end{aligned}$$

where the parameter $\varepsilon \in (1, \sigma)$ equals the elasticity of substitution between the homogenous and differentiated goods. C_D is a CES consumption index over n_h symmetric home sectors and n_f symmetric foreign sectors. Imposing the symmetry on consumption of goods from each sector,

$$\begin{aligned} C_D &= \left(n_h c_h^{\frac{\sigma-1}{\sigma}} + n_f c_f^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}} \\ C_D^* &= \left(n_h c_h^{*\frac{\sigma-1}{\sigma}} + n_f c_f^{*\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}} \end{aligned}$$

where $\sigma > 1$ equals the elasticity of substitution between differentiated products. For consumption variables c, subscripts h and f denote location of origin, while the superscript "*" indicates location of consumption, i.e. c_f and c_h^* are home and foreign imports, respectively.

Free entry is assumed in the differentiated sector, and firms have identical linear technologies with fixed cost of production F and marginal cost λ. When firms ship abroad, they must pay an ad valorem iceberg transport cost ϕ. The homogenous good requires 1 unit of labor to produce and is freely traded. Labor is freely mobile between sectors.

2.1.3 Externality

For the sake of convenience, I assume there is a negative local production externality of $\frac{\lambda}{\sigma-1}$ per good. This assumption results in equilibrium prices equal to the social cost after the monopolist markup, and does not affect the paper's main results.

2.2 Equilibrium

The domestic subsidy impacts the firm entry equilibrium, the price indices, and welfare, but it has no affect on prices. Otherwise results follow Bagwell and Staiger (2009a).

I first solve for consumer prices and welfare, taking government policies and entry as given. Since trade agreement theory is ultimately concerned with long run effects of trade policy, I then consider firm entry under the assumption of zero profits. Having established the equilibrium, I consider the impact of subsidies on overall welfare in my model and contrast it with perfectly competitive case.

2.2.1 Consumer and Incumbent Firm Behavior

I first determine prices and welfare, taking government policies and firm entry as given. The 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 price of the homogeneous good and wages are equal across countries. This is the numeraire equal to 1.

Utility maximization implies demand for the composite $C^D = P^{-\varepsilon}$, where P is the price index for the composite good C_D. Indirect utility then takes the following form, which is decreasing in the price index and increasing in income.

$$\begin{aligned} V(P,I) &= \frac{1}{\varepsilon-1}P^{1-\varepsilon}+I \\ V^*(P,I) &= \frac{1}{\varepsilon-1}P^{*1-\varepsilon}+I^* \end{aligned}$$

where the price index P is standard following Dixit and Stiglitz (1977) under symmetric firms

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

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

$$\begin{aligned} x_h &= c_h+(1+\phi)c_h^* \\ x_f &= c_f+(1+\phi)c_f^* \end{aligned}$$

Total demand for individual products takes the form

$$
\begin{aligned}
x_h &= C_D \left(\frac{p_h}{P}\right)^{-\sigma} + (1+\phi) C_D^* \left(\frac{p_h^*}{P^*}\right)^{-\sigma} = p_h^{-\sigma} P^{\sigma-\varepsilon} + (1+\phi) p_h^{*-\sigma} P^{*\sigma-\varepsilon} \qquad (2) \\
x_f &= C_D^* \left(\frac{p_f^*}{P^*}\right)^{-\sigma} + (1+\phi) C_D \left(\frac{p_f}{P}\right)^{-\sigma} = p_f^{*-\sigma} P^{*\sigma-\varepsilon} + (1+\phi) p_f^{-\sigma} P^{\sigma-\varepsilon}
\end{aligned}
$$

Because markets are integrated,imports are marked up from domestic prices based on total net cross-border costs: $\iota^* \equiv 1 + \phi + \tau_h^* + \tau_f^*$ for the case of foreign imports, and $\iota = 1 + \phi + \tau_h + \tau_f$ for home imports.

$$
\begin{aligned}
p_h^* &= \iota^* p_h \\
p_f &= \iota p_f^*
\end{aligned}
$$

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

$$
p_h = p_f^* = \frac{\sigma}{\sigma - 1} \lambda \equiv p
$$

Total import volumes for home M and foreign M^* are

$$
M = n_f c_f \qquad M^* = n_h c_h^*
$$

National income is a function of wage income trade taxes and subsidies. Income consists of wage income, export policy expense, import policy revenue, the domestic subsidy cost, and the local production externality.

$$
\begin{aligned}
I &= L + \tau_h p M + \tau_h^* p M^* - n_h s_h F - n_h x_h \frac{\lambda}{\sigma - 1} \\
I^* &= L + \tau_f^* p M^* + \tau_f p M - n_f s_f F - n_f x_f \frac{\lambda}{\sigma - 1}
\end{aligned}
$$

2.2.2 Free Entry Equilibrium

The zero-profit conditions equate variable profits with fixed costs.

$$
(p - \lambda) x_h = F(1 - s_h) \qquad (p - \lambda) x_f = F(1 - s_f) \qquad (3)
$$

These zero-profit conditions, demand equations (2), and price index equation (1) then de-

termine functions $n_h(p_f, p_h^*, s_h, s_f)$ and $n_f(p_f, p_h^*, s_h, s_f)$.where I have suppressed dependence on all terms that are constant (e.g. L,$\lambda, \phi, \hat{p}, \sigma, \varepsilon$) Trade policy only affects the number of firms through the local prices, whereas domestic policies do not alter prices.

2.2.3 World Prices and the Representation of Welfare

World prices are the price of goods in between borders.

$$p^{*w} = (1 + \tau_h^*)\hat{p} \qquad p^w = (1 + \tau_f)\hat{p}$$

These are the prices of home exports to foreign, and foreign exports to home, respectively. Only the export policies impact world prices, due to the CES demand specification.

National income can be written as a function of home and foreign firms, local prices, and world prices.

$$\begin{aligned} I(p^w, p^{*w}, p_f, p_h^*, n_h, n_f) &= L + (p^{*w} - \hat{p})M^* + (p_f - \phi p - p^w)M - n_h F \\ I^*(p^w, p^{*w}, p_f, p_h^*, n_h, n_f) &= L^* + (p^w - \hat{p})M + (p_h^* - \phi p - p^{*w})M^* - n_f F \end{aligned}$$

where I have used the result that

$$F s_h + \frac{\lambda}{\sigma - 1} x_h = F s_h + \frac{\lambda}{\sigma - 1}\left(\frac{\sigma - 1}{\lambda} F(1 - s_h)\right) = F$$

The same is true of welfare

$$\begin{aligned} V(p^w, p^{*w}, p_f, p_h^*, n_h, n_f) &= \frac{1}{\varepsilon - 1} P^{1-\varepsilon} + I(p^w, p^{*w}, p_f, p_h^*, n_h, n_f) \\ V^*(p^w, p^{*w}, p_f, p_h^*, n_h, n_f) &= \frac{1}{\varepsilon - 1} P^{*1-\varepsilon} + I^*(p^w, p^{*w}, p_f, p_h^*, n_h, n_f) \end{aligned} \tag{4}$$

World welfare V^w, defined as the sum of the each nation's welfare, does not depend on world prices

$$V^w(p_f, p_h^*, n_h, n_f, s_h, s_f) = \frac{1}{\varepsilon - 1}(P{+}P^*){+}(L{+}L^*){+}(p_h^*{-}(\phi{+}1)p)M^*{+}(p_f{-}(\phi{+}1)p)M{-}F(n_h{+}n_f)$$

The national welfare equations are analogous to the general welfare functions in the perfectly competitive setting of Bagwell and Staiger (2001a), which express welfare as a function of a domestic policy, prices, and terms-of-trade. A distinction is that these welfare

functions depend on the number of firms in each country, which in turn depend on domestic policy choices. Foreign subsidies cause a nonpecuniary cross-border externality[21] that travels through the number of firms.[22] The international policy environment is thus more complicated than the perfectly competitive setting, and it raises the possibility of a new problem for trade agreements. I have isolated these effects by working in an environment in which entry and exit have no effect on the price of individual goods.

2.3 Policy Comparative Statics

To illustrate the nature of the cross-border domestic policy externalities of from the previous subsection, I analyze the comparative statics of domestic policy choices.

Totally differentiating the systems of equations (3) and (1) yields the effects of changes in the fixed cost policies s_h and s_f on the price indices and firms. The comparative statics, derived fully in Appendix A.1, are given here for home policies.

$$\begin{array}{rcl} \dfrac{dn_h}{ds_h} & > & 0 \qquad \dfrac{dn_f}{ds_h} < 0 \\ \dfrac{dP}{ds_h} & < & 0 \qquad \dfrac{dP^*}{ds_h} > 0 \end{array} \tag{5}$$

An increase in a country's fixed cost subsidy leads to firm entry at home and firm exit abroad. The acting country's price index falls, while its trading partner's rises. This is the essence of the firm delocation effect of the subsidies.

Intuitively, an increase in the home subsidy implies that home firms must enter to restore equilibrium. The increased competition from home firms implies that foreign firms must exit to restore equilibrium. The manufacturing market-clearing for foreign implies that an individual firm's domestic sales and foreign sales must move in opposite directions. The home price index falls and the foreign price index rises. As shown in Appendix A.1, the magnitudes of the effects on the trading partner are always smaller, assuming a differential change from identical policies.

The overall welfare effects of an increase in subsidies depends both on the price index effect and the effect of the subsidy on income – this includes both the direct cost of the

[21] Bagwell and Staiger (2001a) acknowledge that nonpecuniary cross-border externalities of domestic policies can cause more problems for international agreements (e.g. global warming), but these problems are best handled outside the WTO. However, these firm delocation externalities are essential to the WTO's mission since nations can use these policies to undermine the benefits of trade liberalization.

[22] The subsidy could also be interpreted as a pecuniary externality that reduces price discontinuously from infinity. The difference is semantic, and either interpretation implies a more complicated role for domestic policies in trade agreements than the perfectly competitive setting of Bagwell and Staiger (2001a).

subsidy and the effect of firm reallocation on other policies. Starting from zero policies, a rise in home subsidy unambiguously makes foreign worse off, and home better off.

2.4 Efficient Policies

The optimal policies for world welfare are a subsidy of $\frac{1}{\sigma}$ and zero net trade taxes (e.g. free trade, or export subsidies that offset any import tariffs.). See Appendix A.2 for the proof. Socially optimal production in a Dixit-Stiglitz type model involves a marginal cost subsidy to correct the monopoly distortion (dealt with in my model by the externality), and a fixed cost subsidy to restore output to its level in absence of intervention. This first-best analysis holds for zero net trade taxes, which ensures price equals marginal cost for both domestic and imported goods.

The non-uniqueness of the efficient point complicates analysis later on, so I assume that one such point is exogenously preferred to the others. This can be also justified in terms of the institution guiding nations to one particular efficient point.

3 Government Policy and Trade Agreements

This section characterizes noncooperative and cooperative government behavior. I find that if countries do not value the terms-of-trade effects of their policy choices, trade policy choices are efficient, as in Bagwell and Staiger (2009a). However, domestic policy choices – effectively unconstrained in this stylized model – are inefficient.

In this benchmark model, countries set domestic subsidies too low from the perspective of international efficiency Firm delocation results in a free-rider problem, as countries do not consider the benefits to the trading partners of subsidy reductions when firms exit. This desire is inconsistent with both GATT and WTO rules on domestic policies, which serve to constrain subsidies.

Terms-of-trade manipulation is the only problem for a trade agreement to solve when either domestic policies or monopolistic competition are added to the perfectly competitive benchmark (Bagwell and Staiger 2001, 2009a). Does this result still hold under monopolistic competition with domestic policy choices? To answer this question, I look at what policies nations would choose if they acted as if they did not value the effects of their policies on world prices (terms-of-trade). Following the literature, these are denoted as the "politically optimal" policies.

In my stylized environment, domestic subsidies have no effect on world prices, so the conditions for politically optimal domestic subsidies are the same as the conditions for unilateral

Nash subsidies.[23]

$$\begin{aligned} V_{n_h}\frac{dn_h}{ds_h} + V_{n_f}\frac{dn_f}{ds_h} &= 0 \\ V^*_{n_h}\frac{dn_h}{ds_f} + V^*_{n_f}\frac{dn_f}{ds_f} &= 0 \end{aligned}$$

whereas efficient domestic policy choices which maximize world welfare must satisfy

$$\begin{aligned} (V_{n_h} + V^*_{n_h})\frac{dn_h}{ds_h} + (V_{n_f} + V^*_{n_f})\frac{dn_f}{ds_h} &= 0 \\ (V_{n_h} + V^*_{n_h})\frac{dn_h}{ds_f} + (V_{n_f} + V^*_{n_f})\frac{dn_f}{ds_f} &= 0 \end{aligned}$$

Differencing the efficiency condition and the Nash condition for each country reveals that domestic policies can only be efficient if their net cross-border externalities are zero. I show that these are always positive.

Given the symmetry of countries, $V_{n_h} = V^*_{n_f}$ and $V^*_{n_h} = V_{n_f}$ at both the Nash equilibrium and politically optimal policies, the cross-border externalities can be rewritten as follows using the Nash conditions.

$$\begin{aligned} V^*_{n_h}\frac{dn_h}{ds_h} + V^*_{n_f}\frac{dn_f}{ds_h} &= V^*_{n_h}(1-\rho^2)\frac{dn_h}{ds_h} \\ V_{n_h}\frac{dn_h}{ds_f} + V_{n_f}\frac{dn_f}{ds_f} &= V_{n_f}(1-\rho^{-2})\frac{dn_f}{ds_f} \end{aligned}$$

where $\rho \equiv \frac{dn_f}{ds_h}/\frac{dn_h}{ds_h}$. These expressions reveal that the sign of the net externalities must be the same as $V^*_{n_h}$, since $(1-\rho^2) > 0$ (the absolute effect of a subsidy on one's own firms is greater, as shown in Appendix A.1), and the subsidy increases one's own firms.

I can then establish that each nation's welfare increases when foreign firms increase, all else equal. Observe that

$$\begin{aligned} V^*_{n_h} &= -P^{*-\varepsilon}P^*_{n_h} + \tau^*_f p M^*_{n_h} + \tau_f p M_{n_h} \\ V_{n_f} &= -P^{-\varepsilon}P_{n_f} + \tau^*_f p M^*_{n_f} + \tau_f p M_{n_f} \end{aligned} \tag{6}$$

All else equal, a rise in the number of home firms decreases the foreign price index,

[23] The Nash equilibrium domestic policies differ from the politically optimal domestic policies due to differences in trade policy choices, however.

increases foreign imports ($M^*_{n_h} > 0$), and decreases home imports ($M_{n_h} < 0$). Since foreign imposes a combination of import tariffs ($\tau^*_f > 0$), export subsidies ($\tau_f < 0$) by assumption[24], it follows the total effect of an increase in home firms on foreign welfare is positive. An analogous result holds for the partial effect of foreign firms on home welfare.

Thus, at both politically optimal and Nash domestic policy choices

$$\begin{aligned}(V_{n_h} + V^*_{n_h})\frac{dn_h}{ds_h} + (V_{n_f} + V^*_{n_f})\frac{dn_f}{ds_h} &> 0\\ (V_{n_h} + V^*_{n_h})\frac{dn_h}{ds_f} + (V_{n_f} + V^*_{n_f})\frac{dn_f}{ds_f} &> 0\end{aligned}$$

so these policies cannot be efficient. Both nations would benefit from a further increase in subsidies at the Nash policies, indicative of a free-riding problem.

I summarize this result in Proposition 1.

Proposition 1 *In the benchmark model of monopolistic competition with domestic subsidies, the Nash domestic policy choices are inefficient. The inefficiency of domestic policies arises because governments do not consider firm delocation effects of their unilateral policy choices.*

The policy mix of nations is then inefficient, although the politically optimal trade policies nevertheless satisfy the trade policy first-order conditions for efficiency. As in Bagwell and Staiger (2009a), each country can set trade policies such that they have no benefit from first-order changes in local prices within either country. Since the trade policy efficiency conditions depend only on these prices, holding domestic policies fixed, the efficiency conditions are satisfied. Since there is nothing new here, I leave this proof to Appendix A.3..

This benchmark model is not consistent with either GATT rules designed to preserve market access or WTO subsidy rules. Starting from a Pareto efficient policy choices, neither would prevent a country from cutting its subsidy to the Nash level. This counterfactual implication motivates a political economy version of the model.

4 The Political Economy Model

This section augments the benchmark model with political economic preferences. Since I am interested in long-run effects of trade policy, I have assumed free entry under which

[24]In the absence of this restriction, the right combination of import subsidies and export taxes could be used to swing $V^*_{n_h} = 0$ or less than zero. However, I know of no evidence suggesting the indirect of subsidies on net trade tax revenue is of such significant importance, or that trade agreements could drive countries to choose such tariffs. Commentators such as Regan (2006) and Ethier (2010) have remarked that trade tax revenue plays an implausibly large role in theory already.

firms make zero profits in the long-run. This prevents me from adding political economy concerns in the standard way, a government weight on profits (Baldwin 1987 or Grossman and Helpman 1994). An alternative is to consider general reduced-form preferences over variables of economic interests with limited restrictions. For example, Bagwell and Staiger (2001a) consider general reduced-form preferences over policies and prices, with the only restriction being that countries value terms-of-trade gains.

My approach is to permit governments to value both home and foreign market share in the differentiated good sector. I do not provide a theoretical foundation for this assumption, but I argue this is motivation is a "plausible implicit story that fills in the gap between what is explicitly modeled and what is left out" (Rodrik 1995). Market share is explicitly codified in the WTO Agreement on Subsidies and Countervailing Measures.[25] In the prominent Boeing-Airbus case, Boeing's loss of market share to Airbus is the first statistic mentioned in the Congressional petition to the U.S. Trade Representative.[26]

I do not model explicitly why governments value this market share apart from profits. Potential answers include employment and factor specificity, which are not included in my single factor model. Market share is a salient statistic of international competition, so one could assume it is directly relevant for election outcomes and long-run implications of short-run lobbying incentives. Furthermore, market share is proportional to trade volumes in my model and the share of world manufacturing employment, which broadens the potential range of interpretations.

This reduced-form modeling of market share motives expands the motivation for subsidizes beyond the desire to get cheaper goods due to lower transport costs. As described in WTO (2006), governments can subsidize for a variety of reasons, such as encouraging production in dynamic industries and protecting employment in declining industries. This political economic concern moves the model closer to capturing this reality.

4.1 The Augmented Model

I define home and foreign market in share in their own markets as

[25] In Article 6.3 of the SCM Agreement, a subsidy causes "serious prejudice" if "the effect of the subsidy is an increase in the world market share of the subsidizing Member...."

[26] Precisely, "Boeing, the nation's largest exporter of manufactured goods, has paid a heavy price, a loss of 20 percentage points of market share in just the last five years...."

$$
\begin{aligned}
S &\equiv \frac{p_h n_h c_h}{p_h n_h c_h + p_f n_f c_f} = \frac{n_h}{n_h + \iota^{1-\sigma} n_f} = n_h (\frac{p}{P})^{1-\sigma} \\
S^* &\equiv \frac{p_f^* n_f c_f^*}{p_f^* n_f c_f^* + p_h^* n_h c_h^*} = \frac{n_f}{n_f + \iota^{*1-\sigma} n_h} = n_f (\frac{p}{P})^{1-\sigma}
\end{aligned} \tag{7}
$$

Governments then maximize the welfare function

$$
\begin{aligned}
W(p^w, p^{*w}, p_f, p_h^*, n_h, n_f) &= V + \alpha(S + (1 - S^*)) \\
W^*(p^w, p^{*w}, p_f, p_h^*, n_h, n_f) &= V + \alpha(S^* + (1 - S))
\end{aligned}
$$

where α is a constant parameter reflecting the weight on market share.

Observe also that $W^W = V^W + 2\alpha$, since the political economic concerns here are assumed to be purely zero-sum, so the optimal policies remain a subsidy of $\frac{1}{\sigma}$ and zero net trade policies.[27] These concerns can, however, significantly alter unilateral policy.

4.2 The Role of Trade Agreements

The addition of political economy considerations can affect the purpose of the trade agreement.

Recall from the previous section that the crucial comparative static in determining the purpose of the trade agreement was the sign of the derivative of foreign firms on home welfare, and vice versa, at noncooperative subsidy choices. A positive derivative implies countries should want agreements that encourage subsidies, a zero derivative suggests there is no subsidy problem for international agreements, while a negative derivative indicates countries should want agreements that constrain subsidies.

$$
\begin{aligned}
W_{n^*} &= V_{n^*} + \alpha(S_{n^*} - S_{n^*}^*) \\
W_n^* &= V_n^* + \alpha(S_n^* - S_n)
\end{aligned}
$$

I established in the previous section that the effect an increase in foreign firms on consumer welfare was positive. The effect on market shares is unsurprisingly and unambiguously negative. Totally differentiating the home and foreign market shares

[27] If I allowed for separate weights on home and foreign market share, this would have led to optimal policies being protection or trade promotion, depending on which received more weight.

$$
\begin{aligned}
dS^* &= S^*(1-S^*)(\hat{n}_f - \hat{n}_h + (\sigma-1)\hat{\imath}^*) \\
dS &= S(1-S)(\hat{n}_h - \hat{n}_f + (\sigma-1)\hat{\imath})
\end{aligned}
$$

where the $\hat{}$ indicates log-derivatives.

Thus

$$
\begin{aligned}
S_{n_f} - S^*_{n_f} &= -\frac{1}{n_f}(S(1-S) + S^*(1-S^*)) \qquad (8) \\
S^*_{n_h} - S_{n_h} &= -\frac{1}{n_h}(S(1-S) + S^*(1-S^*))
\end{aligned}
$$

Similarly, an increase in home firms increases market shares in both sectors.

The problem a trade agreement must solve depends on the parameter α. There exists a cutoff value $\bar{\alpha} > 0$ such that for all a below the cutoff, there is a free-rider problem. At the cutoff, there is no need for subsidy rules.[28] Above the cutoff, nations will seek to constrain subsidies.

The cutoff is calculated by dividing the size of the cross-border subsidy externality by the marginal effects on home and foreign market shares of an increased subsidy, all evaluated at politically optimal policies

$$
\bar{\alpha} = \frac{V^*_{n_h}(1-\rho^2)\frac{dn_h}{ds_h}}{(S_{n_h} - S^*_{n_h}) + \rho(S_{n_f} - S^*_{n_f})}
$$

From (8), the denominator is positive, and I proved that the numerator (see equations (6)) was positive, so $\bar{\alpha} > 0$. I summarize these results in Proposition 2.

Proposition 2 *In the political economy model of monopolistic competition with domestic subsidies, the problem for a trade agreement to solve depends on the strength of political economic preferences. For weak preferences, the Nash subsidy choices are inefficient, and there is a free rider problem. For strong preferences, the Nash subsidy choices are efficient, because governments choose inefficiently large subsidies in pursuit of market share. In a knife's edge case, Nash subsidy choices are efficient, and terms-of-trade manipulation is the only problem for an international agreement to solve.*

[28] One cavaet: the cutoff $\bar{\alpha}$ does depend on the trade policies. Henceforth I consider α results for only the preferred efficient trade policies. Recall that the efficient trade policies are not unique, and one set is exogenously preferred.

4.3 Market Access Rules

A puzzle in the trade agreement literature has been why the WTO chose to impose stricter rules on subsidies rather than relying on non-violation complaints, which have been shown to preserve efficiency in Bagwell and Staiger (2001, 2006).[29] The non-violation complaint essentially acts as a constraint that prevents any nation from choosing policies which lead to a reduction in their trading partner's market access. Here I model market access as the trading partner's market shares, as defined in the previous subsection. GATT and WTO rules are nonsensical when governments seek to encourage subsidies, so I will focus henceforth on the set of political economic models for which $\alpha > \bar{\alpha}$.

The relevant thought experiment is as follows: suppose both home and foreign have chosen Pareto efficient domestic and trade policies. Can foreign then lower tariffs and raise subsidies in a manner that preserves home's share of foreign's market ($\hat{S}^* \leq 0$) and make itself better off, and therefore make home worse off?

First, consider the log-derivative of home's market share in foreign's market

$$\hat{S}^* = (1 - S^*)(\hat{n}_f - \hat{n}_h + (\sigma - 1)\hat{\iota}^*)$$

To preserve home's market share, foreign could either raise tariffs and lower subsidies of entry, or vice versa. However, the tariff is bound, and lowering subsidies makes foreign strictly worse off, so lowering tariffs and raising subsidies is the only option, and $\hat{\iota}^* < 0$. Observing that $\hat{S}^* = 0$ binds, it follows that

$$\hat{n}_h - \hat{n}_f = (\sigma - 1)\hat{\iota}^* \tag{9}$$

Similarly, log differentiating the home domestic market share

$$\hat{S} = (1 - S)(\hat{n}_h - \hat{n}_f) = (1 - S)(\sigma - 1)\hat{\iota} \tag{10}$$

shows that home will lose domestic market share as a result of the change in policy mix. I also show in appendix A.4 that both home and foreign's consumer price index fall.

The effect of a differential change in market access-preserving policies on foreign welfare can be written as

$$dW^* = dV^* - \alpha(S\hat{S})$$

[29] Formally, stricter rules are less desirable due to contracting costs as in Horn, Maggi, Staiger (2010). Bagwell and Staiger (2006) also suggest WTO subsidy rules can prevent nations from negotiating tariff reductions altogether if they have to remove desirable subsidies.

Observe that dV^* is simply the change in foreign welfare at the efficient point, and it does not depend on α. Also observe that $dV^* < 0$, since both the tariff reduction and subsidy increase would make foreign strictly worse off, absent the political economic concerns, and that $\alpha(S\hat{S}) < 0$.

Thus there exists a cutoff $\tilde{\alpha}$ such that for $\alpha > \tilde{\alpha}$, $dW^* > 0$, and the market access constraint does not prevent foreign from manipulating subsidies to its advantage. For $\alpha \leq \tilde{\alpha}$, the market access constraint does prevent foreign from manipulating subsidies to its advantage. Observe that $\tilde{\alpha} > \bar{\alpha}$, because when $\alpha = \bar{\alpha}$, foreign is worse off from the market access-preserving change, since it receives no first-order benefit from subsidies and loses from the trade barrier reduction.[30]

I summarize these results in Proposition 3.

Proposition 3 *In the political economy model of monopolistic competition with domestic subsidies, the effectiveness of market access rules depends on the strength of political economic considerations. For sufficiently strong considerations, market access constraints do not succeed in maintaining efficiency. Foreign can increase subsidies and reduce trade barriers in a manner that maintains home's market access but allows foreign to gain market share in home's market.*

Proposition 3 thus provides an economic explanation for why non-violation complaints have been unsuccessful in disputes between similar countries. This result contrasts with Bagwell and Staiger (2001a), who show that market access rules preserve efficiency, regardless of any political economic considerations.

5 Robustness

In this section, I critically evaluate some of the stylized assumptions in my model, and discuss their importance for the main results.

This model assumed a local externality that eliminated any inefficiency due to the monopolistic markup. This assumption does not affect Proposition 2 or 3, though it does complicates the analysis of Proposition 1 in determining whether agreements seek to constrain subsidies. The efficient trade policies then subsidize trade (permissible in my model as export subsidies greater than import tariffs), and optimal subsidy reflects the price distortions.

I assumed that only import tariffs and export subsidies were permitted. This assumption was both empirically reasonable and analytically convenient in proving Proposition 1, since

[30] Home and foreign consumers both benefit from a fall in their manufacturing price index, however, as I show in Appendix A.4.

allowing import subsidies and export taxes creates the possibility that an increase in foreign firms could lead to a loss in revenue. This assumption is not important for Proposition 2 and 3.

Another arbitrary restriction in my model was the exclusion of marginal cost subsidies. I focused on fixed costs subsidies because of the empirical relevance of fixed cost subsidies described in the introduction, and because they conveniently lack terms-of-trade effects. Marginal cost subsidies can also lead to additional problems for trade agreements to solve. Although the politically optimal trade policy choices will eliminate any potential first-order gains from local domestic or import prices, there are still firm delocation externalities due to the reduction in the domestic price, which the trading partner cannot manipulate.

I assumed a quasilinear good, which permitted me to focus on policies with no terms-of-trade effects. I will leave purer general equilibrium modelling to further research. If true general equilibrium did affect my main results, it would imply that adding more terms-of-trade effects to a model eliminates a non-terms-of-trade problem.

6 Conclusion

This paper has shown that in the presence of imperfect competition, domestic subsidies of fixed costs can create an additional problem for trade agreements to solve. I will discuss here a few interesting questions arising from this result.

While non-violation complaints have been used sparingly by GATT/WTO members, countervailing duties have been used by the United States since the 19th century and were codified in GATT. Bagwell and Staiger (2006) suggests CVDs are not essential in a perfectly competitive setting, because subsidizing causes a terms-of-trade loss, and countries would never pursue strategies necessitating a CVD response. This analysis suggests CVDs could be a second-best solution to the problem – one clearly more appealing to home countries than non-violation complaints because countries can maintain their welfare after a sufficiently large CVD, while non-violation complaints ensure a welfare loss.

This paper takes a step towards explaining a motivation for WTO subsidy rules, since I have shown non-violation complaints alone were not sufficient to deal with the problems created by domestic subsidies. The evolution to WTO subsidy rules suggests CVDs were inadequate. Following a line of reasoning similar to Horn, Maggi, and Staiger (2010), the benefits of improved efficiency in WTO subsidy rules relative to the incumbent regime can be rationalized. As trade volumes became sufficiently large, these benefits outweighed the

contracting costs.[31]

Though WTO subsidy rules can introduce efficiency by reducing noncooperative subsidies to efficient levels, they do introduce an additional inefficiency by removing subsidies which potentially improve world welfare, even if they cause trade distortions. But this inefficiency is mitigated by the possibility that neither country chooses to challenge each other's beneficial subsidies. The fall of WTO disputes since the financial crisis is indicative of how beneficial subsidies (from the perspective of member governments) could still be permitted by the present regime.

Based on the conclusions of prior literature, there was no need for academics to search for efficient rules on international domestic policies, because the efficient rules – constraints on market access – had already been found. My research has shown there is still room for improvement in subsidy rules, relative to either current or past subsidy regimes. Better subsidy rules could be discovered someday, or more costly rules could become desirable as inefficiency from the current regime grows. Understanding the problems subsidy rules are trying to solve is crucial to evaluating their effectiveness and determining potential improvements.

A Appendix

A.1 Comparative Statics

The zero profit conditions (3) and demand equations (2) imply the effects of a change in subsidies on the price indices are

$$(\hat{p}-\lambda)\hat{p}^{-\sigma}\begin{vmatrix} 1 & (1+\phi)\iota^{*-\sigma} \\ (1+\phi)\iota^{-\sigma} & 1 \end{vmatrix}\begin{vmatrix} dP^{\sigma-\varepsilon} \\ dP^{*\sigma-\varepsilon} \end{vmatrix} = -F\begin{vmatrix} ds \\ ds^* \end{vmatrix}$$

After inversion this becomes

$$(\sigma-\varepsilon)(\hat{p}-\lambda)\hat{p}^{-\sigma}\begin{vmatrix} dP \\ dP^* \end{vmatrix} = \frac{F}{1-(1+\phi)^2(\iota\iota^*)^{-\sigma}}\begin{vmatrix} -P^{1-\sigma+\varepsilon} & (1+\phi)\iota^{*-\sigma}P^{1-\sigma+\varepsilon} \\ (1+\phi)\iota^{-\sigma}P^{*1-\sigma+\varepsilon} & -P^{*1-\sigma+\varepsilon} \end{vmatrix}\begin{vmatrix} ds \\ ds^* \end{vmatrix}$$

This proves a subsidy increase lowers one's own price index while increasing the trading partner's.

[31] To understand this result, observe that there is no inefficiency from inefficiently large domestic subsidies when there is no trade volume, and the size of inefficiency of noncooperative subsidies continues to increase as trade costs fall. This result relies on an assumption that contracting costs are not also increasing in trade volumes.

The relative effects on the price indices are

$$\frac{dP/ds}{dP^*/ds} = \frac{1}{-(1+\phi)\iota^{-\sigma}} \left(\frac{P}{P^*}\right)^{1-\sigma+\varepsilon}$$

Since $(1+\phi)\iota^{-\sigma} < 1$, when $P = P^*$, a home subsidy has a larger absolute effect on home than foreign. The lower the trade costs are, the larger is the effect.

To prove the effects of subsidies on firms, totally differentiate the price index equations and invert

$$p^{1-\sigma} \begin{vmatrix} dn_h \\ dn_f \end{vmatrix} = \frac{(1-\sigma)}{1-(\iota\iota^*)^{-\sigma}} \begin{vmatrix} 1 & -\iota^{*1-\sigma} \\ -\iota^{1-\sigma} & 1 \end{vmatrix} \begin{vmatrix} P^{-\sigma} dP \\ P^{*-\sigma} dP^* \end{vmatrix}$$

And then combining with equations (right above)

$$\begin{vmatrix} dn_h \\ dn_f \end{vmatrix} = \frac{(\sigma-1)}{1-(\iota\iota^*)^{-\sigma}} \frac{p^{2\sigma-1}}{(\sigma-\varepsilon)(\hat{p}-\lambda)} \frac{F}{1-(1+\phi)^2(\iota\iota^*)^{-\sigma}} * \begin{vmatrix} P^{1-2\sigma+\varepsilon} + \iota^*(1+\phi)(\iota\iota^*)^{-\sigma} P^{*1-2\sigma+\varepsilon} & -(1+\phi)\iota^{*-\sigma} P^{1-2\sigma+\varepsilon} - \iota^{*1-\sigma} P^{*1-2\sigma+\varepsilon} \\ -\iota^{1-\sigma} P^{1-2\sigma+\varepsilon} - (1+\phi)\iota^{-\sigma} P^{*1-2\sigma+\varepsilon} & P^{*1-2\sigma+\varepsilon} + \iota(1+\phi)(\iota\iota^*)^{-\sigma} P^{1-2\sigma+\varepsilon} \end{vmatrix} \begin{vmatrix} ds \\ ds^* \end{vmatrix}$$

This proves that a subsidy increases entry within one's own borders and causes exit abroad. The relationship between the effect of a subsidy on own firms and trading partner's firms is then

$$\frac{\frac{dn_h}{ds}}{\frac{dn_f}{ds}} = \frac{1+\iota^*(1+\phi)(\iota\iota^*)^{-\sigma}}{-\iota^{1-\sigma}-(1+\phi)\iota^{-\sigma}} \left(\frac{P}{P^*}\right)^{2-\sigma+\varepsilon}$$

Under symmetry, the numerator is strictly larger than the denominator in absolute terms, so the effect of subsidies on own firms is larger, as expected.

A.2 Optimal Policy in Baseline Model

I establish the symmetric first-best optimum for the planner's problem, and show it can be implemented by zero net trade taxes and an ad valorem subsidy of $\frac{1}{\sigma}$. This proof is analogous to p. 301 of Dixit and Stiglitz (1977).

Joint welfare as a function of c_h and c_f and n is

$$\begin{aligned} V^w &= -n(F+\lambda(1+\frac{1}{\sigma-1})(c_h+c_f(1+\phi))+\frac{\varepsilon}{\varepsilon-1}(C_D)^{\frac{\varepsilon-1}{\varepsilon}} \\ \text{where } C_D &= n^{\frac{\sigma}{\sigma-1}}(c_h^{\frac{\sigma-1}{\sigma}}+c_f^{\frac{\sigma-1}{\sigma}})^{\frac{\sigma}{\sigma-1}} \end{aligned}$$

The first order conditions for c_h and c_f reduce to the standard marginal benefit equals marginal cost conditions

$$\begin{aligned} C_D^{\frac{-1}{\varepsilon}}\frac{dC_D}{dc_h} &= \lambda(\frac{\sigma}{\sigma-1}) \\ C_D^{\frac{-1}{\varepsilon}}\frac{dC_D}{dc_f} &= \lambda(\frac{\sigma}{\sigma-1})(1+\phi) \end{aligned}$$

The consumer's optimization in the decentralized problem implies that $p = C_D^{\frac{-1}{\varepsilon}}\frac{dC_D}{dc_h}$, and firms choose price $p = \lambda(\frac{\sigma}{\sigma-1})$. Thus, with the externality, the monopolist's price is efficiently marked up to the marginal social cost. Furthermore, consumer optimization implies $\frac{p}{p_f} = \frac{\frac{dC_D}{dc_h}}{\frac{dC_D}{dc_f}} = \frac{1}{1+\phi}$, and free trade yields the optimal price ratio in the market. The planner's equilibrium allocation then satisfies $\frac{c_f}{c} = (1+\phi)^{-\sigma}$ which is also the decentralized allocation .

Using these results, the consumption index and price index become

$$\begin{aligned} C_D &= n^{\frac{\sigma}{\sigma-1}}x(1+(1+\phi))^{\frac{1}{\sigma-1}} \\ P &= n^{\frac{1}{1-\sigma}}\lambda(\frac{\sigma}{\sigma-1})(1+(1+\phi))^{\frac{1}{1-\sigma}} \end{aligned}$$

The first order condition for n then reduces to

$$F+px = \frac{dC_D}{dn}P = \frac{\sigma}{\sigma-1}px$$

This is satisfied when

$$x = \frac{F(\sigma-1)}{p}$$

The decentralized x is

$$x = \frac{F(1-s)(\sigma-1)}{\lambda}$$

Thus the first-best is implemented with subsidy

$$s = 1 - \frac{\lambda}{p} = \frac{1}{\sigma}$$

A.3 Politically Optimal Tariffs

I prove that the addition of either the marginal cost externality or political economic considerations does not effect the result that the politically optimal tariffs satisfy the first-order conditions for efficiency of trade policy.

As in Bagwell and Staiger (2009a), holding domestic policies fixed, firms can be written as a function of price p_f and p_h^*, and thus welfare functions can be written as $W(p^w, p^{*w}, p_f, p_h^*)$, omitting dependence on constant variables. Adding market shares does not effect this result.

The first-order conditions for efficiency for trade policies are then

$$\begin{aligned} (W_{p_h^*} + W_{p_h^*}^*)\frac{dp_h^*}{d\iota^*} &= 0 \\ (W_{p_f} + W_{p_f}^*)\frac{dp_f}{d\iota} &= 0 \end{aligned} \tag{11}$$

where the conditions for the trade policies that make up ι^* (τ_h^* and τ_f^*) and ι (τ_h and τ_f) are redundant.

By definition, the politically optimal tariff conditions are satisfied when nations act as if they do not value the terms of trade effects of their trade policies. Since $W(p^w, p^{*w}, p_f, p_h^*)$, policies that affect ι^* only affect p_h^* in the politically optimal conditions, and policies that affect ι only affect p_f.The politically optimal tariff conditions are then

$$\begin{aligned} W_{p_h^*}\frac{dp_h^*}{d\iota^*} &= 0 \qquad W_{p_f}\frac{dp_f}{d\iota} = 0 \\ W_{p_h^*}^*\frac{dp_h^*}{d\iota^*} &= 0 \qquad W_{p_f}^*\frac{dp_f}{d\iota} = 0 \end{aligned}$$

which reduce to $W_{p_h^*} = W_{p_h^*}^* = W_{p_f} = W_{p_f}^* = 0$ since total trade costs always have a nonzero effect on prices. Thus, the politically optimal tariffs satisfy (11).

A.4 Effects of Market Access-Preserving Policies on Price Indices

To determine the effects on the home price index, consider the zero-profit conditions (3) rewritten in terms of market shares

$$S + (1 - S^*)\frac{1+\phi}{\iota} = F(1 - s_h)n_h P^{\varepsilon-1}$$

Log-differentiating

$$\alpha_s \hat{S} - (1 - \alpha_s)\hat{\iota} = \hat{n}_h + (\varepsilon - 1)\hat{P} = \hat{S} + (\varepsilon - \sigma)\hat{P}$$

where $\alpha_s \equiv \frac{S}{S+(1-S^*)\frac{1+\phi}{\iota}} = \frac{1}{1+(1+\phi)\iota^{-\sigma}} < 1$. The second equality above made use of the result that $\hat{S} = \hat{n}_h - (1 - \sigma)\hat{P}$, determined by log-differentiating (7).

Using the previous result relating the market share to the tariff (10),

$$(\sigma - \varepsilon)\hat{P} = (1 - \alpha_s)(\hat{S} + \hat{\iota}) = (1 - \alpha_s)((1 - S)(\sigma - 1) + 1)\hat{\iota} \tag{12}$$

which proves that homes price index falls as a result of the policy mix change, since $\hat{\iota} < 0$.

For the foreign price index, log differentiation both price index equations (1)

$$\begin{aligned}(1 - \sigma)\hat{P} &= Sn + (1 - S)(n^*) \\ (1 - \sigma)\hat{P}^* &= Sn^* + (1 - S)(n)\end{aligned}$$

Differencing these two equations, and using equations (9) and (12)

$$P^* = (1 - S)(2S)\hat{\iota} + \hat{P}$$

Thus, the policy change also lowers foreign's price index.

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