THREE ESSAYS IN INTERNATIONAL TRADE THEORY AND POLICY

by

RUBEN SARGSYAN

B.S., Yerevan State Institute of National Economy, 1997
M.S., University of Nebraska at Omaha, 2003

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Economics
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Abstract

Concerns over the possible loss of government revenue resulting from tariff reductions under trade liberalization have triggered many developing countries to opt for a strategy of raising destination-based consumption taxes on tradable goods. The first essay analyzes the welfare effects of a coordinated tariff reduction and domestic tax reform when the objective of a reforming country is to keep its government revenue unchanged. Assuming imperfect competition in an import-competing industry, we find that revenue-neutral reform involving tariff reduction and an increase in domestic tax rate may reduce domestic welfare under plausible assumptions. It also discusses the scenario in which the reforming country's objective is to keep domestic profit (or production) unchanged. We further identify the conditions under which a profit-neutral tariff and tax reform may be welfare-improving or welfare-deteriorating.

The second essay uses a reciprocal-dumping model to examine the welfare effects of the Byrd Amendment (i.e., the Continued Dumping and Subsidy Offset Act, or CDSOA). It analyzes the differences in optimal tariffs set by the home and foreign governments when the home (i.e., the U.S.) government redistributes anti-dumping duties to its domestic firm under the new trade law, as compared to the traditional antidumping policy under which these duties are government revenues. We derive conditions under which the CDSOA may raise or lower the price of an import-competing good in the U.S. market. The results show that the CDSOA is an instrument of protectionism and strictly improves the home country welfare when markets are less competitive than in Cournot equilibrium. We find that under the same market characteristics, the new trade law strictly reduces foreign country welfare. The CDSOA's welfare effect is shown to be ambiguous, however, when markets are more competitive than Cournot.

The third essay modifies the model presented in Essay 2 to allow for the scenario in which the foreign country strategically responds to the home country's CDSOA law by adopting similar trade law. The results show that the foreign country is able to enhance its national welfare when the import-competing markets are less competitive than in the Cournot equilibrium. We also discuss whether it is welfare-improving for the U.S. to voluntarily repeal the Byrd Amendment and restore the traditional antidumping policy, considering that, otherwise, its trading partner may also adopt the CDSOA law. We find that it is still in the best interest to the U.S. not to revoke the Byrd Amendment when markets are less competitive than Cournot. When markets are more competitive than Cournot, however, repealing the Amendment may turn out to be socially welfare-improving.

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Essay 1 - Welfare Effects of Tariff and Domestic Tax Reforms under Imperfect Competition

1.1 Introduction

Reforming tariffs and non-tariff trade barriers accompanied by sound fiscal policies allowed many developing countries and countries in transition to utilize the opportunities for economic growth through international trade.[1] Other things being equal, trade liberalization through tariff reduction has also triggered the concerns over the possible loss of government revenue. In addition to protecting domestic producers from foreign competitors, which is justified under infant industry argument, tariffs have historically been an important revenue source for low and middle income countries. According to the World Bank's World Development Indicators, taxes on international trade accounted for more than 30 percent of overall government revenues in low income countries such as Ghana, Madagascar, Lesotho, and low middle income countries like Namibia and Swaziland in 2003. Within country groups, trade taxes constituted more than 18 percent of government revenues in low income, but less than 2 percent in high income countries in 2003 (Figure 1.1).[2]

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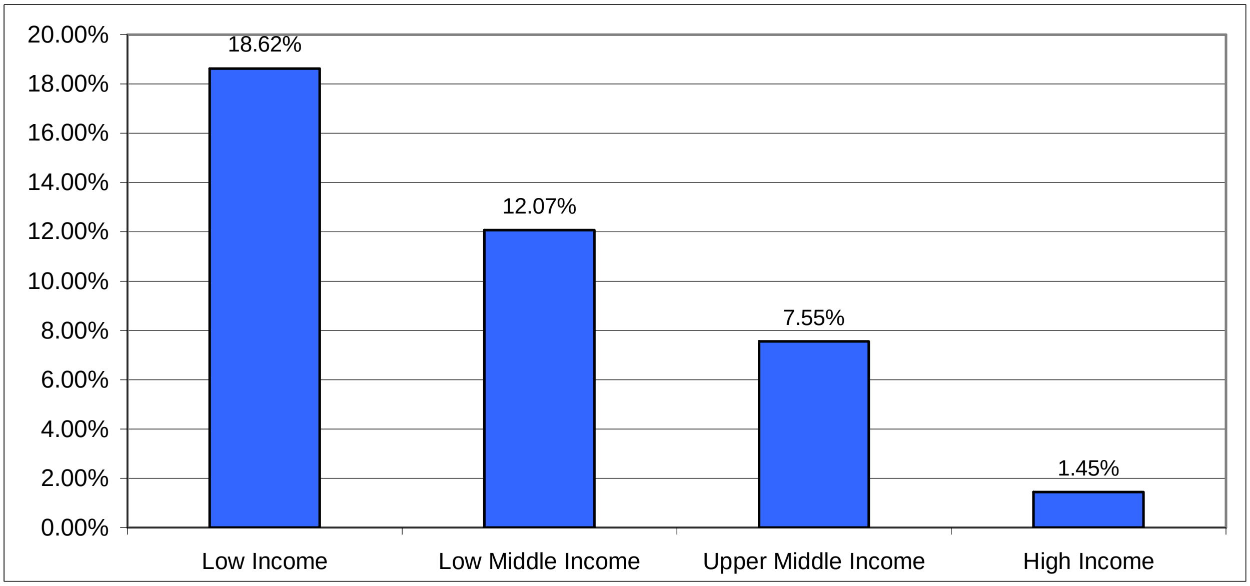
[1] Studies documenting that more open economies historically outperformed economies that pursue more inward-looking trade practices include Sachs and Warner (1995), Dani Ben-David (1996), Frankel and Romer, (1999). Edwards (1993) provides an excellent review of the empirical literature on the relationship between trade orientation and economic performance.

[2] The income classification is according to World Bank's definition. International trade taxes include revenues from taxing both impost and exports. Figure 1 shows the average trade tax as a percent in total government revenue for 17 low income, 24 low middle income, 20 upper middle income, and 12 high income countries for which data for 2003 is available.

Figure 1.1 International Trade Tax Revenue as a Percent of Total Government Revenue for Selective Income Country Groups in 2003



Source: World Development Indicator, World Bank (2006).

In theory, trade taxes such as tariffs are known to be doubly distortionary, as they interfere with both consumer and producer prices.[3] Thus trade tax reforms, which have been strongly advocated by international organizations such as World Trade Organization (WTO), World Bank (WB), International Monetary Fund (IMF), aiming to promote outward oriented economies, also reduce the production distortions and allow utilizing production efficiency gains by reforming countries.[4] However, the threat of potential fiscal imbalances caused by lowering tariffs has entailed governments of low and middle income countries with heavier dependence on trade taxes to seek for alternative domestic sources of revenue. Studies have proposed that these countries introduce or raise the existing domestic indirect taxes and destination based value-added tax (henceforth VAT) to compensate for revenue loss from tariff cuts.

[3] See, for example, Dixit (1985).
[4] Welfare enhancement due to tariff reduction has been shown by Hatt (1977a), Diewert et al. (1989).

Emran and Stiglitz (2005) report that the number of developing countries introducing VAT has increased dramatically over the decade of 1990s, and as of 2001, 123 countries already had some form of VAT (p. 600). Since VAT type taxes apply to both imports as well as domestic consumption, and thus have broader base than trade taxes which apply only to exports and imports, a majority of revenue-neutral tax reforms propose that tariff cuts be combined with smaller than one-to-one increases in consumption type taxes.[5] Unfortunately, empirical studies provide conflicting results regarding whether low income or developing countries were able to fully recover their trade tax revenue losses because of tariff reforms. For instance, Baunsgaard and Keen (2005) use data for 125 countries over the period 1975-2005 and report that high and middle income countries were able to offset reductions in trade tax revenues by increasing their domestic tax revenues, while low-income countries have only to a minor part recovered the loss of trade taxes (no more than around 30 cents of each lost dollar). Unlike Baunsgaard and Keen's (2005) results, Buettner et al. (2006) find that developing and transition countries have been able to increase VAT revenues enough to compensate for declining tariff revenue in a sample of 20 developing and transition countries in the time period between 1990 - 2004.

Although the literature offers vast theoretical and empirical studies on the welfare effects of revenue and price-neutral trade and domestic tax policy reforms, the results vary significantly, and the overall welfare effects are ambiguous. The ultimate goal of this essay is to revisit the literature of imperfect competition and study the welfare effects of tariff reforms coordinated with government revenue-neutral as well as home firm's profit-neutral domestic tax reforms. We wish to derive the conditions under which these reforms can enhance reforming country social welfare in an international duopoly model with a homogeneous good.

[5] Mitra (1990) provides a thorough discussion.

The plan of the essay is as follows: Section 2 presents literature review. Section 3 develops the theoretical model and presents its comparative statics. Welfare implications of the model under revenue and profit-neutral policy reforms are in Section 4. A summary of conclusions follows in Section 5.

1.2 Literature Review

The literature on tariffs and indirect taxes offers vast theoretical as well as empirical studies on the welfare effects of revenue and profit-neutral trade and domestic tax policy reforms. The effects of such reforms have shown to be different depending on models' specifications and market structure. The theoretical literature has mainly focused on the welfare effects for the following three types of radial or selective tariff and tax reforms: *i)* coordinated tariff and tax reforms with a passive government budget constraint, *(ii)* coordinated tariff and tax reforms with an active government budget constraint, *(iii)* consumer or producer price-neutral tariff and tax reforms.[6] Since developing countries' tariff and domestic tax reforms generally fall under the last two categories of reforms, we will discuss the studies that fit in one of these two categories.

Michael, Hatzipanayotou and Miller (1993) is one of the pioneering studies that discusses integrated tariff and indirect tax reforms, and identifies the conditions when revenue-neutral tariff and tax reforms enhance welfare in a many-good general trade model of a small open economy. The authors argue that when some conditions are met under revenue-neutral reforms,

[6] Radial reform involves every product in the economy, while a selective reform implies to a single commodity only. According to Emran and Stiglitz (2005), "The government budget constraint is said to be active when a reduction in the revenue due to a reduction in one tax needs to be balanced by an offsetting increase in another distortionary tax." (p. 601). Passive budget constraint implies that reduction in government revenue is balanced by an offsetting equal reduction in lump-sum government transfers.

government revenue generating function can be shifted from tariffs to indirect taxes and reforms may increase welfare.[7]

Abe (1995) derives welfare improving targeted rates for uniform changes in tariffs and commodity taxes in a general equilibrium model of a small open economy. Abe (1995) endogenizes the supply of public good which is provided directly to consumers and positively depends on government revenue, and shows that the welfare improvement is attainable due to increase in the supply of the public good. The author notes, that the problem with this reform is that even if the reform applies continuously, it may not bring the economy to the first-best optimum unless targeted rates include the marginal benefit and cost of the public good. In the second part of the paper Abe (1995) derives new combination of targeted rates of tariff and tax reforms that incorporate marginal cost and benefit of the public good thus allowing the economy to achieve to its first-best optimum. Importantly, this adjustment enhances welfare at each stage of the reform.

Anderson (1999) argues that when government budget constraint is active, a radial reform of trade taxes is not guaranteed to improve welfare ambiguously when non-tradables are included in the model of competitive equilibrium. The welfare enhancement is possible only with further substitutability restrictions between private and public goods, along with non-subsidization conditions. The author concludes, "Thus trade reform is probably better argued from the benefits of the international division of labor, the stimulation of competition, and the reduction of rent seeking behavior".

Keen and Ligthart (2002) study the welfare effects of coordinated tariff and tax reforms that leave consumer prices unchanged. In a small open economy where all goods are tradable, a radial tariff reduction coordinated with point-for-point increase in domestic consumption taxes

[7] These conditions are summarized in Proposition 2 (see Michael et al. (1993) p. 424).

leaves consumer prices unchanged and improves both welfare and government revenue. The same results hold when all tariffs are replaced by consumption taxes such that consumer prices are unaffected. However, when nontradeable goods and intermediate inputs are included in the model the initial results hold only when additional conditions are satisfied.

Emran and Stiglitz (2005) point out that the existence of a large informal sector is a common feature for developing economies and should not be ignored. The model assumes competitive small economy framework which includes an informal sector, and discuss the welfare effects of consumer as well as producer price-neutral radial and selective trade tax and VAT reforms. The results show that with informal sector the coordinated tariff and tax reform that leaves consumer or producer prices unchanged is likely to reduce both welfare and revenue under plausible sufficient conditions. These results contradict with Keen and Ligthart's (2002) findings.

Keen and Ligthart (2005) is one of few studies that explores the welfare effects of coordinated tariff and domestic tax reforms under imperfect competition. The results suggest that tariff cuts combined with one-for-one increase in destination based consumption taxes strictly reduce the national welfare.[8] This is because such reforms negatively affect both domestic consumers and firm. Tariff cuts combined with an increase in consumption tax of the same magnitude increase consumer price causing consumer welfare to decline, and reduce home firm's output and profit. Although such reform may increase government revenue if initial tariff is too high, however, the increase in government revenue is dominated by the decline in consumer welfare and domestic firm's profit. In addition, Keen and Ligthart (2005) show that consumer price-neutral tariff and destination based consumption tax reforms again strictly reduce national welfare without any plausible conditions. Thus, unlike Keen and Ligthart's (2002)

[8] National welfare is measured as the sum of consumer surplus, producer surplus and government revenue.

welfare enhancing results derived from a competitive economy model, the same reforms were shown to reduce national welfare under the assumption of imperfect competition.

Kim and Kose (2007) use a dynamic general equilibrium model and present the welfare effects of revenue-neutral tariff and domestic tax reforms.[9] Various combinations of taxes and tariffs suggest that the welfare implications of such reforms crucially depend on how government finances the tariff cuts. Kim and Kose (2007) state, "Tariff cuts financed by consumption and labor income taxes are welfare-improving in general, while capital income tax financing can generate large welfare loss. Removal of tariffs on imported capital goods with consumption tax financing provides the largest welfare gains."

Thus the literature suggests that the effects coordinated tariff and domestic tax reforms may have on reforming country's social welfare crucially depend on the models' specifications and market structure.

1.3 The Model

Following Dixit (1984) and Brander and Spencer (1984), we consider the case of an international Cournot duopoly where a home and a foreign firm compete in a home market of a homogenous tradable good. The home firm produces output X and the foreign firm produces output X^*. The home country's government imposes a destination-based consumption tax t on each unit of the good consumed in home market and a tariff τ on each unit of the good exported by the foreign firm. For analytical simplicity we assume that demand in the home market is characterized by a linear demand function $P = P(X + X^*)$ (where $P'(\cdot) < 0$ and $P''(\cdot) = 0$). Thus, the price paid by the consumers for each unit of good in the home market is P, while the prices

[9] The tariff reform is assumed to take place in a form of complete removal of tariff rates.

received by the home and foreign firms are $P-t$ and $P-t-\tau$ respectively. Let F be the fixed cost and c the (constant) marginal cost of each firm. As in Keen and Ligthart (2005), we assume that transportation costs are zero. The home and foreign firms independently and simultaneously solve the following problems:

$$\underset{\{X\}}{Max}\,\Pi^h = (P-t-c)X - F\,, \tag{1}$$

$$\underset{\{X^*\}}{Max}\,\Pi^f = (P-t-\tau-c)X^* - F\,, \tag{2}$$

where Π^h and Π^f are respectively profits of the home and foreign firms.[10]

The first-order conditions (FOCs) that characterize the Cournot equilibrium in the home market imply that the home firm's marginal revenue equals its marginal cost plus the consumption tax rate:

$$P'X + P = c + t\,, \tag{3}$$

and the foreign firm's marginal revenue is the sum of the foreign firm's marginal cost, the consumption tax and the tariff rates:

$$P'X^* + P = c + t + \tau\,. \tag{4}$$

Totally differentiating the FOCs in (3) and (4), allowing for any arbitrary changes in tax and tariff rates yields

$$P'dX + P'(dX + dX^*) = dt \tag{5}$$

$$P'dX^* + P'(dX + dX^*) = dt + d\tau \tag{6}$$

Equations (5) and (6) can be rewritten in matrix form as follows:

$$\begin{bmatrix} 2P' & P' \\ P' & 2P' \end{bmatrix} \begin{bmatrix} dX \\ dX^* \end{bmatrix} = \begin{bmatrix} dt \\ dt + d\tau \end{bmatrix}. \tag{7}$$

[10] The standard assumption that $X > 0$ and $X^* > 0$ implies that $P > t + \tau + c$.

From (7) we find how the home and foreign firms' outputs will respond to any exogenous changes in tariff and tax rates:

$$dX = \frac{1}{3P'}\left(dt - d\tau\right), \tag{8}$$

$$dX^{*} = \frac{1}{3P'}\left(dt + 2d\tau\right). \tag{9}$$

Equations (8) and (9) together determine how changes in tariff and tax rates alter the total consumption of a homogenous product in the home country:

$$dX + dX^{*} = \frac{1}{3P'}\left(2dt + d\tau\right). \tag{10}$$

We measure the home country social welfare as the sum of consumer surplus (CS), the home firm's profit (Π^{h}), and government revenue (G). That is,

$$W = CS + \Pi^{h} + G, \tag{11}$$

where Π^{h} is given in (1), and

$$CS = U(X + X^{*}) - P(X + X^{*}),$$

$$G = t(X + X^{*}) + \tau X^{*}.$$

It follows from (11) that welfare change in the home country market is:

$$dW = d(CS) + d\Pi^{h} + dG, \tag{12}$$

where

$$d(CS) = -P'(dX + dX^{*})(X + X^{*}), \tag{13}$$

$$d\Pi^{h} = P'(dX + dX^{*})X - Xdt + \left(P - t - c\right)dX, \tag{14}$$

$$dG = dt(X + X^{*}) + t(dX + dX^{*}) + X^{*}d\tau + \tau dX^{*}. \tag{15}$$

In what follows, we first examine the welfare effects of a coordinated tariff and destination-based consumption tax reform when the objective of the home government is to keep its aggregate revenue unchanged (i.e., the case of revenue-neutral tariff and tax reform). We then discuss the case in which the home government's objective is to keep its firm's profit unchanged (i.e., the case of profit-neutral tariff and tax reform).

1.4 Welfare Effects of Tariff and Tax Reform

1.4.1 Welfare Effects of Revenue-Neutral Tariff and Tax Reform

Since the revenue-neutral tariff and tax reform leaves government revenue unchanged, we can express the required change in tax in terms of models' parameters and tariff change which allows the reforming country's government to meet its revenue-neutrality objective ($dG = 0$). This is done by substituting the change in total consumption from (10) into dG in (15) and then setting dG to be zero. Finally, taking into account the FOCs in (3) and (4), we derive the revenue-neutral tariff-tax relationship as follows:

$$dt = -\left[\frac{3P-4t-5\tau-3c}{2(3P-4t-2\tau-3c)}\right]d\tau \ . \qquad (16)$$

For the rest of the essay, to make the discussion easily tractable, we refer to tariff reform as tariff reduction $(d\tau < 0)$.

Equation (16) can be used to discuss how changes in tariff and tax rates must be coordinated in order to leave government revenue neutral. There are three possibilities:

Case 1: $3P - 4t - 2\tau - 3c > 0$ and $3P - 4t - 5\tau - 3c > 0$;

Case 2: $3P - 4t - 2\tau - 3c > 0$ and $3P - 4t - 5\tau - 3c < 0$;

Case 3: $3P - 4t - 2\tau - 3c < 0$ and $3P - 4t - 5\tau - 3c < 0$.

Cases 1 and 3 imply that $d\tau$ and dt are opposite in sign $(\frac{dt}{d\tau} < 0)$. That is, the tariff and tax reforms must have opposite directions (i.e., a reduction in tariff must be followed by an increase in domestic tax) whenever the pre-reform or initial market price in the reforming country's market is either greater than the threshold level of $\frac{3c + 4t + 5\tau}{3}$ or less than that of $\frac{3c + 4t + 2\tau}{3}$. Note that since the lower bound of the pre-reform price level is $c + t + \tau$ due to the non-negativity assumption of the foreign firm's output, the pre-reform price could be less than the lower threshold of $\frac{3c + 4t + 2\tau}{3}$ only if the pre-reform domestic tax is higher than the pre-reform tariff $(t > \tau)$.[11]

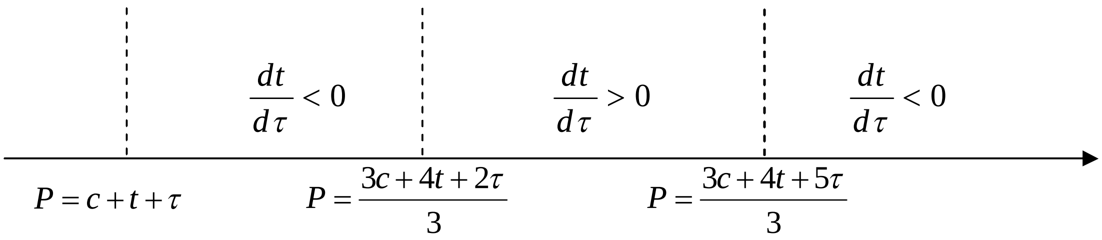
Case (2) implies that if the pre-reform price in the home market is within the range given by the inequality equation in (17), the domestic tax and tariff reform turn out to have the same directions (i.e., a reduction in tariff tax must be followed by a reduction in domestic tax) in order government to keep its revenue unchanged.

$$\frac{4t + 2\tau + 3c}{3} < P < \frac{4t + 5\tau + 3c}{3}. \qquad (17)$$

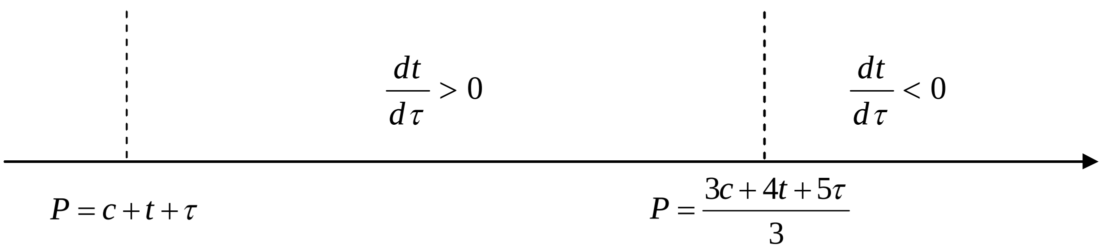
The three price ranges below summarize how tariff and domestic tax reform should be coordinated when a country's pre-reform domestic tax is higher than its pre-reform tariff:

---

[11] When pre-reform tax (t) is lower than pre-reform tariff (τ), we have $\frac{3c + 4t + 2\tau}{3} < c + t + \tau$, which implies that any price below $\frac{3c + 4t + 2\tau}{3}$ violates the sufficient condition for $X^* > 0$.



and the following two areas indicate the coordination of policies when the country's pre-reform domestic tax is lower than its pre-reform tariff:



We now discuss the welfare effects of revenue-neutral tariff and domestic tax reforms. With $dG = 0$, the welfare change in (12) becomes:

$$dW = dCS + d\Pi^h . \tag{18}$$

Substituting (14) and (15) into the welfare change equation in (18) and simplifying yields

$$dW = -\left(P'X^*\right)(dX + dX^*) - X\left(dt\right) + \left(P - t - c\right)\left(dX\right). \tag{19}$$

The expression identifying the change in the home country welfare can be derived by substituting (4) and (10) into (19):

$$dW = \frac{1}{3P'}\left[\left(6P - 6t - 2\tau - 6c\right)dt - \tau d\tau\right]. \tag{20}$$

Finally, substituting the revenue-neutral tariff-tax relationship in (16) into (20) and simplifying the latter, we have:

$$dW = -\frac{1}{P'}\left[\left(P - t - c\right) - \frac{\tau(3P - 3t - \tau - 3c)}{3P - 4t - 2\tau - 3c}\right]d\tau . \tag{21}$$

The sign of dW is ambiguous and depends on the pre-reform levels of price, domestic tax, tariff, and marginal cost, thus the effect of a coordinated tariff and tax reform on the reforming country welfare can not be determined strictly without additional plausible assumptions pertaining to the initial values of the model's parameters. Equation (21) also shows that the coordination of the tariff reduction with domestic tax reform that leaves government revenues unchanged strictly reduces the reforming country's social welfare if the pre-reform market price is lower than a threshold level of $\frac{3c+4t+2\tau}{3}$. As shown earlier, the pre-reform price level can be below this threshold only if country's pre-reform domestic tax is higher than its pre-reform tariff, and in this case a tariff reduction must be followed by an increase in domestic tax.

To complete the welfare effect of the revenue-neutral tariff and tax reform, our next step is to analyze how this reform affects both domestic consumers and the home firm. To see the effect on consumer surplus, we first substitute (3), (4), and (10) into $d(CS)$ in (13), and then use the revenue-neutral tariff-tax relationship in (16) to obtain:

$$d(CS) = \frac{\tau}{P'}\left[\frac{2P-2c-2t-\tau}{3P-3c-4t-2\tau}\right]d\tau \tag{22}$$

Similarly, to see the effect on the home firm's profit, we substitute (3) and (10) into $d\Pi^h$ in (14), and utilize the revenue-neutral tariff-tax relationship in (16). Simplifying (16) we have:

$$d\Pi^h = -\frac{1}{P'}\left(P-t-c\right)\left[\frac{3P-3c-4t-3\tau}{3P-3c-4t-2\tau}\right]d\tau \tag{23}$$

Equations (22) and (23) indicate that the coordinated revenue-neutral reform has an ambiguous effect on both domestic consumer surplus and the home firm's profit.

The reform's effect on consumer surplus depends on the sign of the parenthesis term in (22). Since the numerator is strictly positive due to the non-negativity of output by the foreign firm, the effect of tariff reduction on consumer surplus is explained by the sign of the denominator; it increases consumer welfare if the denominator is positive, and decreases otherwise. More specifically, we have two possibilities:

(i) $2P-2c-2t-\tau>0$ and $3P-3c-4t-2\tau>0$;

(ii) $2P-2c-2t-\tau>0$ and $3P-3c-4t-2\tau<0$.

The first possibility identifies the lowest pre-reform price level above which the tariff reduction coordinated with domestic tax reform will increase consumer surplus. Domestic consumers gain if the pre-reform price level is above the threshold level:

$$\frac{3c+4t+2\tau}{3}<P. \tag{24}$$

The second possibility implies that a tariff cut coordinated with revenue-neutral tax reform reduces consumer surplus if the pre-reform price level in the home market satisfies the following inequality condition:

$$\frac{2c+2t+\tau}{2}<P<\frac{3c+4t+2\tau}{3}. \tag{25}$$

Since the lower bound in (25) is below the price level required to ensure positive output by the foreign firm, a necessary adjustment must be made to the above condition. Thus the pre-reform price level which strictly makes domestic consumers worse off must be within the following range:

$$c+t+\tau<P<\frac{3c+4t+2\tau}{3}. \tag{26}$$

As shown earlier the above inequality condition is feasible only when pre-reform tax is greater than pre-reform tariff. If pre-reform tax is lower than pre-reform tariff, the condition (24) always holds, with the result that domestic consumers will unambiguously benefit from the coordinated reform. It can be easily shown that when the pre-reform price satisfies condition (24), the tariff reduction coordinated with tax reform will lower and hence will increases consumer surplus.[12]

As for the effect of the revenue-neutral reform on the home firm's profit (see equation (23)), we have the following three possibilities:

(a) $3P - 3c - 4t - 3\tau > 0$ and $3P - 3c - 4t - 2\tau > 0$;

(b) $3P - 3c - 4t - 3\tau < 0$ and $3P - 3c - 4t - 2\tau > 0$;

(c) $3P - 3c - 4t - 3\tau < 0$ and $3P - 3c - 4t - 2\tau < 0$.

Possibilities (a) and (c) respectively imply that revenue-neutral tariff reform reduces the home firm's profit when the pre-reform price is either greater than the threshold level of $\dfrac{3c + 4t + 3\tau}{3}$ or smaller than that of $\dfrac{3c + 4t + 2\tau}{3}$. Possibility (b) implies that if the pre-reform price is between $\dfrac{3c + 4t + 2\tau}{3}$ and $\dfrac{3c + 4t + 3\tau}{3}$, the revenue-neutral reform will increase the home firm's profit.[13]

The price ranges below summarize the various effects of a revenue-neutral tariff and tax reform when pre-reform tax is higher than pre-reform tariff $(t > \tau)$:

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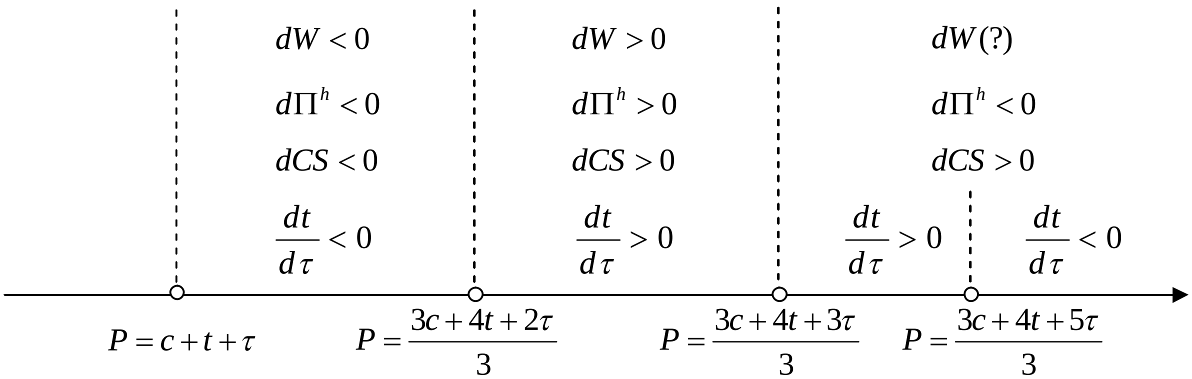
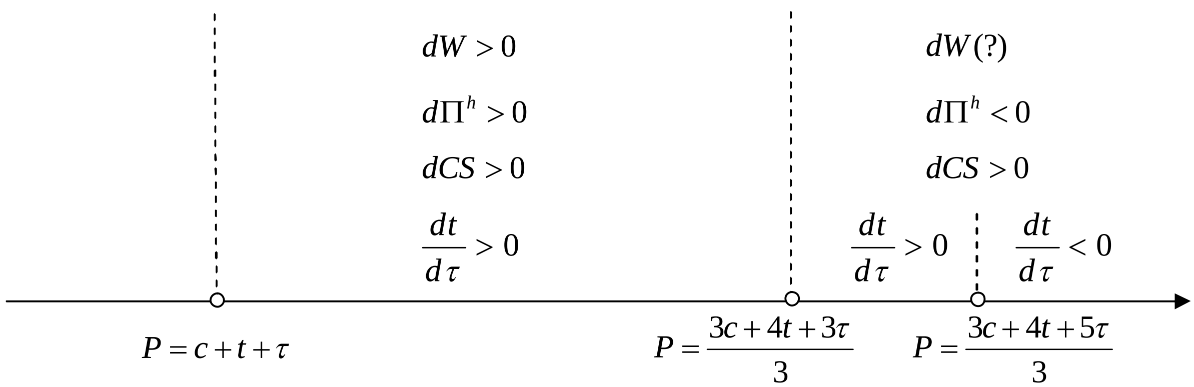
[12] Given that price change is $dP = P'(dX + dX^*)$, we substituting equations (10) and (16) into this equation we get $dP = \left(\frac{\tau}{3P - 3c - 4t - 2\tau}\right) d\tau$. When $P > \frac{3c+4t+2\tau}{3}$, the sign of the parenthesis term is positive, thus tariff reduction reduces domestic product price, ceteris paribus.

[13] Given that the effect on domestic output is given by $dX = \frac{1}{3P'}(dt - d\tau)$, we substitute the revenue-neutral tariff-tax relationship in (16) into this equation to obtain $dX = -\frac{1}{2P'}\left(\frac{3P - 3c - 4t - 3\tau}{3P - 3c - 4t - 2\tau}\right) d\tau$. When $\frac{3c+4t+2\tau}{3} < P < \frac{3c+4t+3\tau}{3}$, the sign of the parenthesis term is negative, which implies that a tariff cut will increase domestic production, *ceteris paribus.*



Since $P < \frac{3c + 4t + 2\tau}{3}$ is not feasible when pre-reform tax is lower than pre-reform tariff, the price ranges below summarize the effects of a revenue-neutral tariff and tax reform when pre-reform tax is lower than pre-reform tariff $(t < \tau)$:



The above analyses lead us to establish the following proposition:

Proposition 1.

(i) For the case in which pre-reform tax is <u>*greater*</u> *than pre-reform tariff, if the objective of reforming country is to keep government revenues unchanged, the reform that involves a reduction in tariff should be combined with an* <u>*increase*</u> *in domestic consumption tax when the pre-reform price is within the threshold levels of* $(c + t + \tau)$ *and* $\frac{3c + 4t + 2\tau}{3}$*. Nevertheless, the*

reform negatively affects domestic consumers and the home firm, with the consequence that social welfare decreases.

(ii) For the case in which pre-reform tax is <u>greater</u> than pre-reform tariff, a revenue-neutral reform that involves a reduction in tariff should be combined with a <u>decrease</u> in domestic consumption tax when the pre-reform price is within the threshold levels of $\frac{3c+4t+2\tau}{3}$ *and* $\frac{3c+4t+3\tau}{3}$. *The reform unambiguously increases consumer surplus and firm's profit in the reforming country, causing its domestic welfare to increase.*

(iii) If the pre-reform tax is <u>lower</u> than the pre-reform tariff, then a revenue-neutral reform that involves a reduction in tariff should be combined with a <u>decrease</u> in domestic consumption tax when the pre-reform price is within the threshold levels of $c+t+\tau$ *and* $\frac{3c+4t+3\tau}{3}$. *The reform is welfare-improving in that consumer surplus and firm's profit in the reforming country are increasing.*

(vi) If the initial price is above the threshold level of $\frac{3c+4t+3\tau}{3}$, *a revenue-neutral tariff and tax reform increases consumer surplus but has a negative effect on profit of the domestic firm. In this case, the effects of tariff reduction on both domestic tax and on social welfare cannot be determined unambiguously, depending on the pre-reform levels of tariff, tax, and marginal cost.*

1.4.2 Welfare Effects of Profit-Neutral Tariff Reduction and Tax Reform

We now present the welfare effects of a coordinated tariff and domestic tax reform which aims to keep the home firm's profit unchanged $(d\Pi^h = 0)$. Substituting (3), (8), and (10) into $d\Pi^h$ in (14) yields

$$d\Pi^h = -\frac{2}{3P'}(P+t+c)(d\tau - dt). \tag{27}$$

Based on (27), the profit-neutral tariff and tax reform requires that the direction and the magnitude of changes in tariff and tax rates be the same:[14]

$$d\tau = dt. \tag{28}$$

With the home firm's profit unchanged, the change in domestic welfare (see equation (12)) now becomes:

$$dW = d(CS) + dG. \tag{29}$$

Substituting (13) and (15) into (29) and utilizing (4) and (28), we express welfare change in terms of the tariff change as follows:

$$dW = -\frac{1}{P'}\left(P - c - 2t - 2\tau\right)d\tau. \tag{30}$$

Equation (30) reveals that the tariff reduction accompanied with domestic tax reduction of equal magnitude $\left(d\tau = dt < 0\right)$ raises domestic welfare if the pre-reform price is such that

$$P < c + 2t + 2\tau, \tag{31}$$

and reduces welfare if the pre-reform price is such that

$$P > c + 2t + 2\tau. \tag{32}$$

[14] Note that we will obtain the same relationship if the government's objective is to keep the home firm's output (i.e., the domestic employment) unchanged. This can easily be verified by looking at (8) that $dX = 0$ when $d\tau = dt$. Thus, the analyses of this section is equivalent to the case of an *output-neutral* tariff and tax reform.

Again, by modifying the inequality condition in (31) to rule out negative outputs, we derive the price range under which this reform increases domestic welfare:

$$c+t+\tau < P < c+2t+2\tau \; . \tag{33}$$

We thus have the following proposition:

Proposition 2.

For achieving the objective of a neutrality in firm profit (or domestic output), a reform that involves a reduction in tariff should be combined with a <u>*decrease*</u> *in domestic consumption tax of equal magnitude* $(dt = d\tau < 0)$. *The reform increases social welfare of the reforming country if the pre-reform price level is critically low (within the threshold levels given in (33)). It decreases the country's welfare otherwise.*

To examine how this reform affects domestic consumers, we substitute (10) into $d(CS)$ in (13), and simplify (13), utilizing the FOCs in (3) and (4) and the profit-neutral tariff-tax relationship in (28). We have:

$$d(CS) = \frac{1}{P'}\left(2P-2c-2t-\tau\right)d\tau \; . \tag{34}$$

Since the parenthesis term on the right-hand side of (34) is positive, the coordinated profit-neutral tariff and tax reduction of equal magnitude unambiguously increases consumer surplus.

Similarly, by substituting (9) and (10) into dG in (15), and using (3), (4), and (28), we derive the reform's effect on government revenue as follows:

$$dG = -\frac{1}{P'}\left(3P-3c-4t-3\tau\right)d\tau \; . \tag{35}$$

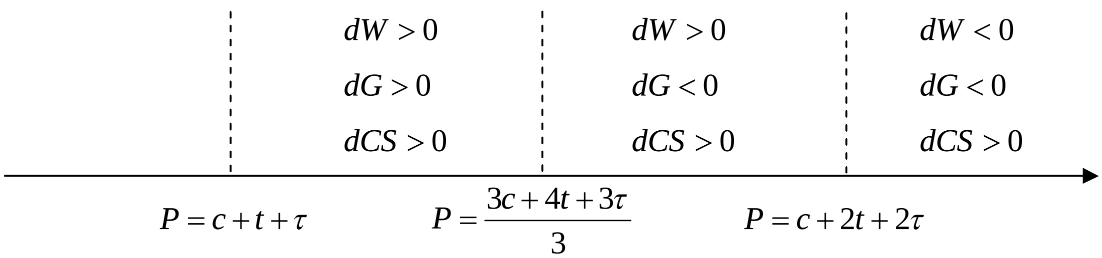
Equation (35) indicates that the effect of the profit-neutral tariff and tax reform on government revenue depends crucially on the pre-reform price level. The reform reduces government revenue if the pre-reform price is such that

$$P > \frac{3c + 4t + 3\tau}{3}, \tag{36}$$

and increases government revenue if the pre-reform price is such that

$$c + t + \tau < P < \frac{3c + 4t + 3\tau}{3}. \tag{37}$$

These results are summarized as follows:



The three different price regions above indicate that the profit-neutral tariff and tax reform increases the home country's social welfare only under plausible assumptions. It makes both consumers and government better off when the home price is critically low (see (37)). Although the reform reduces the home government's revenue when the domestic market price is above the threshold level of $\frac{3c + 4t + 3\tau}{3}$, it still increases consumer surplus by enough to offset fully the decline in government revenue so the net effect is welfare increasing. This occurs only if the initial home price is below the threshold level defined in (31). Finally, the decline in government revenue dominates any increase in consumer surplus if the initial price in home country is crucially high (above the level shown in (32)). In this case, the coordinated tariff and tax reform will be welfare-deteriorating.

1.5 Concluding Remarks

Many developing countries have opted for the strategy of raising destination-based consumption taxes on tradable goods due to the concern that trade liberalization through tariff reductions would lower government revenues. Based on a stylized model of strategic trade policy under imperfect competition, we analyze the welfare effects of a coordinating tariff and domestic tax reform when the objective of a reforming country is to keep its government revenue unchanged. We show that whether a tariff reduction should be combined with an increase or a decrease in domestic tax rate depends crucially on the pre-reform price level of an import-competing product. Our model suggests that when the good's market price is critically low and the pre-reform tax is higher than the pre-reform tariff, a revenue-neutral reform requires that a tariff cut be followed by an increase in domestic consumption rate. In this case, the increase in consumption tax is welfare-deteriorating. The analyses of a coordinated tariff and tax reform show that, when the pre-reform price of an import competing good is within a relevant price range, a revenue-neutral reform may increase domestic welfare only when the tariff reduction is coordinated with a tax cut. We find that the reform has an ambiguous result on domestic welfare when the pre-reform market price is crucially high. Our results indicate that domestic consumers strictly benefit from the reform if the pre-reform tariff is higher than the pre-reform tax.

We also examine the case in which a reforming country's objective is to keep its domestic profit (or production). Whether such a profit-neutral tariff and tax reform is welfare-improving depends crucially on the pre-reform levels of market price, marginal cost, and tariff and tax rates. Even though the domestic consumers always benefit from this reform, however, when the market price of an import-competing good is critically high due to high tariff and tax rates prior to the reform, a tariff reduction combined with a decrease in consumption tax reduces government revenue and will cause the domestic welfare to decline.

Although this essay lends a support to the findings in the literature that coordinated tariff and tax reforms under plausible assumptions may guarantee welfare improvements, the results of our analyses should be interpreted with caution. The simple model presented here does not capture many of the common features of the low and middle income countries. For instance, it does not consider the existence of such important factors as informal and non-tradable sectors, and intermediate products. As shown in Emran and Stiglitz (2005) for the case of perfect competition, the incorporation of informal sector into our model may significantly change the outcome of the reforms. An extension of the model that accounts for these important aspects of developing economies is needed, allowing policymakers to have a better understanding about the economic outcomes of coordinated tariff and tax reforms.

Essay 2 - Tariffs, Prices, and Welfare Effects of the Byrd Amendment in a Reciprocal-Dumping Model

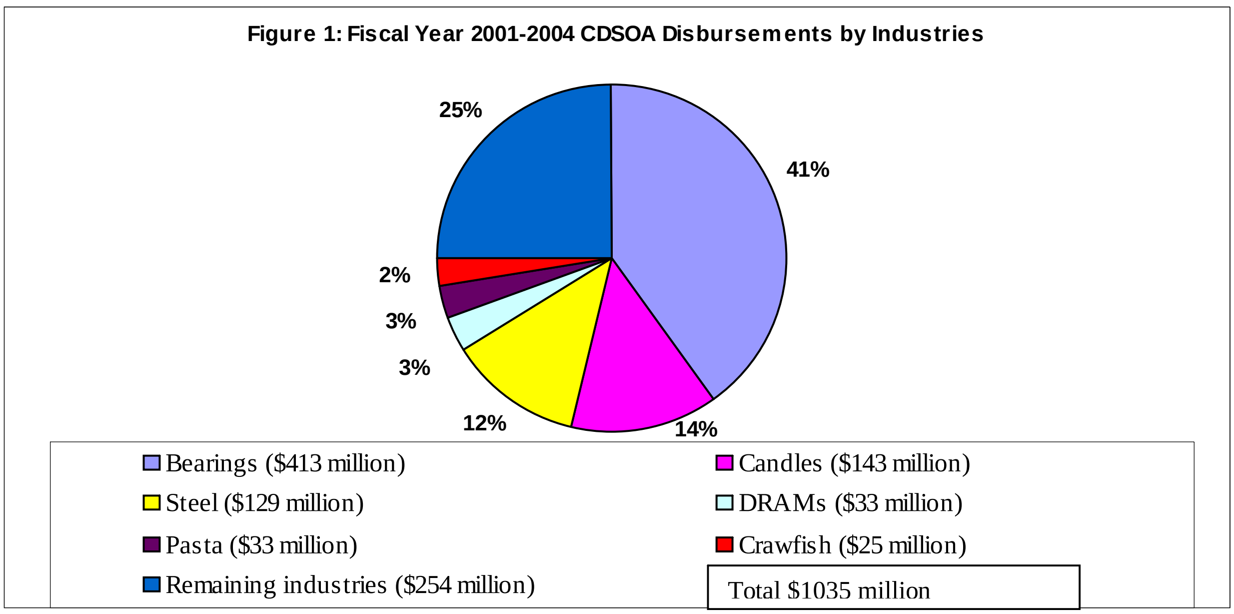
2.1 Introduction

Antidumping and countervailing duties are trade policies widely used by countries around the world to mitigate the negative impact of dumping and foreign subsides on domestic producers. Traditionally, these duties are collected and transferred to their treasuries by the importing countries' customs agencies. However, in October 2000, the U.S. passed a trade law called the Byrd Amendment also known as the "Continued Dumping and Subsidy Offset Act" or "CDSOA". The new Section 754, which amended Title VII of the Tariff Act of 1930, states that "Duties assessed pursuant to a countervailing duty order, an antidumping duty order, or a finding under the Antidumping Act of 1921 shall be distributed on an annual basis under this section to the affected domestic producers for qualifying expenditures. Such distribution shall be known as the 'continued dumping and subsidy offset."[15] The Byrd Amendment requires that all revenues from antidumping and countervailing duties on a given import be redistributed to the domestic qualifying producers. The Amendment also establishes certain criteria that restrict domestic firms' eligibility. In order to qualify for the "offset payments" domestic producers should be either petitioners or interested parties supporting the petition that resulted in the duties levied on that import.

[15] The CDSOA was contained in the Agricultural Bill (Public Law 106-387).

Since the passage of the Byrd Amendment, offset subsidies paid to U.S. companies have been substantial. The Government Accountability Office (GAO) reports that between 2001 and 2004 over $1 billion was transferred to 770 domestic companies. Figure 2.1 illustrates the disbursements of the CDSOA by the industries during this period. Of these 770 companies, 5 companies received 50 percent, and 39 companies received 80 percent of the disbursements made during this period (Figure 2.2).[16] The Congressional Budget Office (CBO) estimated that $3.85 billion in revenues would be collected and distributed to firms between 2005 and 2014.[17]

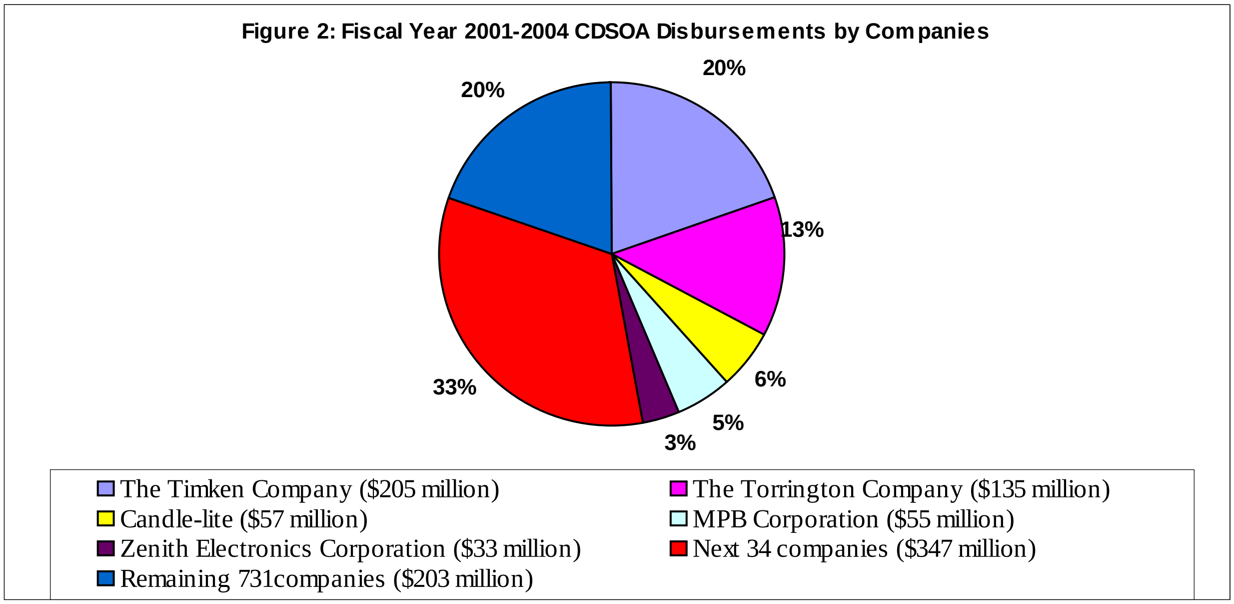
Figure 2.1 Fiscal Year 2001-2004 CDSOA Disbursement by Industries



Source: GAO analysis of CBO data.

[16] See GAO, "Issues and Effects of Implementing the Continued Dumping and Subsidy Offset Act", September 2005, available at: http://www.gao.gov/new.items/d05979.pdf.
[17] Congressional Budget Office, "Economic Analysis of The Continued Dumping and Subsidy Offset Act of 2000", March 2004, available at: http://www.cbo.gov/ftpdoc.cfm?index=5130&type=0&sequence=0.

Figure 2.2 Fiscal Year 2001-2004 CDSOA Disbursement by Companies



Source: GAO analysis of CBO data.

The Byrd Amendment had raised enormous concerns among World Trade Organization (WTO) members. Eleven members challenged the WTO compatibility of the legislation.[18] After the Panel in September 2002, Appellate Body in January 2003 confirmed that the Amendment is an illegal response to dumping and subsidization. The WTO then asked the U.S. to bring the Act into conformity with WTO agreements.[19] As the United States refused to comply with the WTO ruling on the CDSOA, the WTO had authorized the European Union (EU) and other countries to introduce measures that penalize the U.S. for up to 72% of the tariff revenue raised and distributed through the Byrd Amendment.[20] Following this authorization, on April 4, 2005, the

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[18] The eleven WTO members filed the complaint were: Australia, Brazil, Canada, Chile, EU, India, Indonesia, Japan, Korea, Mexico and Thailand. These countries claimed that the Bird amendment was an illegal response against dumping and subsidization. Offset payments constitute a remedy in addition to the imposition of an antidumping or antisubsidy duty, and this remedy is not envisaged in the WTO legislation.

[19] The WTO Appellate Body declared that the CDSOA "is a non-permissible specific action against dumping or a subsidy" contrary to Article 18.1 of the WTO's Antidumping Agreement and Article 32.1 of the Agreement on Subsidies and Countervailing Measures.

[20] After long debates, the U.S. eventually repealed the Byrd Amendment in February 2006 effective from October 2007.

EU announced plans to implement limited sanctions on a selection of U.S. products, charging a 15% levy on U.S. paper, farm goods, textiles and machinery beginning May 1, 2005. On May 1, 2005, Canada imposed a 15% surtax sanction on imports of U.S. cigarettes, oysters and live swine. On September 1, 2005, the Japanese government introduced 15% retaliatory duties on U.S. steel imports.

Although there is a vast trade literature on antidumping legislation, there are only few studies that analyze the economic effects of the CDSOA. Even though the CDSOA law is a history, there are still numerous questions on this subject that policymakers need to be aware about. To our knowledge, there is no theoretical study to discuss the optimal trade policy and welfare effects of the Byrd Amendment within a two-way trade framework. Current literature on the CDSOA focuses on studies that find the welfare-maximizing level of the antidumping tariff, discuss the changes in producers and consumer surpluses and analyze the CDSOA's impact only on the CDSOA-implementing country social welfare under various market structures. Existing studies usually derive conclusions by comparing results from models with the CDSOA to those under free trade or traditional antidumping policies.[21] The models used in these studies completely ignore the fact that the CDSOA implemented by one country will also affect the trading partner country's producers (through its impact on implementing country's prices) and thus the social welfare of the partner country. Hence, it is essentially important to study the price and welfare effects of the CDSOA within a two-way trade (i.e., an intra-industry trade) model.

The objective of this essay is to develop an analytical framework to examine the impact of the Byrd Amendment on tariffs, prices and social welfares in a two-country model: CDSOA implementing country (i.e., U.S.), and its trading partner country which follows a traditional

[21] In the context of this essay a traditional antidumping policy presumes that a government retains all the collected antidumping revenues.

antidumping trade policy. We wish to answer the important questions concerning whether it is optimal for the U.S. government to implement such an amendment, and how this policy would affect the welfare of the U.S. trading partner country. We first analyze how such trade law affects an optimal tariff set by each of the two governments under the traditional antidumping policy. We then examine the price levels, and the both countries' social welfares under the new trade regime.

The rest of the essay is organized as follows. Section 2 presents a review of the literature. Section 3 uses a reciprocal-dumping framework to analyze the case in which the U.S. adopts a trade law of the CDSOA type. Section 4 discusses implications of the model for optimal tariffs, price levels and social welfares. Section 5 contains concluding remarks.

2.2 Literature Review

Governments around the world frequently impose antidumping and countervailing duties to alleviate the negative impact of unfair trade practices resulting from dumping and foreign government subsides on domestic firms. The effects of the antidumping legislation on domestic and foreign firms' behavior under various market structures have been well addressed in current trade literature. Nevertheless, few of these studies have examined the economic effects of the CDSOA.

2.2.1 Studies on Dumping and Countervailing Duties

Brander and Krugman (1983) show that the oligopolistic competition in Cournot quantities of a homogeneous product generates the outcome where each firm dumps into its rival's home market.[22] The authors call this type of intra-industry trade "reciprocal dumping." The model assumes two identical countries and no production cost differences. Brander and Krugman show that the welfare effects of the reciprocal dumping may vary depending on transportation costs. The results suggest that each country's welfare increases if transportation costs are low and decreases if transportation costs are high. There are three channels – two producing welfare gain and one producing welfare loss – through which transportation costs affect the welfare. Lower transportation costs imply both lower cost of imports as well as higher domestic consumption. Lower transportation costs have a negative effect on the home firm's profit due to the replacement of domestic production with imports. When transportation costs are low, the welfare gains through the first two channels dominate the welfare loss, and, therefore, low transportation costs result in higher welfare.

Brander and Krugman further extend their analysis to show that the reciprocal dumping also arises in the case of conjectural variation and that the welfare effects are similar to those of Cournot equilibrium. In the case of conjectural variation, the transportation costs again play a crucial role.

Importantly, the authors note that reciprocal dumping does not arise in the homogeneous product case if the price is the strategy variable. In this case, in order for each firm to dump in its rival's home market, at least a slight amount of product differentiation is required.

Friberg and Ganslandt (2005) analyze the welfare effects of trade in an international oligopoly in which the home and foreign firm produce differentiated products and compete in prices å la Bertrand. They refer to their model as "Reciprocal dumping with Bertrand

[22] The authors assume segmented markets. According to the authors, the markets are defined as segmented when each firm perceives each country as a separate market and makes a distinct quantity decision for each (Brander and Krugman (1983) pp. 314).

competition". The authors' assumptions include: segmented markets, constant marginal cost of production and per-unit transportation cost. In autarky, each firm is a monopoly in its home market. Friberg and Ganslandt compare the welfare from autarky and Bertrand competition at different levels of transportation cost. The authors summarize their results: "The welfare is a U-shaped function in the transportation cost as long as trade occurs in equilibrium." Interestingly, Friberg and Ganslandt show that the U-shaped welfare function also implies that, with a Cournot duopoly, the minimum welfare level with trade is lower than in autarky, for any degree of product differentiation.[23] The authors' findings from Bertrand competition also suggest that if products are sufficiently close substitutes, and the autarky equilibrium is sufficiently competitive, then the welfare in autarky is higher than the lowest welfare with trade.

Dixit (1988) uses a conjectural variations model of an oligopoly of the home and foreign firms selling in the home market to study the home country's optimal response to a foreign government's subsidization and foreign firm's dumping. Dixit considers two models: first with linear demand and imperfectly substitutable products, and second with nonlinear demand and homogeneous products.

The results from the first model suggest that the home government's best response to an increase in foreign government's subsidy is to increase the optimal tariff but by a smaller amount than the change in subsidy (also known as partial countervailing duty) and to decrease the optimal subsidy to the home firms. Furthermore, the better substitutes the home and foreign goods are the larger the response is. Also, the home government's optimal tariff is smaller when foreign firms are more competitive.

[23] The unit-transported cost plays crucial role for this striking result. For detailed intuition for this result, see p. 7 in Friberg and Ganslandt (2005).

To discuss the optimal trade policy as a response to foreign dumping, Dixit first notes that dumping may arise as a direct result of more competitive conduct by the foreign firms in the home country market. As a result, the price in the home country may fall below the price that foreign firms charge in their market or their average cost of production. Dixit (1988) shows that imperfectly substitutable products and linear demand function, together with more competitive foreign firms, imply lower optimal tariff as well as lower optimal home government's subsidy to domestic firms as a best response to dumping. Dixit concludes: "This oligopoly model provides normative justification for a partial countervailing duty, but not for antidumping duty".

When discussing the model with homogeneous products and nonlinear demand, Dixit notes that because of the homogeneity assumption there might be three optimums: two corner solutions (determined by the home and foreign firms' cost efficiency), and one interior solution. The results suggest that when home firms are more cost efficient than foreign firms in terms of marginal costs, the home country should prohibit all imports and make sure that the home firms set the price of the homogeneous product equal to its marginal cost.[24] Note that such pricing by the home firms will prohibit imports, so the home government does not need to set any prohibitive tariff. On the contrary, if the foreign firms are more cost efficient, the home government should abandon the home market to foreign firms, and use a tariff for extracting some of their profits. Finally, when there is an interior optimum (home production and imports coexist), the results indicate that more aggressive behavior by the foreign firms results in dumping which increases foreign firms' share in the home market. In this case, the home government's optimal policy response to dumping should be a lower tariff. The author concludes that the interior solution does not provide any justification for an antidumping duty.

[24] This assumes that the home firms' marginal cost is less than foreign firms' marginal cost which also includes foreign government subsidies.

2.2.2 Studies on the CDSOA

Studies found in the current literature on the CDSOA generally discuss the economic effects of the CDSOA for a specific market. Based on the assumption of international Cournot duopoly, Ogawa and Ono (2006) examine the effect of the CDSOA on home and foreign firms' outputs and profits. The authors study two alternative cases – one with a predetermined tariff rate and the other with a tariff rate which is optimally chosen by the government following the tariff revenue distribution rate. They find that the imposition of a predetermined ad valorem tariff on foreign imports reduces home firms' output and increases foreign firms' output, hence increasing the total amount of tariff revenue. Although the home firm reduces its output, it still enjoys higher profits compared to its pre-CDSOA profits. This is due to the distribution of tariff revenues by the domestic government. Results show that both home and foreign firms' profits are the largest when all the tariff revenue is distributed to the home firm. As a result of the CDSOA, the total supply in the home market decreases which increases price and lowers consumer surplus. Whether the home country social welfare will increase or decrease depends on the market size and the two firms' marginal costs.[25] The findings by Ogawa and Ono (2006) suggest that the CDSOA with a predetermined tariff increases total surplus in the home country if the market size is sufficiently small, or if a foreign firm's marginal cost is much lower than its domestic competitor's.

Similar to the case with a predetermined tariff, when the tariff rate is optimally chosen, Ogawa and Ono find that an increase in the tariff rate still increases the foreign firm's output and profit if the foreign firm is more efficient than the home firm. This is because an inefficient home firm prefers to receive larger reimbursements from its government, hence enjoying a

[25] Authors define the home total surplus as the sum of the home firm's profit, the tariff revenue for the government, and consumer's surplus. In calculating the home total surplus, Ogawa and Ono place equal weights on each of these three components.

higher profit, via reducing its production and allowing the foreign firm to increase its market share. Again, similar to the case with a predetermined tariff, both firms benefit from the CDSOA while domestic consumers lose. The results of Ogawa and Ono again suggest that if a foreign firm is more efficient than the home firm then the increase in a firm's profit dominates the decrease in consumer surplus and the CDSOA results in an increase in a home's social welfare. Ogawa and Ono conclude that the CDSOA is justified as both home country and foreign firm benefit when inefficient domestic firm competes with its efficient foreign rival. However, when the difference in marginal costs between the home and foreign firms is relatively small, the home country social welfare and foreign firm's profit decline, while the home firm benefits from the CDSOA and, hence, the CDSOA is not justified.

Collie and Vandenbussche (2004) is another interesting study in which a Cournot oligopoly framework is used to study the case when the home country passes the CDSOA. In their analysis the home government's objective is assumed to choose an optimal tariff that maximizes the home country welfare. Unlike Ogawa and Ono's which assigns equal weights to consumer and producers surpluses, Collie and Vandenbussche attach a larger weight on producers surplus relative to that of consumers'. The results show that with the CDSOA, if the home government places a larger weight on the domestic profits in the social welfare function, it will choose to set a lower tariff, with the consequence that domestic welfare will be higher compared to that in the absence of the CDSOA. The necessary condition for this result is that the market share of the domestic industry must exceed 50 percent. Collie and Vandenbussche conclude that because in the U.S. domestic firms subject to antidumping tariffs have significantly larger market share than their foreign competitors, the CDSOA is an additional tool to improve domestic social welfare. According to the authors, this is one of the reasons why the U.S. is reluctant to comply with WTO rulings.

One of the most recent works on the CDSOA by Chang and Gayle (2006) examines the economic effects of the CDSOA under imperfect competition. Unlike the previous two studies, the authors compare the particular trade law to the traditional antidumping policy for different degrees of market competitiveness. Chang and Gayle find that with a specific tariff the CDSOA may have different effects on domestic production, imports, and market price depending on the degree of market competitiveness and the inefficiency gap between home and foreign firms.[26] Assuming that the number of home firms and the inefficiency gap are not small the authors state: "the CDSOA may increase foreign imports when the domestic market is more competitive than the Cournot competition. This finding runs contrary to what the E.U. and some exporting countries have claimed. But when the market is less competitive than in the Cournot equilibrium, the CDSOA becomes an effective instrument for further restricting imports."[27]

Olson (2004), Olson and Liebman (2006), and Gayle and Puttitanum (2008) empirically test the effects of the Byrd Amendment. Although these studies do not discuss optimal tariff or welfare effects of the Amendment, their contributions lie in their interesting findings concerning the effects of this law on the home and foreign firms' conduct. Olson (2004) tests whether the number of firms filing antidumping petitions has increased as a result of the CDSOA. Using data on 447 four-digit SIC87 and 365 six-digit NAICS97 manufacturing industries from 1979 to 1997 and from 1997 to 2002 respectively, and the number of petitions filed between 1995 and 2003, Olson reports a significant, 34.9 percent increase in the number of antidumping petitions

[26] An inefficiency gap is the difference between marginal costs between home and foreign firms. A higher inefficiency gap means home firms' marginal cost is significantly higher than its foreign competitors'.
[27] For a more detailed analysis, see the analysis on p. 531 in Chang and Gale (2006).

filed by the industries during 2001 to 2003.[28] However, there is no statistically significant evidence that more firms within industries have chosen to file petitions since the passage of the Byrd Amendment. One possible explanation of the latter result is that the law allows domestic firms to receive benefits not only when filing for petitions, but also indicating strong support for the petition. The author concludes that the Amendment does not completely eliminate the incentive to free-ride.

Olson and Liebman (2006) investigate the relationship between campaign contributions and disbursements received by domestic firms due to the CDSOA. Interestingly, their results show that campaign contributions by the ultimate recipients of the antidumping duty revenues have significantly influenced support for the Byrd Amendment. Marginal effects calculated by the authors suggest that the likelihood that a member of Congress will vote for the Byrd Amendment increases by 0.43 percent for each additional thousand dollars spent in contributions.[29] Olson and Liebman also find a positive and statistically significant correlation between campaign contributions from 1998 to 2000 and the disbursements received by these contributors. Specifically, every million dollar increase in disbursements resulted in a very small average increase in political contributions of 194 dollar.

To our knowledge Gayle and Puttitanum (2008) is the latest empirical work on the CDSOA. The study uses a panel of 362 U.S. manufacturing industries over the period 1998 to 2003, and employs a difference-in-difference econometric approach to examine the effect of the CDSOA on U.S. imports in the industries that filed petitions under the Byrd Amendment. The results suggest that industries in which market competition is relatively low the CDSOA has in

[28] For further details on data, a complete list of the variables included in the model, and econometric specification, see pp. 5-9 in Olson (2004).

[29] Olson and Liebman (2006) present a detailed calculation of marginal effects (see the footnote on p. 1355).

fact reduced U.S. imports.[30] These results confirm Chang and Gayle's (2006) theoretical findings that the CDSOA is an effective instrument for trade protectionism in less competitive markets.

2.3 The Model

To examine welfare effects of the Continued Dumping and Subsidy Offset Act, we employ the Brander-Krugman (1983) framework of reciprocal dumping. Brander and Krugman indicate that reciprocal dumping (each firm dumps into its competitor's home market) is a natural outcome of oligopolistic competition. The generality of this finding has been shown by Murray and Turdaliev (1999) for the case with multiple firms in multiple countries and is considered as "universal dumping" (firms export at dumped price).[31]

Within the intra-industry trade framework of dumping, it is interesting to analyze the situations under which one nation adopts a trade law similar to that of the CDSOA implemented by the U.S while the other nation continues to follow a traditional antidumping policy. In what follows, we incorporate the CDSOA into a reciprocal dumping model to evaluate various effects on productions, market prices, and social welfares.

For analytical simplicity, we consider the case of competition between two countries ("home" as country 1 and "foreign" as country 2). Each country has one producing-exporting firm, selling in each others' markets. The home firm in country 1 produces output x_1 for its own market and output x_2 for export to the market in country 2. Likewise, the foreign firm produces

[30] The authors use four-firm industry concentration ratio as a measure of market competitiveness. The concentration threshold above which the CDSOA is found to reduce U.S. imports is reported 28.78 per cent.

[31] In our analysis, we assume a homogenous good, identical demands, identical constant marginal costs, and imperfectly competitive markets in each country. These assumptions can also be found in Murray and Turdaliev (1999, pp. 581).

output y_2 for its own market and exports output y_1 to the market in country 1. Following Brander (1981), we use linear (inverse) demand functions for the two firms. Hence, in the domestic and foreign markets we have:

$$p_h = \alpha - (x_1 + y_1) \text{ and } p_f = \alpha - (x_2 + y_2),$$

where $\alpha > 0$. That is, total consumption in country $i(i = 1, 2)$ is $D_i = x_i + y_i$. The home firm's total production is $X = x_1 + x_2$, and the foreign firm's total production is $Y = y_1 + y_2$. For analytical simplicity, we assume that marginal costs of production are zero, and firm i's transportation cost of exports is $k_i (> 0)$, which may include a per unit export subsidy from its government.[32] We assume that both firms determine their outputs for the home and foreign markets in a simultaneous quantity-setting game. As in Dixit (1988), we allow both markets' competitiveness to vary from perfectly competitive to collusive equilibrium.

The home country government imposes an optimal tariff on each unit of the good exported by the foreign firm. To follow suit, the foreign country government imposes an optimal tariff on each unit of the good exported by the home firm. The timing of the game is as follows. In the first stage, two governments simultaneously determine their optimal tariffs that maximize the social welfares of their respective countries. In the second stage, the home and foreign firms take the tariffs as given and compete in the two markets by simultaneously deciding on their outputs that maximize their own profits. In the first stage of the two-stage game, we consider two alternative scenarios in terms of trade policies. The first scenario is the traditional antidumping policy under which anti-dumping or countervailing duties are revenues to each

[32] Although it is possible to have a negative transportation cost due to a large subsidy provided by a country to its exporting firm, we assume that the per-unit subsidy is not large enough to make the transportation cost negative. Also, the standard assumption that $\alpha > k_i$ implies.

country's treasury. The second scenario is of the CDSOA in which the home country's government re-distributes its anti-dumping or countervailing duties to its domestic firm alleging harm from dumping, while the foreign government retains revenues in its own market.

We use backward induction to determine the sub-game perfect Nash equilibrium of the two-stage game for the alternative trade regimes. Under the traditional antidumping policy, the home and foreign firms in the second stage of the game simultaneously solve the following problems:

$$\underset{\{x_1,x_2\}}{Max}\,\hat{\pi}^h = p_h x_1 + (p_f - k_1 - \hat{t}_f)x_2\,, \tag{1}$$

$$\underset{\{y_1,y_2\}}{Max}\,\hat{\pi}^f = (p_h - k_2 - \hat{t}_h)y_1 + p_f y_2\,, \tag{2}$$

where $\hat{\pi}^h$ and $\hat{\pi}^f$ are profits of the home and foreign firms, and $\hat{t}_h$ and $\hat{t}_f$ are specific tariffs imposed by their respective governments.

Under the scenario in which the home country implements the CDSOA-type trade law, the home and foreign firms in the second stage of the game simultaneously solve the following problems:

$$\underset{\{x_1,x_2\}}{Max}\quad \tilde{\pi}^h = p_h x_1 + (p_f - k_1 - \tilde{t}_f)x_2 + \tilde{t}_h y_1\,, \tag{3}$$

$$\underset{\{y_1,y_2\}}{Max}\quad \tilde{\pi}^f = p_f y_2 + (p_h - k_2 - \tilde{t}_h)y_1\,, \tag{4}$$

where $\tilde{\pi}^h$ and $\tilde{\pi}^f$ are profits of the home and foreign firms, $\tilde{t}_h$ and $\tilde{t}_f$ are specific tariffs imposed by their respective governments.

From the market demands in (1) and the profit functions in (3) and (4), it follows that the first order conditions (FOCs) for the home firm are given respectively as:

$$\frac{\partial \tilde{\pi}^h}{\partial x_1} = [\alpha - (x_1 + y_1)] - x_1(1 + \frac{\partial y_1}{\partial x_1}) + \tilde{t}_h(\frac{\partial y_1}{\partial x_1}) = 0\,, \tag{5}$$

$$\frac{\partial \tilde{\pi}^h}{\partial x_2} = [\alpha - (x_2 + y_2) - k_1 - \tilde{t}_f] - x_2(1 + \frac{\partial y_2}{\partial x_2}) = 0\,, \tag{6}$$

where $\partial y_i / \partial x_i$ for $i = 1, 2$ are conjectural variations showing the amount by which the home firm believes the foreign firm will respond to a unit increase in its outputs in the domestic and foreign markets. Similarly, the FOCs for the foreign firm are:

$$\frac{\partial \tilde{\pi}^f}{\partial y_2} = [\alpha - (x_2 + y_2)] - y_2(1 + \frac{\partial x_2}{\partial y_2}) = 0\,, \tag{7}$$

$$\frac{\partial \tilde{\pi}^f}{\partial y_1} = [\alpha - (x_1 + y_1) - k_2 - \tilde{t}_h] - y_1(1 + \frac{\partial x_1}{\partial y_1}) = 0\,, \tag{8}$$

where $\partial x_i / \partial y_i$ for $i = 1, 2$ are conjectural variations showing the amount by which the foreign firm believes the home firm will respond to a unit increase in its output in the markets. Following Dixit (1988), we assume that $\partial y_i / \partial x_j = \partial x_i / \partial y_j = \lambda$ (for $i = 1, 2$, $j = 1, 2$, $i \neq j$) and that the value of λ can be used to capture the degree of competitiveness in the home and foreign markets. It is easy to verify that both markets are characterized by Cournot competition when $\lambda = 0$. When $-1 < \lambda < 0$, the markets are more competitive than Cournot; when $0 < \lambda < 1$, the markets are less competitive than Cournot.

We use equations (5) and (8) to solve for the equilibrium outputs x_1 and y_1 for the home market, and equations (6) and (7) to solve for the equilibrium outputs x_2 and y_2 for the foreign market under the CDSOA regime. That is,

$$\tilde{x}_1 = \frac{\alpha + k_2 + t_h + \alpha\lambda + \lambda^2 t_h + 2\lambda t_h}{(\lambda + 1)(\lambda + 3)}\,, \tag{9}$$

$$\tilde{x}_2 = \frac{\alpha(1+\lambda)-(2+\lambda)(t_f+k_1)}{(\lambda+1)(\lambda+3)}, \tag{10}$$

$$\tilde{y}_1 = \frac{(\alpha-2t_h)(\lambda+1)-k_2(2+\lambda)}{(\lambda+1)(\lambda+3)}, \tag{11}$$

$$\tilde{y}_2 = \frac{k_1+\alpha+\alpha\lambda+t_f}{(\lambda+1)(\lambda+3)}. \tag{12}$$

To allow for positive quantities of exports by the home and foreign firms ($\tilde{x}_2 > 0$ and $\tilde{y}_1 > 0$), we assume that market size in each country is sufficiently large.[33] Total consumptions and product prices in the home and foreign countries under the CDSOA regime are:

$$\tilde{D}_h = \tilde{x}_1 + \tilde{y}_1 = \frac{2\alpha - k_2 - t_h + \lambda t_h}{\lambda+3}, \tag{13}$$

$$\tilde{p}_h = \alpha - \tilde{D}_h = \frac{\alpha(\lambda+1)+k_2+(1-\lambda)t_h}{\lambda+3}, \tag{14}$$

$$\tilde{D}_f = \tilde{x}_2 + \tilde{y}_2 = \frac{2\alpha - k_1 - t_f}{\lambda+3}, \tag{15}$$

$$\tilde{p}_f = \alpha - \tilde{D}_f = \frac{\alpha(\lambda+1)+k_1+t_f}{\lambda+3}. \tag{16}$$

We proceed to the first stage of the game in which each country's government determines an optimal tariff rate that maximizes its own national welfare. Under the traditional regime, a country social welfare is taken to be the sum of consumer surplus (S), producer surplus (i.e., profit), and tariff revenue. That is,

[33]To ensure interior solutions, restrictions should be placed on the value of the parameter α which reflects market size. It follows from (10) that for $\tilde{x}_2 > 0$ it requires that $\alpha > \frac{(2+\lambda)(k_1+t_f)}{1+\lambda}$. Also, it follows from (12) that for $\tilde{y}_1 > 0$ it requires that $\alpha > \frac{k_2(2+\lambda)}{(1+\lambda)} + 2t_h$.

$$\hat{W}_h = \hat{S}_h + \hat{\pi}_h + \hat{t}_h \hat{y}_1 \text{ and } \hat{W}_f = \hat{S}_f + \hat{\pi}_f + \hat{t}_f \hat{x}_2, \tag{17}$$

where $\hat{S}_h = \int_0^{D_h} (\alpha - X)dX - p_h D_h = \frac{1}{2}(\hat{x}_1 + \hat{y}_1)^2$ and $\hat{S}_f = \int_0^{D_f} (\alpha - X)dX - p_f D_f = \frac{1}{2}(\hat{x}_2 + \hat{y}_2)^2$.

Under the CDSOA trade regime, the home country social welfare is the sum of consumer surplus and producer surplus, while the foreign country social welfare is still given as in (17). That is,

$$\tilde{W}_h = \tilde{S}_h + \tilde{\pi}_h \text{ and } \tilde{W}_f = \tilde{S}_f + \tilde{\pi}_f + \tilde{t}_f \tilde{x}_2, \tag{18}$$

where $\tilde{S}_h = \int_0^{D_h} (\alpha - X)dX - p_h D_h = \frac{1}{2}(\tilde{x}_1 + \tilde{y}_1)^2$ and $\tilde{S}_f = \int_0^{D_f} (\alpha - X)dX - p_f D_f = \frac{1}{2}(\tilde{x}_2 + \tilde{y}_2)^2$.

To find the optimal tariffs for the alternative trade regimes in the first stage of the game, the home government solves the following two problems:

$$\underset{\{t_h\}}{Max}\ \hat{W}_h \text{ and } \underset{\{t_h\}}{Max}\ \tilde{W}_h,$$

and the foreign government solves:

$$\underset{\{t_f\}}{Max}\ \hat{W}_f \text{ and } \underset{\{t_f\}}{Max}\ \tilde{W}_f.$$

The optimal tariffs set by the governments under the traditional antidumping policy are:[34]

$$\hat{t}_h = \frac{(\lambda+1)(\alpha - k_2)}{2\lambda+3} \text{ and } \hat{t}_f = \frac{(\lambda+1)(\alpha - k_1)}{2\lambda+3}. \tag{19}$$

While the home country CDSOA does not affect the optimal tariff ($\tilde{t}_f = \hat{t}_f$) set by the foreign government, the home government's optimal tariff under the CDSOA regime becomes:

[34] See A-1 in the Appendix for detailed derivations of the optimal tariffs under the traditional antidumping policy.

$$\tilde{t}_h = \frac{\alpha(\lambda+1) - k_2}{\lambda+3}. \tag{20}$$

It follows that the differences between the optimal tariffs under the alternative trade regimes in the home country is:

$$\tilde{t}_h - \hat{t}_h = \frac{\lambda[\alpha(\lambda+1) + k_2(2+\lambda)]}{2\lambda^2 + 9\lambda + 9}. \tag{21}$$

2.4 Effects of the CDSOA on Tariffs, Prices and Social Welfares

2.4.1 Effects on the Optimal Tariffs

Equations (19)-(21) can be used to discuss how the CDSOA affects the home country's optimal tariffs for the two alternative trade policies. First look at the optimal tariffs under the traditional antidumping regime (see (19)).

The home and the foreign governments' optimal choices under the traditional antidumping regime are to set positive tariffs regardless of market competitiveness. That is, $\hat{t}_h > 0$ and $\hat{t}_f > 0$ regardless the values of λ. Furthermore, the optimal tariffs set by the two governments increase

(i) with a decrease in market competitiveness $\left(\frac{\partial \hat{t}_h}{\partial \lambda} > 0, \frac{\partial \hat{t}_f}{\partial \lambda} = \frac{\partial \tilde{t}_f}{\partial \lambda} > 0, \frac{\partial \tilde{t}_h}{\partial \lambda} > 0 \right)$,

(ii) with an increase in the market size $\left(\frac{\partial \hat{t}_h}{\partial \alpha} > 0, \frac{\partial \hat{t}_f}{\partial \lambda} = \frac{\partial \tilde{t}_f}{\partial \lambda} > 0, \frac{\partial \tilde{t}_h}{\partial \alpha} > 0 \right)$,

(iii) with a decrease in transportation costs $\left(\frac{\partial \hat{t}_h}{\partial k_2} < 0, \frac{\partial \hat{t}_f}{\partial \lambda} = \frac{\partial \tilde{t}_f}{\partial \lambda} < 0, \frac{\partial \tilde{t}_h}{\partial k_1} < 0\right)$, *ceteris paribus*.[35]

Whether the implementation of the CDSOA increases or decreases the home country's optimal tariff depends on the degree of market competitiveness. When the home market is less competitive than in the Cournot equilibrium $(\lambda > 0)$, the tariff optimally chosen by the home government under the CDSOA regime is strictly positive ($\tilde{t}_h > 0$) and higher than the optimal tariff under the traditional antidumping policy ($\tilde{t}_h > \hat{t}_h$).[36]

When the home market is characterized by Cournot competition $(\lambda = 0)$, we have $\tilde{t}_h = \hat{t}_h > 0$. In this case, the optimal tariffs set by the home government are identical, irrespective of which trade policy is adopted. It can easily be shown that when the home market is more competitive than Cournot ($\lambda < 0$), the home country's optimal tariff under the CDSOA regime remains to be strictly positive.[37] However, when markets are more competitive than Cournot the optimal tariff under the CDSOA regime is always *lower* than that under the traditional antidumping trade regime, regardless the market size and transportation cost. Our results indicate that the degree of market competitiveness in the home market is a decisive factor in

[35] A decrease in home/foreign firm's transportation costs can be also looked as an increase in home/foreign government subsidy, to which foreign/home government responds by increasing optimal antidumping tariff.

[36] Since both the denominator and the numerator in (21) are always positive, the values of λ determine the sign of the difference between the optimal tariffs.

[37] Note from (20) that the necessary condition for a positive optimal tariff under the CDSOA regime requires that $\alpha > \frac{k_2}{1+\lambda}$. As shown earlier, the model's general restriction on the market size to guarantee a positive amount of the foreign firm's export (y_1) is $\alpha > \frac{k_2(2+\lambda)}{1+\lambda} + 2t_h$. Substituting the home country's optimal tariff from (20) into this general restriction on market size, after simplifying, yields the following restriction on market size: $\alpha > \frac{k_2(4+3\lambda+\lambda^2)}{1-\lambda^2}$. Since $\frac{k_2(4+3\lambda+\lambda^2)}{1-\lambda^2} > \frac{k_2}{1+\lambda}$, the necessary condition for a positive optimal tariff is always satisfied.

determining whether the optimal tariff increases or decreases with the implementation of the CDSOA.

2.4.2 Effects on the Market Prices

Next, we look at how the CDSOA affects market price in the home country.[38] Market price under the CDSOA regime is given by (14), and that under the traditional antidumping policy is given by

$$\hat{p}_h = \frac{k_2 + \alpha(\lambda + 1) + \hat{t}_h}{\lambda + 3}. \tag{23}$$

It follows from (14) and (23) that difference in market prices between the two trade regimes is:

$$\tilde{p}_h - \hat{p}_h = \frac{\left(\tilde{t}_h - \hat{t}_h\right) - \tilde{t}_h \lambda}{\lambda + 3}, \tag{24}$$

where the differences in tariffs, $(\tilde{t}_h - \hat{t}_h)$, is given in (21). Equation (24) indicates that the effect of CDSOA on the home market price depends crucially on (i) the difference between the optimal tariffs under two regimes, and (ii) the product of market competitiveness and the size of optimal tariff under the CDSOA. Substituting the optimal values of tariffs from (19) and (20) into (24), and solving for the price difference under the two alternative trade regimes yields:

$$\tilde{p}_h - \hat{p}_h = \frac{\lambda\left[k_2(5 + 3\lambda) - 2\alpha(1 + 2\lambda + \lambda^2)\right]}{(\lambda + 3)(2\lambda^2 + 9\lambda + 9)}. \tag{25}$$

Equation (25) can be used to derive the conditions in which the home market price under the CDSOA regime is higher or lower than that under the traditional antidumping policy.

[38] Since the CDSOA implemented by the home country does not affect the foreign county's market, the law does not affect product price in the foreign market. For this reason, we focus our discussions only on the home country market.

Because the denominator of the equation is positive, price difference is determined by the sign of the numerator. First, note that with the restriction on home market size (i.e. the lowest possible value for α) the bracket term in the numerator is negative when the home market is less competitive than Cournot.[39] In this case, the CDSOA regime strictly causes the home price to decrease.

The CDSOA's effect on the home market price is rather complicated when the home market is more competitive than Cournot. Defining $Z \equiv \frac{k_2(5+3\lambda)}{2(1+2\lambda+\lambda^2)}$, we have (i) $\tilde{p}_h < \hat{p}_h$ if $\alpha < Z$ and $\lambda < 0$; (ii) $\tilde{p}_h > \hat{p}_h$ if $\alpha > Z$ and $\lambda < 0$. Cases (i) and (ii) imply that when the home market is more competitive than Cournot the CDSOA regime causes the home price to decrease (increase) if the market size is fairly small (large). Furthermore, since the derivative of Z with respect to λ is negative, case (ii) implies that even a relatively smaller market size (α) is sufficient to ensure that the CDSOA regime has a higher market price than the traditional antidumping policy.[40] The above analysis leads us to establish the following preposition:

Proposition 1:

(i) When the home market is less competitive than Cournot, the optimal tariff set by the home government is higher under the CDSOA regime than under the traditional antidumping regime. The CDSOA strictly reduces product price in the home market.

[39] With the restriction on home market size the term in the bracket in numerator becomes: $\left[k_2\left(5+3\lambda\right)-2\frac{k_2\left(4+3\lambda+\lambda^2\right)}{1-\lambda^2}(1+2\lambda+\lambda^2)\right]=-\frac{k_2}{1-\lambda}\left(2\lambda^3+11\lambda^2+16\lambda+3\right)$, which is negative when $\lambda > 0$.

[40] The derivative of Z with respect to λ is: $\frac{\partial Z}{\partial \lambda}=-\frac{k_2(7+3\lambda)}{2(1+\lambda)^3}<0$.

(ii) When the home market is more competitive than Cournot, the optimal tariff set by the home government is lower under the CDSOA regime than under the traditional antidumping regime. The effect of the CDSOA on domestic price cannot be determined unambiguously, and depends on the degree of market competitiveness, the home market size, and transportation cost.

Two special cases are when there is a Cournot equilibrium $(\lambda = 0)$ and when $\alpha = Z$. In both cases the home country's optimal tariff remains the same, regardless of whether or not the home government adopts the CDSOA trade law.

Table 1 summarizes the effects on the home market price under different conditions discussed above.

Table 2.1 The Effects of Market Competitiveness and Size on the Market Price

Domestic Market Size (α)	Market is less competitive than in Cournot $(\lambda > 0)$	Cournot competition $(\lambda = 0)$	Market is more competitive than Cournot $(\lambda < 0)$
Large	$\tilde{p}_h < \hat{p}_h$	$\tilde{p}_h = \hat{p}_h$	$\tilde{p}_h > \hat{p}_h$
Small	$\tilde{p}_h < \hat{p}_h$	$\tilde{p}_h = \hat{p}_h$	$\tilde{p}_h < \hat{p}_h$
$\alpha = \frac{k_2(5+3\lambda)}{2(1+2\lambda+\lambda^2)}$	$\tilde{p}_h = \hat{p}_h$	$\tilde{p}_h = \hat{p}_h$	$\tilde{p}_h = \hat{p}_h$

2.4.3 Effects on Domestic Consumers and on Social Welfares in Both Countries

Table 1 indicates that when the home market is less competitive than Cournot, the switch in trade regime from the traditional antidumping policy to the CDSOA makes domestic consumers better off. The economic reasons are presented as follows. When markets are less competitive than Cournot, the CDSOA increases the home government's tariff which lowers the quantity of exports by foreign firm and raises the quantity of output by the home firm for the domestic market. However, the increased output by the home firm dominates the decreased exports by the foreign firm. Consequently, relative to the equilibrium outcome under the traditional antidumping policy, the CDSOA leads to a net increase in total consumption in the home market.[41]

The opposite is true when the home market is more competitive than in Cournot competition. In this case, the CDSOA causes the home firm to decrease its output for its domestic market and the foreign firm to increase its exports to the market. The decreased output by the home firm dominates the increased exports by the foreign firm when the home market size is large.

These results suggest that the CDSOA is an instrument of trade protectionism when the domestic market is less competitive than Cournot. The new trade law also raises consumer welfare when (i) the home market is less competitive or (ii) when the market size is small but is more competitive than Cournot.

Next, we discuss welfare effects of the CDSOA, using the level of welfare under the traditional antidumping policy as a reference base. The home country social welfare under the CDSOA trade regime is given by (18) and is measured as the sum of its consumer's surplus and home firm's profit. Given that consumer surplus for a linear demand is

$$\tilde{S}_h = \frac{1}{2}(\tilde{x}_1 + \tilde{y}_1)^2, \tag{26}$$

[41] See Appendix A-3 for detailed derivations of changes in each firm's outputs and the total consumption in the home country.

we first substitute the home country's optimal tariff from (20) into (9) and (11) and then substituting the resulting (9) and (11) into (26) to obtain

$$\tilde{S}_h = \frac{\left(5\alpha - 2k_2 + 2\alpha\lambda - 2\lambda k_2 + \alpha\lambda^2\right)^2}{2(\lambda+3)^4}. \tag{27}$$

For determining the home firm's profit under the CDSOA regime, we first substitute the home country's optimal tariff from (20) into (9), (11) and (14) and the foreign country's optimal tariff from (19) into (10) and (16). We then substitute the resulting results from (9), (11), (14), (10), (16) and (20) into the profit function in (3) to obtain

$$\begin{aligned}\tilde{\pi}_h = {} & \frac{2(2\alpha + k_2)\left(4\alpha + 2k_2 + 7\alpha\lambda - \lambda k_2 + 4\alpha\lambda^2 + \alpha\lambda^3 - \lambda^2 k_2\right)}{(\lambda+3)^4} + \frac{\left(\alpha - 4k_1 + 2\alpha\lambda - 4\lambda k_1 + \alpha\lambda^2 - \lambda^2 k_1\right)^2}{(\lambda+1)\left(2\lambda^2 + 9\lambda + 9\right)^2} \\ & + \frac{(\alpha - k_2 + \alpha\lambda)\left(\alpha - 4k_2 - 3\lambda k_2 - \alpha\lambda^2 - \lambda^2 k_2\right)}{(\lambda+1)(\lambda+3)^3}.\end{aligned} \tag{28}$$

The home country social welfare under the CDSOA regime is then the sum of (27) and (28). That is,

$$\begin{aligned}\tilde{W}_h = {} & \left(\frac{\left(5\alpha - 2k_2 + 2\alpha\lambda - 2\lambda k_2 + \alpha\lambda^2\right)^2}{2(\lambda+3)^4}\right) + \left(\frac{2(2\alpha + k_2)\left(4\alpha + 2k_2 + 7\alpha\lambda - \lambda k_2 + 4\alpha\lambda^2 + \alpha\lambda^3 - \lambda^2 k_2\right)}{(\lambda+3)^4}\right. \\ & \left. + \frac{\left(\alpha - 4k_1 + 2\alpha\lambda - 4\lambda k_1 + \alpha\lambda^2 - \lambda^2 k_1\right)^2}{(\lambda+1)\left(2\lambda^2 + 9\lambda + 9\right)^2} + \frac{(\alpha - k_2 + \alpha\lambda)\left(\alpha - 4k_2 - 3\lambda k_2 - \alpha\lambda^2 - \lambda^2 k_2\right)}{(\lambda+1)(\lambda+3)^3}\right).\end{aligned} \tag{29}$$

The effect of the CDSOA trade law on the home country welfare can be discussed by calculating welfare difference between the two alternative trade regimes as follows:[42]

$$\tilde{W}_h - \hat{W}_h = \frac{\lambda\left(2\alpha^2\lambda^2 + 6\alpha^2\lambda + 4\alpha^2 - 2\alpha\lambda k_2 - 2\alpha k_2 - \lambda k_2^2 - 2k_2^2\right)}{2(\lambda+3)^2(2\lambda+3)}. \tag{30}$$

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[42] See A-4 in the Appendix for detailed derivations of the home and foreign countries' social welfares under the traditional antidumping policy.

When the home market is characterized by Cournot competition, the CDSOA regime does not affect production and market prices. As a result, domestic welfare under the two alternative trade regimes is fundamentally equivalent ($\tilde{W}_h - \hat{W}_h = 0$ when $\lambda = 0$). The effect that the CDSOA has on social welfare depends on the degree of home market competitiveness. The CDSOA regime has a positive effect on domestic welfare when the home market is less competitive than Cournot.[43] Interestingly, with a decrease in market competitiveness and an increase in the home market size, the gain in domestic welfare from the CDSOA regime becomes larger. These results explain why it may not well be in the interest to the U.S. government to voluntarily repeal the Byrd Amendment.

Nevertheless, the CDSOA's effect on the home country welfare when its market is more competitive than Cournot cannot be determined unambiguously, depending on model's parameters.

Finally, we discuss the CDSOA's effect on the foreign country welfare (see (a.33) in the Appendix). Since the CDSOA does not affect the foreign country's market, it does not affect consumer surplus and the foreign government's revenue from their traditional antidumping policy levels.[44] However, the CDSOA affects the foreign firm's profit through its effect on home country's optimal tariff and price levels (see Proposition 1**)**. As explained earlier, the CDSOA strictly reduces both the foreign firm's exports and the home country's price when the domestic market is less competitive than the Cournot equilibrium. The CDSOA thus strictly reduces foreign welfare under the assumption of less competitive market than Cournot. Because

[43] To verify this first note that the denominator in (30) is strictly positive, and rewrite the term in the bracket in numerator as follows: $\left(2\alpha^2\lambda^2\right)+\left(\alpha^2\lambda-\lambda k_2^2\right)+\left(5\alpha^2\lambda-2\alpha\lambda k_2\right)+\left(2\alpha^2-2\alpha k_2\right)+\left(2\alpha^2-2k_2^2\right)$. Since each of these five terms in the brackets is positive for $\lambda > 0$, the denominator in (30) is positive when home market is less competitive than Cournot equilibrium.

[44] The foreign country's consumer surplus and government revenue under the traditional antidumping regime are the first and the last terms respectively in (a.33) as shown in A-5 in the Appendix.

the CDSOA's effect on the domestic price depends on (i) transportation costs, (ii) the home country's market size, and (iii) the degree of market competitiveness, how the new trade law would affect foreign welfare turns out to be unambiguous when the home market is more competitive than Cournot.

2.5 Concluding Remarks

Using s stylized reciprocal-dumping framework, we present a model that examines the optimal tariffs, prices, and welfare effects of the Byrd Amendment which requires the home country's government redistribute its all anti-dumping or countervailing duties to a domestic firm filing petition. We compare tariffs set by the governments of the two trading nations under the new trade law, with tariffs under the traditional anti-dumping policies when these duties are government revenues. We show that tariffs under both regimes are strictly positive. The optimal tariffs under both regimes are equivalent under the Cournot competition, but the home country's optimal tariff under the CDSOA regime is *higher* than its tariff under the traditional antidumping policy when the home market is less competitive than Cournot. When home and foreign markets are more competitive than Cournot, the home government's optimal tariff is lower under the CDSOA regime than under the traditional antidumping policy. These results hold regardless of market size and transportation cost. Since the model separates the home and the foreign markets, the CDSOA introduced by the home country does not affect the foreign government's tariff which is optimally chosen under traditional antidumping trade regime.

We found that the CDSOA strictly reduces market price of an import-competing good when the home country market is less competitive that Cournot. The effect of the CDSOA on the home price is ambiguous when market is more competitive than Cournot. The necessary conditions for price to be higher under the CDSOA are: *i)* large market size, and *ii)* more competitive than Cournot markets.

We show the condition under which the CDSOA is an instrument for trade protectionism (strictly reduces foreign firm's exports) and improves welfare in the CDSOA-implementing country. Our results indicate that under the same condition the CDSOA unambiguously reduces the foreign country welfare.

We find that when the home market of an import-competing good is less competitive than Cournot, it may not well be in the interest to the U.S. government to voluntarily repeal the Byrd Amendment. The reason is that the CDSOA lowers market price and hence makes domestic consumers better off when the home market is less competitive than Cournot. These results are consistent with theoretical predictions in Chang and Gayle (2006) and empirical results in Gayle and Puttitanun (2008). Moreover, we find that when markets are less competitive than Cournot, home firm increases its production and may still receive higher profits due to the CDSOA. Importantly, the gain in domestic welfare increases with the market size. The CDSOA thus could trigger domestic firms to engage in "lobbying" for the CDSOA offset payments,[45] especially when the payments are directly linked to the volume of foreign imports. This topic is beyond the scope of this essay and is potentially important and interesting for future research.

[45] Olson (2004) documents that U.S. firms have chosen to lobby for more tariff protection or filed more anti-dumping petitions since the passage of the CDSOA. Olson and Liebman (2005) indicate that despite WTO condemnation of the CDSOA, U.S. firms continue to benefit from the CDSOA offset payments and enjoy the favorable market conditions resulting from the anti-dumping protection.

Appendix A - Appendix to Essay 2

A-1. Derivations of Optimal Variables under the Traditional Antidumping Policy

The home firm's profit function is

$$\pi^h = x_1 p_h + x_2 (p_f - k_1 - t_f)$$

and that of the foreign firm's is

$$\pi^f = y_2 p_f + y_1 (p_h - k_2 - t_h).$$

The first-order conditions for the firms are given respectively as

$$\frac{\partial \pi^h}{\partial x_1} = [\alpha - (x_1 + y_1)] - x_1 (1 + \frac{\partial y_1}{\partial x_1}) = 0; \tag{a.1}$$

$$\frac{\partial \pi^h}{\partial x_2} = [\alpha - (x_2 + y_2) - k_1 - t_f] - x_2 (1 + \frac{\partial y_2}{\partial x_2}) = 0; \tag{a.2}$$

$$\frac{\partial \pi^f}{\partial y_2} = [\alpha - (x_2 + y_2)] - y_2 (1 + \frac{\partial x_2}{\partial y_2}) = 0; \tag{a.3}$$

$$\frac{\partial \pi^f}{\partial y_1} = [\alpha - (x_1 + y_1) - k_2 - t_h] - y_1 (1 + \frac{\partial x_1}{\partial y_1}) = 0. \tag{a.4}$$

Let $\lambda = \frac{\partial y_1}{\partial x_1} = \frac{\partial x_1}{\partial y_1}$. Solving (a.1) and (a.4) simultaneously for x_1 and y_1 yields

$$\hat{x}_1 = \frac{k_2 + \alpha + \alpha\lambda + t_h}{(\lambda + 1)(\lambda + 3)}, \tag{a.5}$$

$$\hat{y}_1 = \frac{\alpha - 2k_2 - k_2\lambda + \alpha\lambda - (2 + \lambda) t_h}{(\lambda + 1)(\lambda + 3)}, \tag{a.6}$$

$$\hat{D}_h = \hat{x}_1 + \hat{y}_1 = \frac{2\alpha - k_2 - t_h}{\lambda + 3}, \tag{a.7}$$

$$\hat{p}_h = \alpha - \hat{D}_h = \frac{k_2 + \alpha + \alpha\lambda + t_h}{\lambda + 3}. \tag{a.8}$$

Let $\lambda = \frac{\partial y_2}{\partial x_2} = \frac{\partial x_2}{\partial y_2}$. Solving (a.2) and (a.3) simultaneously for y_2 and x_2 yields

$$\hat{y}_2 = \frac{k_1 + \alpha + \alpha\lambda + t_f}{(\lambda+1)(\lambda+3)}, \tag{a.9}$$

$$\hat{x}_2 = \frac{\alpha - 2k_1 - k_1\lambda + \alpha\lambda - (2+\lambda)t_f}{(\lambda+1)(\lambda+3)}, \tag{a.10}$$

$$\hat{D}_f = \hat{x}_2 + \hat{y}_2 = \frac{2\alpha - k_1 - t_f}{\lambda+3}, \tag{a.11}$$

$$\hat{p}_f = \alpha - \hat{D}_f = \frac{k_1 + \alpha + \alpha\lambda + t_f}{\lambda+3}. \tag{a.12}$$

The home country welfare under the traditional antidumping policy is given as

$$\hat{W}_h = CS_h + PS_h + t_h y_1, \tag{a.13}$$

where

$$CS_h = \tfrac{1}{2}(x_1 + y_1)^2; \tag{a.14}$$

$$PS_h = x_1 p_h + x_2\left(p_f - k_1 - t_f\right). \tag{a.15}$$

The derivative of $\hat{W}_h$ with respect to t_h is

$$\frac{\partial \hat{W}_h}{\partial t_h} = \frac{\partial CS_h}{\partial t_h} + \frac{\partial PS}{\partial t_h} + t_h \frac{\partial y_1}{\partial t_h} + y_1.$$

Setting $\frac{\partial \hat{W}_h}{\partial t_h} = 0$ and solving for the optimal tariff set by the home country yields

$$\hat{t}_h = \frac{(\alpha - k_2)(\lambda+1)}{2\lambda+3} > 0. \tag{a.16}$$

Note that

$$\frac{\partial \hat{t}_h}{\partial \lambda} = \frac{(\alpha - k_2)}{(2\lambda+3)^2} > 0.$$

The foreign country welfare under the traditional policy is

$$\hat{W}_f = CS_f + PS_f + t_f x_2, \tag{a.17}$$

where

$$CS_f = \frac{1}{2}(x_2 + y_2)^2; \tag{a.18}$$

$$PS_f = y_2 p_f + y_1\left(p_h - k_2 - t_h \right) . \tag{a.19}$$

The derivative of $\hat{W}_h$ with respect to t_h is

$$\frac{\partial \hat{W}_f}{\partial t_f} = \frac{\partial CS_f}{\partial t_f} + \frac{\partial PS_f}{\partial t_f} + t_f \frac{\partial x_2}{\partial t_f} + x_2 .$$

Setting $\frac{\partial \hat{W}_f}{\partial t_f} = 0$ and solving for the optimal tariff set by the foreign country yields:

$$\hat{t}_f = \frac{(\alpha - k_1)(\lambda + 1)}{2\lambda + 3} > 0 . \tag{a.20}$$

Note that

$$\frac{\partial \hat{t}_f}{\partial \lambda} = \frac{(\alpha - k_1)}{(2\lambda + 3)^2} > 0 .$$

The equilibrium price of the product in the home country is:

$$\hat{p}_h = \frac{(\lambda + 2)(2\alpha + k_2 + 2\alpha\lambda)}{(\lambda + 3)(2\lambda + 3)} . \tag{a.21}$$

And that in the foreign country is:

$$\hat{p}_f = \frac{(\lambda + 2)(2\alpha + k_1 + 2\alpha\lambda)}{(\lambda + 3)(2\lambda + 3)} . \tag{a.22}$$

A-3. Changes in home production, foreign exports, and total consumption in the home country for the two alternative trade regimes:

First, we calculate difference in the quantities of output by the home firm in the home country under the two alternative trade regimes as follows:

$$\tilde{x}_1 - \hat{x}_1 = \frac{\alpha + k_2 + t_h + \alpha\lambda + \lambda^2 t_h + 2\lambda t_h}{(\lambda+1)(\lambda+3)} - \frac{k_2 + \alpha + \alpha\lambda + \hat{t}_h}{(\lambda+1)(\lambda+3)}.$$

Substituting the optimal tariffs from (19) and (20) into the above expression, after arranging terms, yields:

$$\tilde{x}_1 - \hat{x}_1 = \lambda \frac{[7\alpha(1+\lambda) - (2+\lambda)2k_2 + 2\alpha\lambda^2]}{(\lambda+3)^2(2\lambda+3)}. \tag{a.23}$$

Since both the denominator and numerator are always positive, it follows that $\tilde{x}_1 - \hat{x}_1 > 0$ when $\lambda > 0$, and $\tilde{x}_1 - \hat{x}_1 < 0$ when $\lambda < 0$.

Next, we calculate the difference between the quantities of exports by the foreign firm under the alternative trade regimes is:

$$\tilde{y}_1 - \hat{y}_1 = \frac{(\alpha - 2t_h)(\lambda+1) - k_2(2+\lambda)}{(\lambda+1)(\lambda+3)} - \frac{\alpha - 2k_2 - k_2\lambda + \alpha\lambda - (2+\lambda)t_h}{(\lambda+1)(\lambda+3)}.$$

Substituting the optimal tariffs from (19) and (20) into the above expression, after arranging terms, yields:

$$\tilde{y}_1 - \hat{y}_1 = -\lambda \frac{[5\alpha + 3\alpha\lambda + (1+\lambda)k_2]}{(\lambda+3)^2(2\lambda+3)}. \tag{a.24}$$

It follows that $\tilde{y}_1 - \hat{y}_1 < 0$ when $\lambda > 0$, and $\tilde{y}_1 - \hat{y}_1 > 0$ when $\lambda < 0$.

Relative to the traditional antidumping policy, the effect of the CDSOA on total consumption in the home market is:

$$(\tilde{x}_1 - \hat{x}_1) + (\tilde{y}_1 - \hat{y}_1) = \frac{\lambda(2\alpha - 5k_2 + 4\alpha\lambda - 3\lambda k_2 + 2\alpha\lambda^2)}{(\lambda+3)^2(2\lambda+3)}. \tag{a.25}$$

With the restriction on the home market size (the lowest possible value for α) the above equation becomes:

$$(\tilde{x}_1 - \hat{x}_1) + (\tilde{y}_1 - \hat{y}_1) = \lambda \frac{k_2}{1-\lambda}\left(2\lambda^3 + 11\lambda^2 + 16\lambda + 3\right), \tag{a.26}$$

which is positive for $\lambda > 0$. Thus the total consumption effect is positive when the home market is less competitive than in Cournot equilibrium. Also (a.26) shows that CDSOA's effect on total consumption depends on the model's parameters for $\lambda < 0$.

A-4. Derivations of the Home and Foreign Countries' Social Welfares under the Traditional Antidumping Policy

The home country's consumer surplus under the traditional antidumping policy is found by first substituting (a.16) into (a.5) and (a.6), and then substituting the resulting results in (a.5) and (a.6) into (a.14):

$$CS = \frac{\left(2k_2 - 3\alpha\lambda - 5\alpha + \lambda k_2\right)^2}{2\left(2\lambda+3\right)^2\left(\lambda+3\right)^2}. \tag{a.27}$$

The home firm's profit is found by first substituting (a.16) into (a.5), and (a.8), and equation (a.20) into (a.10) and (a.12), and then substituting the resulting results in (a.5), (a.8), (a.10), (a.12) and (a.20) into (a.15):

$$PS_h = \frac{\left(\lambda+2\right)^2\left(2\alpha+k_2+2\alpha\lambda\right)^2}{\left(\lambda+1\right)\left(\lambda+3\right)^2\left(2\lambda+3\right)^2} + \frac{\left(\alpha-4k_1+2\alpha\lambda-4\lambda k_1+\alpha\lambda^2-\lambda^2 k_1\right)^2}{\left(\lambda+1\right)\left(\lambda+3\right)^2\left(2\lambda+3\right)^2}. \tag{a.28}$$

The home government's tariff revenue is calculated by substituting (a.16) into (a.6), and then multiplying (a.16) by (a.6):

$$t_h y_1 = \frac{\left(\alpha-k_2\right)\left(\alpha-4k_2+2\alpha\lambda-4\lambda k_2+\alpha\lambda^2-\lambda^2 k_2\right)}{\left(\lambda+3\right)\left(2\lambda+3\right)^2}. \tag{a.29}$$

Domestic welfare under the traditional trade regime is the sum of (a.27), (a.28) and (a.29):

$$\begin{aligned}\hat{W}_h = &\left(\frac{\left(2k_2-3\alpha\lambda-5\alpha+\lambda k_2\right)^2}{2\left(2\lambda+3\right)^2\left(\lambda+3\right)^2}\right) + \left(\frac{\left(\lambda+2\right)^2\left(2\alpha+k_2+2\alpha\lambda\right)^2}{\left(\lambda+1\right)\left(\lambda+3\right)^2\left(2\lambda+3\right)^2} + \frac{\left(\alpha-4k_1+2\alpha\lambda-4\lambda k_1+\alpha\lambda^2-\lambda^2 k_1\right)^2}{\left(\lambda+1\right)\left(\lambda+3\right)^2\left(2\lambda+3\right)^2}\right) \\ &+\left(\frac{\left(\alpha-k_2\right)\left(\alpha-4k_2+2\alpha\lambda-4\lambda k_2+\alpha\lambda^2-\lambda^2 k_2\right)}{\left(\lambda+3\right)\left(2\lambda+3\right)^2}\right).\end{aligned} \tag{a.30}$$

Similarly, due to symmetry, foreign welfare under the traditional antidumping trade regime is:

$$\hat{W}_f = \left(\frac{\left(2k_1 - 3\alpha\lambda - 5\alpha + \lambda k_1\right)^2}{2\left(2\lambda+3\right)^2\left(\lambda+3\right)^2} \right) + \left(\frac{\left(\lambda+2\right)^2\left(2\alpha+k_1+2\alpha\lambda\right)^2}{\left(\lambda+1\right)\left(\lambda+3\right)^2\left(2\lambda+3\right)^2} + \frac{\left(\alpha-4k_2+2\alpha\lambda-4\lambda k_2+\alpha\lambda^2-\lambda^2 k_2\right)^2}{\left(\lambda+1\right)\left(\lambda+3\right)^2\left(2\lambda+3\right)^2} \right) + \left(\frac{\left(\alpha-k_1\right)\left(\alpha-4k_1+2\alpha\lambda-4\lambda k_1+\alpha\lambda^2-\lambda^2 k_1\right)}{\left(\lambda+3\right)\left(2\lambda+3\right)^2} \right). \tag{a.31}$$

A-5. Derivation of the Foreign Country Social Welfares under the CDSOA Trade Regime

Given that the CDSOA does not affect foreign government's optimal tariff and price in the foreign market, it does not change foreign consumer surplus and the foreign government's tariff revenues from their traditional antidumping policy levels. These are the first and the last terms in (a.31) respectively.

Profit of the foreign firm in the case of the CDSOA trade regime can be found by the following procedure: first substituting the home government's optimal tariff from (20) into (11) and (14); and the foreign country's optimal tariff from (19) into (12) and (16), and then substituting the resulting results in (11), (14), (12), (16) and (20) into (4). Simplifying (4) yields

$$PS_f = \frac{\left(\lambda+2\right)^2\left(2\alpha+k_1+2\alpha\lambda\right)^2}{\left(\lambda+1\right)\left(\lambda+3\right)^2\left(2\lambda+3\right)^2} + \frac{\left(4k_2-\alpha+3\lambda k_2+\alpha\lambda^2+\lambda^2 k_2\right)^2}{\left(\lambda+1\right)\left(2+3\right)^4}. \tag{a.32}$$

Foreign welfare under the CDSOA trade regime is then given as:

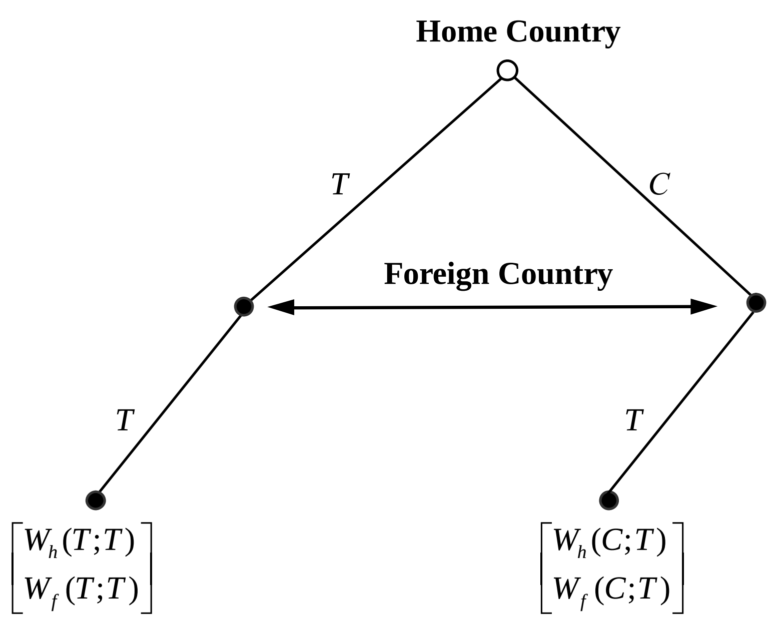
$$\tilde{W}_f = \left(\frac{\left(2k_1 - 3\alpha\lambda - 5\alpha + \lambda k_1\right)^2}{2\left(2\lambda+3\right)^2\left(\lambda+3\right)^2} \right) + \left(\frac{\left(\lambda+2\right)^2\left(2\alpha+k_2+2\alpha\lambda\right)^2}{\left(\lambda+1\right)\left(\lambda+3\right)^2\left(2\lambda+3\right)^2} + \frac{\left(4k_2-\alpha+3\lambda k_2+\alpha\lambda^2+\lambda^2 k_2\right)^2}{\left(\lambda+1\right)\left(2+3\right)^4} \right) + \left(\frac{\left(\alpha-k_1\right)\left(\alpha-4k_1+2\alpha\lambda-4\lambda k_1+\alpha\lambda^2-\lambda^2 k_1\right)}{\left(\lambda+3\right)\left(2\lambda+3\right)^2} \right). \tag{a.33}$$

Essay 3 - Byrd Amendment with an Active Foreign Government: Will the CDSOA be Welfare-Improving to the U.S.?

3.1 Introduction

The objective of this essay is to extend the CDSOA model developed in Essay 2. In Essay 2, we find that, for the case in which the import-competing markets are less competitive than Cournot, it is in the home country's best interest to adopt a CDSOA trade law, and the law negatively affects foreign welfare. However, these results are derived based on the assumptions that the foreign government stays inactive and continues to follow a traditional antidumping trade policy. To illustrate this point, we present the extensive form of the two-stage Nash game discussed in Essay 2 (hereafter the *unilateral* CDSOA game) when the home country unilaterally adopts the CDSOA trade law as follows:

Figure 3.1 Extensive Form of the Unilateral CDSOA Game



In Figure 3.1, T represents the choice of the traditional antidumping policy and C represents that of the CDSOA trade regime. The level of social welfare in country $i(i = h, f)$ is denoted as $W_i(j;l)$, where $j(j = T,C)$ and $l(l = T,C)$ are the strategic choices of the home and foreign countries respectively.

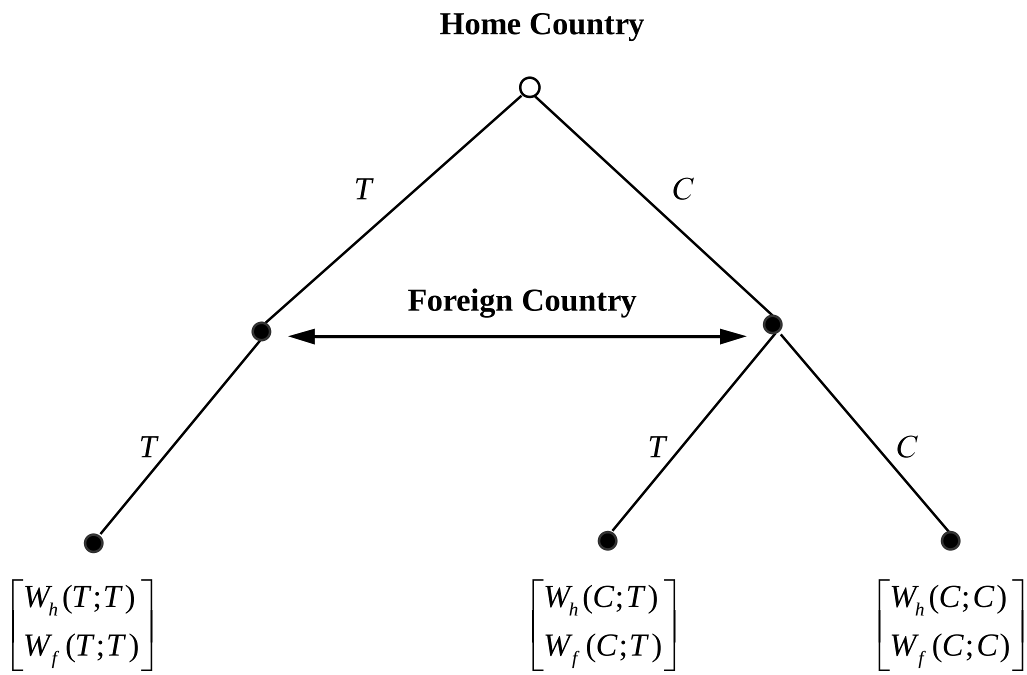
In the unilateral CDSOA game, the home country's strategy simply specifies its government's announcement regarding to its trade policy: The home government can implement the traditional antidumping policy (T) or adopt the CDSOA (C). Under the unilateral CDSOA game the foreign country has only one possible strategy, which is:

> Implement the traditional antidumping policy (T) if the home country implements the traditional antidumping policy (T); implement the traditional antidumping policy (T) if the home country unilaterally adopts the CDSOA (C).

Given the prediction of the model in Essay 2 that the home country's unilateral CDSOA strictly reduces foreign welfare under the relevant market competitiveness (i.e., $W_f(C;T) < W_f(T;T)$ when $\lambda > 0$), the foreign country may not choose to stay inactive. Obviously, since each country's welfare depends not only on its trading partner country's actions but also on its own policies, in response to home country's CDSOA, the foreign country's government is likely to take adequate measures to protect its domestic industries and enhance its country social welfare. Thus our model needs to be extended to include foreign government's possible actions. In fact, the WTO has authorized the European Union (EU) and other countries to introduce legal measures against the U.S. exporters.

In the present essay, we study the case in which the foreign country strategically responds to the home country's CDSOA by also adopting the same trade law. We shall refer to this as the *bilateral* CDSOA game. The extensive form of the bilateral CDSOA game is depicted in Figure 3.2.

Figure 3.2 Extensive Form of the Bilateral CDSOA Game



Under the bilateral CDSOA game the home country's strategy is similar to that of the unilateral CDSOA game: The home government can implement the traditional antidumping policy (T) or adopt the CDSOA (C). However, the foreign country now has two possible strategies:

Strategy 1: Implement the traditional antidumping policy (T) if the home country implements the traditional antidumping policy (T); implement the traditional antidumping policy (T) if the home country adopts the CDSOA (C).

Strategy 2: Implement the traditional antidumping policy (T) if the home country implements the traditional antidumping policy (T); adopt the CDSOA (C) if the home country adopts the CDSOA (C).

Note that even though the bilateral CDSOA game allows the foreign country to have one more strategy than the unilateral CDSOA game does, however, here we still have placed some restrictions on foreign government's actions. In particular, we assume that the foreign government can adopt the CDSOA law only if the home country government has already done so. We argue that since the CDSOA is found to be in violation of the WTO's policies on dumping and subsidization, it is not in a foreign country's best interest to violate the WTO policies by its own.[46] However, once the home country has the CDSOA in place, the foreign country's actions are no longer viewed as WTO inconsistent in that the country will be authorized by the WTO to implement a trade law of the similar nature.

In this essay our question of interest is: Will bilateral CDSOA game improve foreign country welfare? In other words, it is always the case that $W_f(C;C) > W_f(C;T)$? If the answer is positive, then will it be in the best interest to the U.S. government to repeal the CDSOA and re-establish the traditional antidumping trade regime, given that the foreign country's actions may replace the unilateral CDSOA game by bilateral one? Thus we wish to analyze whether or not home country welfare, when both countries implement the traditional antidumping policy $W_h(T;T)$, is greater than home country welfare when both counties adopt the CDSOA trade laws $(W_h(C;C))$. Answers to these questions allow us to derive more complete and meaningful conclusions concerning the welfare consequences of these types of administered trade regimes.

The objective of this essay is twofold. First, we modify the analytical framework developed in Essay 2 to examine the impact of the Byrd Amendment on social welfare of a foreign country that trades with the U.S. when the foreign country's government also implements

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[46] Thus we have ruled out the possibility of the following two payoffs $\begin{bmatrix} W_h(T;C) \\ W_f(T;C) \end{bmatrix}$.

a law similar to the Amendment. Second, we wish to answer the important question concerning whether it is optimal for the U.S. government to voluntarily repeal the Amendment and restore the traditional antidumping policy, considering that, otherwise, its trading partner may also adopt the CDSOA. As in Essay 2, we first derive each country's social welfare for the bilateral CDSOA game. Then we compare the resulting foreign country welfare with that of the unilateral CDSOA game, and the home country welfare with that of the traditional antidumping trade policy regime (when both countries implement traditional antidumping policy).

The rest of the essay is organized as follows. Section 2 presents the analytical structure of the model. In this section, we derive the optimal levels of outputs by home and foreign firms, as well as market price in the foreign country. Section 3 presents optimal tariffs and social welfares and discusses the implications of the model. Concluding remarks can be found in Section 4.

3.2 The Model

We preserve all the assumptions and notations of the model developed in Essay 2 regarding the number of countries and firms, market structure and demand functions as well as marginal and transportation costs. But we consider the case in which both trading nations adopt a trade law similar to that of the CDSOA (i.e., both governments redistribute their anti-dumping duties to their respective firms alleging harm from dumping). In this bilateral CDSOA game, the home and foreign firms at the second stage of the game simultaneously solve the following problems:

$$\underset{\{x_1, x_2\}}{Max} \quad \bar{\pi}^h = p_1 x_1 + (p_2 - k_1 - t_f) x_2 + t_h y_1, \tag{1}$$

$$\underset{\{y_1,y_2\}}{Max} \quad \bar{\pi}^f = (p_1 - k_2 - t_h)y_1 + p_2 y_2 + t_f x_2 . \tag{2}$$

The first-order conditions for the home and foreign firms are given respectively as:

$$\frac{\partial \bar{\pi}^h}{\partial x_1} = [\alpha - (x_1 + y_1)] - x_1(1 + \frac{\partial y_1}{\partial x_1}) + t_h(\frac{\partial y_1}{\partial x_1}) = 0 , \tag{3}$$

$$\frac{\partial \bar{\pi}^h}{\partial x_2} = [\alpha - (x_2 + y_2) - k_1 - t_f] - x_2(1 + \frac{\partial y_2}{\partial x_2}) = 0 , \tag{4}$$

$$\frac{\partial \bar{\pi}^f}{\partial y_2} = [\alpha - (x_2 + y_2)] - y_2(1 + \frac{\partial x_2}{\partial y_2}) + t_f(\frac{\partial x_2}{\partial y_2}) = 0 , \tag{5}$$

$$\frac{\partial \bar{\pi}^f}{\partial y_1} = [\alpha - (x_1 + y_1) - k_2 - t_h] - y_1(1 + \frac{\partial x_1}{\partial y_1}) = 0 , \tag{6}$$

where $\partial y_i / \partial x_i = \partial x_i / \partial y_i = \lambda$ (for $i = 1, 2$) are conjectural variations as stated previously.

Note that due to the separation of the home and foreign markets,[47] the home firm's FOCs in (3), (4) and the foreign firm's FOC in (6) are exactly identical to those discussed in Essay 2 (see equations (5), (6) and (8) in that essay). The only difference lies in how the foreign firm's profit responds to changes in its output produced for consumption in the foreign country's market as shown in (5) above. Since the home and foreign firms' FOC's in the home country market ((3) and (6) respectively) are not affected when switching from the unilateral CDSOA trade regime to the bilateral CDSOA, the home government's optimal tariffs (t_h), the home and foreign firms' equilibrium outputs for the home country domestic market $((x_1)$ and (y_1) respectively), home price levels (p_h), as well as consumer surplus (S_h) under both regimes are

[47] Since the model assumes that the home and the foreign firms make their decisions on the level of their exports $(x_2$ and y_1, respectively) independent from their output levels that are intended for their own markets $(x_1$ and $y_2)$, it separates the home and the foreign markets.

equal.[48] We therefore focus our analysis on how the bilateral CDSOA game affects the foreign country's domestic market and welfare.

We use (4) and (5) to solve for the equilibrium levels of outputs by the home and foreign firms for the foreign market as follows:

$$\bar{x}_2 = \frac{(\alpha - 2t_f)(\lambda+1) - k_1(2+\lambda)}{(\lambda+1)(\lambda+3)}, \tag{7}$$

$$\bar{y}_2 = \frac{\alpha + k_1 + t_f + \alpha\lambda + \lambda^2 t_f + 2\lambda t_f}{(\lambda+1)(\lambda+3)}. \tag{8}$$

For the quantity of the product exported by the home firm to be positive ($\bar{x}_2 > 0$), we assume that the foreign country's market size is sufficiently large.[49] The foreign country's total consumption of the product and its price are:

$$\bar{D}_f = \bar{x}_2 + \bar{y}_2 = \frac{2\alpha - k_1 - t_f + \lambda t_f}{\lambda+3}, \tag{9}$$

$$\bar{p}_f = \alpha - \bar{D}_f = \frac{\alpha(\lambda+1) + k_1 + (1-\lambda)t_f}{\lambda+3}. \tag{10}$$

3.3 Effects on Foreign Country's Optimal Tariff and Welfare

3.3.1 Effects on Optimal Tariff

To find its socially optimal tariff for the bilateral CDSOA game, the foreign government in the first stage of the game solves the following problem:

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[48] Thus $\bar{t}_h = \tilde{t}_h$, $\bar{x}_1 = \tilde{x}_1$, $\bar{y}_1 = \tilde{y}_1$, $\bar{p}_h = \tilde{p}_h$, $\bar{S}_h = \tilde{S}_h$. The derivations of the optimal variables in the home country's market for the bilateral CDSOA game are presented in B-1 in the Appendix (see (b.12), (b.5), (b.6), (b.8), and (b.10)).

[49] The sufficient condition for $\bar{x}_2 > 0$ is $\alpha > \frac{k_1(2+\lambda)}{(1+\lambda)} + 2t_f$.

$$\underset{\{t_f\}}{Max}\ \overline{W}_f ,$$

where foreign country welfare is the sum of its consumer surplus ($\overline{S}_f$) and foreign firm's profit ($\overline{\pi}_f$):

$$\overline{W}_f = \overline{S}_f + \overline{\pi}_f , \tag{11}$$

where

$$\overline{S}_f = \int_0^{D_f} (\alpha - X)dX - p_f \overline{D}_f = \frac{1}{2}(\overline{x}_2 + \overline{y}_2)^2 , \tag{12}$$

and the foreign firm's profit is defined as in (4).

The tariff optimally chosen by the foreign country is calculated as follows:

$$\overline{t}_f = \frac{\alpha(\lambda+1) - k_1}{\lambda+3} . \tag{13}$$

From (13) and (b.12) it follows that, in the bilateral CDSOA game, the foreign government's optimal tariff is symmetric to that of the home country's government. The difference in optimal tariffs between the home and foreign countries comes from the difference in transportation costs for the home and foreign firms. These two equations also imply the following: (i) the two countries' optimal tariffs are equal if transportation costs are identical (i.e., $\overline{t}_h = \overline{t}_f$ if $k_1 = k_2$); (ii) a country in which its exporting firm has a higher (lower) transportation cost chooses to set a higher (lower) tariff rate than its trade partner. That is,

$$\overline{t}_h > \overline{t}_f \text{ if } k_1 > k_2 \text{ and } \overline{t}_h < \overline{t}_f \text{ if } k_1 < k_2 .$$

It is easy to verify that a country in which its firm has a higher (lower) transportation cost will have a lower (higher) market price.[50]

$$k_1 > k_2 \Rightarrow \overline{p}_h < \overline{p}_f \text{; and if } k_1 < k_2 \Rightarrow \overline{p}_h > \overline{p}_f .$$

As shown above in the bilateral CDSOA game, the foreign government chooses a new optimal tariff which is symmetric to the optimal tariff set by the home country's government for the unilateral CDSOA game. Since Essay 2 has detailed how the unilateral CDSOA game affects the home country's optimal tariff set under the traditional antidumping regime, we can conclude that our results from Essay 2 can also be extended here to discuss the bilateral CDSOA's effect on foreign country's optimal tariff and product price.[51] That is, in the bilateral CDSOA game, the foreign country's optimal tariff is strictly positive ($\overline{t}_f > 0$) regardless of the degree of its market competitiveness, market size and transportation costs.[52] Moreover, the foreign government's optimal tariff in the bilateral CDSOA game is higher (lower) than its optimal tariff in the unilateral CDSOA game ($\overline{t}_f > \hat{t}_f$), when foreign market is less (more) competitive than Cournot equilibrium.

Similarly, given that the foreign country's market price in the bilateral CDSOA game and the home country's market price in the unilateral CDSOA game are symmetric, we can modify our results from Essay 2 to present how the bilateral CDSOA game affects market price and consumer surplus in the foreign country. The bilateral CDSOA game increases foreign firm's

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[50] Substituting the foreign government's optimal tariff (14) into $\overline{p}_f$ in (12), and substituting the home government's optimal tariff (20) (from Essay 2) into (16) (from Essay 2), we calculate the difference in product price between the foreign market and the home market to obtain $\overline{p}_f - \overline{p}_h = (k_1 - k_2)\dfrac{\lambda + 1}{(\lambda + 3)^2}$.

[51] Recall that before adopting a CDSOA trade policy, the foreign government implementing traditional antidumping policy.

[52] Assuming that general restriction on market size always holds.

output for its domestic consumption (y_2) and decreases domestic firm's exports (x_2) to the foreign country when markets are less competitive than in Cournot competition. However, total consumption of the import-competing good in the foreign market increases when markets are less competitive than in Cournot.[53]

$$\left(\bar{y}_2 - \tilde{y}_2\right) + \left(\bar{x}_2 - \tilde{x}_2\right) > 0 \text{ when } \lambda > 0 .$$

Thus the bilateral CDSOA game reduces market price in the foreign country, making consumers there better off when the market is less competitive than Cournot.

The effects that the bilateral CDSOA game has on (i) product price in the foreign market and (ii) consumer welfare in the foreign country cannot be determined unambiguously when the market there is more competitive than Cournot.

3.3.2 Effects on Social Welfares

The bilateral CDSOA game affects social welfares in the home and foreign countries through its effect on foreign government's optimal tariff, and thus foreign country consumers surplus and foreign and home firms' profits. We first derive the foreign country welfare and discuss whether bilateral CDSOA game improves its welfare using foreign country welfare under the unilateral CDSOA regime as a reference base. The foreign country welfare under the bilateral CDSOA game is given in (11) and is measured as the sum of its consumer surplus and firm's profit. The consumer surplus can be found by first substituting the foreign government's optimal tariff (13) into the home and foreign firms optimal outputs ((7) and (8) respectively), and then substituting (7) and (8) into (12). Simplifying (12) we have:

[53] Appendix A-3 in Essay 2 shows these results for the home country for the unilateral CDSOA game. These results also hold for the foreign country since the total consumption in home country market for the unilateral CDSOA game is symmetric to that of the foreign country in the bilateral CDSOA game.

$$\overline{S}_f = \frac{\left(5\alpha - 2k_1 + 2\alpha\lambda - 2\lambda k_1 + \alpha\lambda^2\right)^2}{2\left(\lambda+3\right)^4}. \tag{14}$$

To derive the foreign firm's profit in the bilateral CDSOA game, we first substitute the foreign government's optimal tariff from (13) into (7), (8) and (10), and the home government's optimal tariff from (b.12) into (b.6). We then substitute the resulting equations in (7), (8), (10), (b.6), and (b.13) into (2) to obtain

$$\begin{aligned}\overline{\pi}_f = {} & \frac{2\left(2\alpha+k_1\right)\left(4\alpha+2k_1+7\alpha\lambda-\lambda k_1+4\alpha\lambda^2+\alpha\lambda^3-\lambda^2 k_1\right)}{\left(\lambda+3\right)^4} + \frac{\left(4k_2-\alpha+3\lambda k_2+\alpha\lambda^2+\lambda^2 k_2\right)^2}{\left(\lambda+1\right)\left(\lambda+3\right)^4} \\ & + \frac{\left(\alpha-k_1+\alpha\lambda\right)\left(\alpha-4k_1-3\lambda k_1-\alpha\lambda^2-\lambda^2 k_1\right)}{\left(\lambda+1\right)\left(\lambda+3\right)^3}.\end{aligned} \tag{15}$$

Taking the sum of (14) and (15), we have the optimal level of foreign welfare for the bilateral CDSOA game as follows:

$$\begin{aligned}\overline{W}_f = {} & \left(\frac{\left(5\alpha-2k_1+2\alpha\lambda-2\lambda k_1+\alpha\lambda^2\right)^2}{2\left(\lambda+3\right)^4}\right) + \left(\frac{2\left(2\alpha+k_1\right)\left(4\alpha+2k_1+7\alpha\lambda-\lambda k_1+4\alpha\lambda^2+\alpha\lambda^3-\lambda^2 k_1\right)}{\left(\lambda+3\right)^4}\right. \\ & \left. + \frac{\left(4k_2-\alpha+3\lambda k_2+\alpha\lambda^2+\lambda^2 k_2\right)^2}{\left(\lambda+1\right)\left(\lambda+3\right)^4} + \frac{\left(\alpha-k_1+\alpha\lambda\right)\left(\alpha-4k_1-3\lambda k_1-\alpha\lambda^2-\lambda^2 k_1\right)}{\left(\lambda+1\right)\left(\lambda+3\right)^3}\right).\end{aligned} \tag{16}$$

The foreign country optimal welfare for unilateral CDSOA game discussed in Essay 2 is[54]

$$\begin{aligned}\tilde{W}_f = {} & \left(\frac{\left(2k_1-3\alpha\lambda-5\alpha+\lambda k_1\right)^2}{2\left(2\lambda+3\right)^2\left(\lambda+3\right)^2}\right) + \left(\frac{\left(\lambda+2\right)^2\left(2\alpha+k_2+2\alpha\lambda\right)^2}{\left(\lambda+1\right)\left(\lambda+3\right)^2\left(2\lambda+3\right)^2} + \frac{\left(4k_2-\alpha+3\lambda k_2+\alpha\lambda^2+\lambda^2 k_2\right)^2}{\left(\lambda+1\right)\left(2+3\right)^4}\right) \\ & + \left(\frac{\left(\alpha-k_1\right)\left(\alpha-4k_1+2\alpha\lambda-4\lambda k_1+\alpha\lambda^2-\lambda^2 k_1\right)}{\left(\lambda+3\right)\left(2\lambda+3\right)^2}\right).\end{aligned} \tag{17}$$

It follows from (16) and (17) that the difference in welfares is:

[54] See Appendix A-5 (a.33) in Essay 2.

$$\bar{W}_f - \tilde{W}_f = \frac{\lambda\left(2\alpha^2\lambda^2+6\alpha^2\lambda+4\alpha^2-2\alpha\lambda k_1-2\alpha k_1-\lambda k_1^2-2k_1^2\right)}{2(\lambda+3)^2(2\lambda+3)}. \quad (18)$$

Note that equation (18) is symmetric to equation (30) as derived in Essay 2.[55] This result is important for two reasons. First, since (18) is strictly positive for $\lambda > 0$, it suggests that when markets are less competitive than Cournot, the bilateral CDSOA game improves foreign country welfare, and thus it is in the best interest to the foreign government to follow the home firm's CDSOA policy. That is, the Strategy 2 is a dominant strategy for the foreign country when markets are less competitive than Cournot. When markets are more competitive than Cournot, however, the effect that the bilateral CDSOA game has on foreign welfare is ambiguous. Second, assuming that transportation costs are equal, if markets are less competitive than Cournot, the foreign country welfare gain due to switching from unilateral CDSOA game to bilateral CDSOA game is equal to welfare gain of the home country when the latter implements a CDSOA unilaterally. That is, $\tilde{W}_h - \hat{W}_h = \bar{W}_f - \tilde{W}_f$.

Finally, given the results that the Strategy 2 is a dominant strategy for the foreign country when markets are less competitive than Cournot, we wish to analyze whether it is to the benefit of the home country to voluntarily eliminate the unilateral CDSOA regime and restore the traditional antidumping policy. We do this by comparing the home country welfare in the bilateral CDSOA game to that of the traditional antidumping trade regime. By definition, under the bilateral CDSOA game, when both countries have similar market structures, the home country welfare is symmetric to the foreign country welfare given in (16), and can be derived as follows:

[55] As shown in Essay 2 the expression in (18) is positive for $\lambda > 0$, but is ambiguous in sign for $\lambda < 0$.

$$\overline{W}_h = \left(\frac{\left(5\alpha - 2k_2 + 2\alpha\lambda - 2\lambda k_2 + \alpha\lambda^2\right)^2}{2(\lambda+3)^4} \right) + \left(\frac{2(2\alpha + k_2)\left(4\alpha + 2k_2 + 7\alpha\lambda - \lambda k_2 + 4\alpha\lambda^2 + \alpha\lambda^3 - \lambda^2 k_2\right)}{(\lambda+3)^4} \right.$$
$$\left. + \frac{\left(4k_1 - \alpha + 3\lambda k_1 + \alpha\lambda^2 + \lambda^2 k_1\right)^2}{(\lambda+1)(\lambda+3)^4} + \frac{(\alpha - k_2 + \alpha\lambda)\left(\alpha - 4k_2 - 3\lambda k_2 - \alpha\lambda^2 - \lambda^2 k_2\right)}{(\lambda+1)(\lambda+3)^3} \right). \tag{19}$$

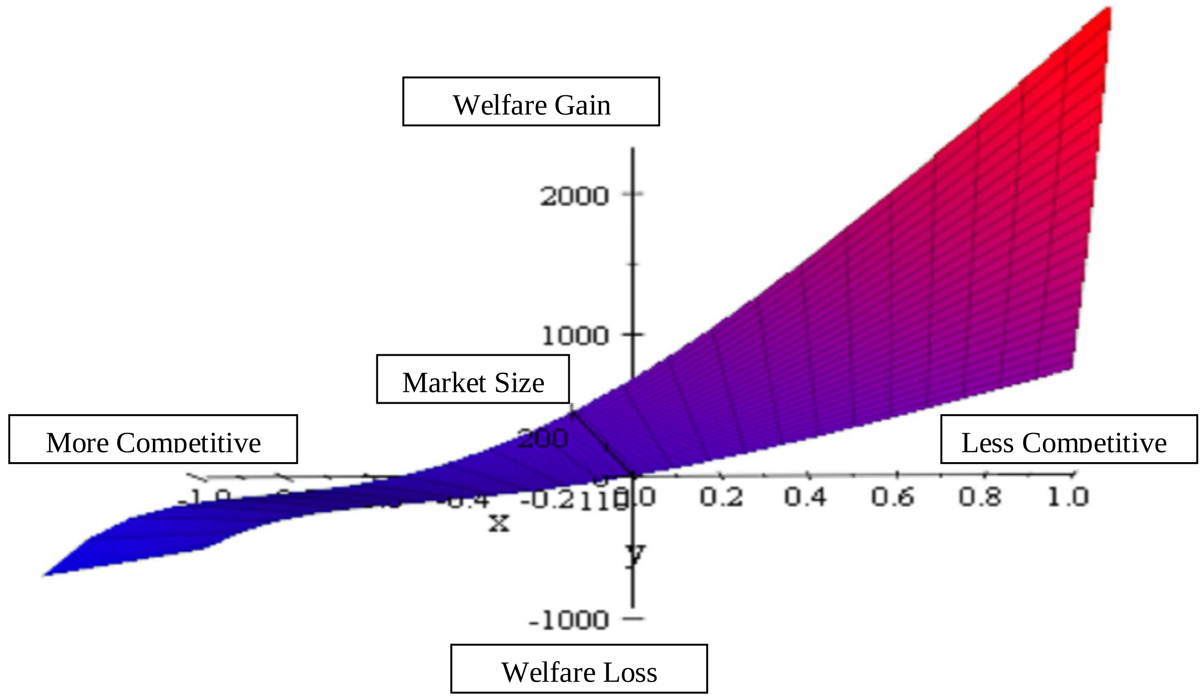
The home country welfare when both countries follow the traditional antidumping policy is shown in B-3 in the Appendix. This welfare is recorded as follows:

$$\hat{W}_h = \left(\frac{\left(2k_2 - 3\alpha\lambda - 5\alpha + \lambda k_2\right)^2}{2(2\lambda+3)^2(\lambda+3)^2} \right) + \left(\frac{(\lambda+2)^2(2\alpha + k_2 + 2\alpha\lambda)^2}{(\lambda+1)(\lambda+3)^2(2\lambda+3)^2} + \frac{\left(\alpha - 4k_1 + 2\alpha\lambda - 4\lambda k_1 + \alpha\lambda^2 - \lambda^2 k_1\right)^2}{(\lambda+1)(\lambda+3)^2(2\lambda+3)^2} \right)$$
$$+ \left(\frac{(\alpha - k_2)\left(\alpha - 4k_2 + 2\alpha\lambda - 4\lambda k_2 + \alpha\lambda^2 - \lambda^2 k_2\right)}{(\lambda+3)(2\lambda+3)^2} \right). \tag{20}$$

It is instructive to conduct a simulation to show how the home country welfare is affected when both countries abandon the traditional antidumping policies to bilaterally adopt the CDSOA. Figure 3.3 is drawn for $\overline{W}_h - \hat{W}_h$, which illustrates how the degree of market competitiveness and market size affect the home country social welfare when switching between two above-mentioned regimes.[56]

[56] In the simulation, both firms transportation costs are fixed at 10 $(i.e., k_i (i = 1, 2) = 10)$, and the market size is chosen such that the sufficient condition for positive quantities of output ($y_1 > 0$ and $x_2 > 0$) are met.

Figure 3.3 The Effects of Market Competitiveness and Size on the Home Country Welfare



Compared to the traditional antidumping case, the bilateral CDSOA still increases the home country welfare ($\bar{W}_h - \hat{W}_h > 0$) if the markets are less competitive than Cournot. This result might explain why the U.S. government was not reluctant to voluntarily repeal the Byrd Amendment even though governments of its trading partners were threatening to impose a similar trade law.

Nevertheless, when markets are more competitive than Cournot, our results suggest that the home country may prefer the traditional antidumping policy over the case when both countries end up having the CDSOA trade laws. This is because the latter leads to a lower level of social welfare.

3.4 Concluding Remarks

In this essay we extend the model of Essay 2 to discuss the effect of the CDSOA trade law when a foreign country that trades with the U.S. responds by implementing a trade law of similar nature. We show that the country in which its firm has a higher (lower) transportation cost will have lower (higher) market price of an import competing product and will choose to set a higher (lower) tariff and than its foreign competitor. Our results indicate that when markets are less competitive than Cournot, it is beneficial to a country that trades with the U.S. to also adopt CDSOA-type trade law. By doing so, the country is able to improve its social welfare. We find that the foreign country's adequate response to the U.S. CDSOA law has an ambiguous effect on foreign welfare when markets are less competitive than Cournot.

Furthermore, our model suggests that when markets are less competitive than Cournot, the bilateral CDSOA turns out to be a preferred trade regime for the U.S. government than the case when both countries adopt the traditional antidumping policies. Thus, when markets are less competitive than Cournot, the bilateral CDSOA trade regime is the only rational outcome of the game. This may explain why foreign countries were so eager to acquire the TWO's approval to implement defensive actions against the U.S. firms, and why the U.S. was so resistant to abandon its law at the first place.

Appendix B - Appendix to Essay 3

B-1. The Home Country's Optimal Variables for the Bilateral CDSOA Game

The home firm's profit function is

$$\overline{\pi}^h = p_1 x_1 + (p_2 - k_1 - t_f) x_2 + t_h y_1 .$$

and the foreign firm's profit function is

$$\overline{\pi}^f = (p_1 - k_2 - t_h) y_1 + p_2 y_2 + t_f x_2 .$$

The first-order conditions for the home and foreign firms are given respectively as

$$\frac{\partial \pi^h}{\partial x_1} = [\alpha - (x_1 + y_1)] - x_1(1 + \frac{\partial y_1}{\partial x_1}) + t_h(\frac{\partial y_1}{\partial x_1}) = 0 . \quad \text{(b.1)}$$

$$\frac{\partial \overline{\pi}^h}{\partial x_2} = [\alpha - (x_2 + y_2) - k_1 - t_f] - x_2(1 + \frac{\partial y_2}{\partial x_2}) = 0 . \quad \text{(b.2)}$$

$$\frac{\partial \overline{\pi}^f}{\partial y_2} = [\alpha - (x_2 + y_2)] - y_2(1 + \frac{\partial x_2}{\partial y_2}) + t_f(\frac{\partial x_2}{\partial y_2}) = 0 . \quad \text{(b.3)}$$

$$\frac{\partial \pi^f}{\partial y_1} = [\alpha - (x_1 + y_1) - k_2 - t_h] - y_1(1 + \frac{\partial x_1}{\partial y_1}) = 0 . \quad \text{(b.4)}$$

As in Essay 2, we assume that $\lambda = \frac{\partial y_1}{\partial x_1} = \frac{\partial x_1}{\partial y_1}$. Solving (a.1) and (a.4) simultaneously for x_1 and y_1 yields

$$\overline{x}_1 = \frac{\alpha + k_2 + t_h + \alpha\lambda + \lambda^2 t_h + 2\lambda t_h}{(\lambda+1)(\lambda+3)} . \quad \text{(b.5)}$$

$$\overline{y}_1 = \frac{(\alpha - 2t_h)(\lambda+1) - k_2(2+\lambda)}{(\lambda+1)(\lambda+3)} . \quad \text{(b.6)}$$

The levels of consumption and market price are:

$$\overline{D}_h = \overline{x}_1 + \overline{y}_1 = \frac{2\alpha - k_2 - t_h + \lambda t_h}{\lambda + 3} . \quad \text{(b.7)}$$

$$\overline{p}_h = \alpha - \overline{D}_h = \frac{\alpha(\lambda+1) + k_2 + (1-\lambda)t_h}{\lambda+3}. \tag{b.8}$$

The home country's welfare is defined as

$$\overline{W}_h = \overline{CS}_h + \overline{PS}_h, \tag{b.9}$$

where

$$\overline{CS}_h = \tfrac{1}{2}(\overline{x}_1 + \overline{y})^2 = \left(\frac{2\alpha - k_2 - t_h + \lambda t_h}{\lambda+3}\right)^2, \tag{b.10}$$

$$\overline{PS}_h = \overline{\pi}_h = \overline{x}_1\overline{p}_h + x_2\left(\overline{p}_f - k_1 - t_f\right) + t_h\overline{y}_1. \tag{b.11}$$

The partial derivative of $\overline{W}_h$ with respect to t_h is

$$\frac{\partial\overline{W}_h}{\partial t_h} = \frac{\partial\overline{CS}_h}{\partial t_h} + \frac{\partial\overline{PS}}{\partial t_h}.$$

Setting $\frac{\partial\overline{W}_h}{\partial t_h} = 0$ and solving for the tariff rate optimally chosen by the home country yields

$$\bar{t}_h = \frac{\alpha(\lambda+1) - k_2}{\lambda+3}. \tag{b.12}$$

Substituting $\bar{t}_h$ from (a.12) into (a.8) yields the equilibrium price in the home country market as follows:

$$\overline{p}_h = \frac{2(\lambda+1)(2\alpha+k_2)}{(\lambda+3)^2}. \tag{b.13}$$

B-2. Derivations of Optimal Variables When Both Countries Adopt the Traditional Antidumping Policies

The home firm's profit function is

$$\pi^h = x_1 p_h + x_2(p_f - k_1 - t_f).$$

and that of the foreign firm's is

$$\pi^f = y_2 p_f + y_1(p_h - k_2 - t_h).$$

The first-order conditions for the home and foreign firms are given respectively as

$$\frac{\partial \pi^h}{\partial x_1} = [\alpha - (x_1 + y_1)] - x_1(1 + \frac{\partial y_1}{\partial x_1}) = 0. \tag{b.14}$$

$$\frac{\partial \pi^h}{\partial x_2} = [\alpha - (x_2 + y_2) - k_1 - t_f] - x_2(1 + \frac{\partial y_2}{\partial x_2}) = 0. \tag{b.15}$$

$$\frac{\partial \pi^f}{\partial y_2} = [\alpha - (x_2 + y_2)] - y_2(1 + \frac{\partial x_2}{\partial y_2}) = 0. \tag{b.16}$$

$$\frac{\partial \pi^f}{\partial y_1} = [\alpha - (x_1 + y_1) - k_2 - t_h] - y_1(1 + \frac{\partial x_1}{\partial y_1}) = 0. \tag{b.17}$$

Let $\lambda = \frac{\partial y_1}{\partial x_1} = \frac{\partial x_1}{\partial y_1}$. Solving equations (b.1) and (b.4) simultaneously for x_1 and y_1 yields

$$\hat{x}_1 = \frac{k_2 + \alpha + \alpha\lambda + t_h}{(\lambda+1)(\lambda+3)}. \tag{b.18}$$

$$\hat{y}_1 = \frac{\alpha - 2k_2 - k_2\lambda + \alpha\lambda - (2+\lambda)t_h}{(\lambda+1)(\lambda+3)}. \tag{b.19}$$

The levels of consumption and price in the home market are:

$$\hat{D}_h = \hat{x}_1 + \hat{y}_1 = \frac{2\alpha - k_2 - t_h}{\lambda + 3}. \tag{b.20}$$

$$\hat{p}_h = \alpha - \hat{D}_h = \frac{k_2 + \alpha + \alpha\lambda + t_h}{\lambda + 3}. \tag{b.21}$$

Let $\lambda = \frac{\partial y_2}{\partial x_2} = \frac{\partial x_2}{\partial y_2}$. Solving equations (b.2) and (b.3) simultaneously for y_2 and x_2 yields

$$\hat{y}_2 = \frac{k_1 + \alpha + \alpha\lambda + t_f}{(\lambda+1)(\lambda+3)}. \tag{b.22}$$

$$\hat{x}_2 = \frac{\alpha - 2k_1 - k_1\lambda + \alpha\lambda - (2+\lambda)t_f}{(\lambda+1)(\lambda+3)}. \tag{b.23}$$

The levels of consumption and price in the foreign market are:

$$\hat{D}_f = \hat{x}_2 + \hat{y}_2 = \frac{2\alpha - k_1 - t_f}{\lambda + 3}. \tag{b.24}$$

$$\hat{p}_f = \alpha - \hat{D}_f = \frac{k_1 + \alpha + \alpha\lambda + t_f}{\lambda + 3}. \tag{b.25}$$

The home country's welfare under the traditional antidumping policy is given as

$$\hat{W}_h = CS_h + PS_h + t_h y_1, \tag{b.26}$$

where

$$CS_h = \tfrac{1}{2}(x_1 + y_1)^2, \tag{b.27}$$

$$PS_h = x_1 p_h + x_2\left(p_f - k_1 - t_f\right). \tag{b.28}$$

The derivative of $\hat{W}_h$ with respect to t_h is

$$\frac{\partial \hat{W}_h}{\partial t_h} = \frac{\partial CS_h}{\partial t_h} + \frac{\partial PS}{\partial t_h} + t_h \frac{\partial y_1}{\partial t_h} + y_1.$$

Setting $\frac{\partial \hat{W}_h}{\partial t_h} = 0$ and solving for the tariff rate optimally chosen by the home country yields

$$\hat{t}_h = \frac{(\alpha - k_2)(\lambda + 1)}{2\lambda + 3}. \tag{b.29}$$

The foreign country's social welfare under the traditional antidumping policy is given as

$$\hat{W}_f = CS_f + PS_f + t_f x_2, \tag{b.30}$$

where

$$CS_f = \frac{1}{2}(x_2 + y_2)^2, \tag{b.31}$$

$$PS_f = y_2 p_f + y_1\left(p_h - k_2 - t_h\right). \tag{b.32}$$

The derivative of $\hat{W}_f$ with respect to t_h is:

$$\frac{\partial \hat{W}_f}{\partial t_f} = \frac{\partial CS_f}{\partial t_f} + \frac{\partial PS_f}{\partial t_f} + t_f \frac{\partial x_2}{\partial t_f} + x_2 .$$

Setting $\frac{\partial \hat{W}_f}{\partial t_f} = 0$ and solving for the tariff rate optimally chosen by the foreign country yields:

$$\hat{t}_f = \frac{(\alpha - k_1)(\lambda + 1)}{2\lambda + 3} . \tag{b.33}$$

B-3. Derivations of the Home Country Social Welfare under the Traditional Antidumping Policy

The home country's consumer surplus is found by first substituting (b.29) into (b.18) and (b.19), and then substituting (b.18) and (b.19) into (b.27):

$$CS = \frac{\left(2k_2 - 3\alpha\lambda - 5\alpha + \lambda k_2\right)^2}{2\left(2\lambda + 3\right)^2\left(\lambda + 3\right)^2} . \tag{b.33}$$

The home firm's profit is found by the following procedure. We substitute (b.29) into (b.18) and (b.21). Also, we substitute (b.32) into (b.23) and (b.25). We then substitute the resulting equations from (b.18), (b.21), (b.23), (b.25) and (b.32) into (b.28) to obtain

$$PS_h = \frac{\left(\lambda + 2\right)^2\left(2\alpha + k_2 + 2\alpha\lambda\right)^2}{\left(\lambda + 1\right)\left(\lambda + 3\right)^2\left(2\lambda + 3\right)^2} + \frac{\left(\alpha - 4k_1 + 2\alpha\lambda - 4\lambda k_1 + \alpha\lambda^2 - \lambda^2 k_1\right)^2}{\left(\lambda + 1\right)\left(\lambda + 3\right)^2\left(2\lambda + 3\right)^2} . \tag{b.34}$$

Using equations (b.9) and (b.29), we calculate the home government's tariff revenue as follows:

$$t_h y_1 = \frac{\left(\alpha - k_2\right)\left(\alpha - 4k_2 + 2\alpha\lambda - 4\lambda k_2 + \alpha\lambda^2 - \lambda^2 k_2\right)}{\left(\lambda + 3\right)\left(2\lambda + 3\right)^2} . \tag{b.35}$$

The home country's social welfare is the sum of (b.33), (b.34) and (b.35):

$$\hat{W}_h = \left(\frac{\left(2k_2 - 3\alpha\lambda - 5\alpha + \lambda k_2\right)^2}{2\left(2\lambda+3\right)^2\left(\lambda+3\right)^2} \right) + \left(\frac{\left(\lambda+2\right)^2\left(2\alpha + k_2 + 2\alpha\lambda\right)^2}{\left(\lambda+1\right)\left(\lambda+3\right)^2\left(2\lambda+3\right)^2} + \frac{\left(\alpha - 4k_1 + 2\alpha\lambda - 4\lambda k_1 + \alpha\lambda^2 - \lambda^2 k_1\right)^2}{\left(\lambda+1\right)\left(\lambda+3\right)^2\left(2\lambda+3\right)^2} \right)$$
$$+ \left(\frac{\left(\alpha - k_2\right)\left(\alpha - 4k_2 + 2\alpha\lambda - 4\lambda k_2 + \alpha\lambda^2 - \lambda^2 k_2\right)}{\left(\lambda+3\right)\left(2\lambda+3\right)^2} \right). \tag{b.36}$$

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