Free Trade Area and Welfare: Is A Bigger Trade Diversion More Detrimental?

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Abstract

This paper analyzes how the welfare of a member country is affected by the formation of a new free trade area (FTA). In particular, we examine whether a change in a member country's welfare is related to the volume of trade diverted from a non-member country to another member country. It has been long and widely believed that a bigger trade volume diverted from a non-member country to another member country is an indication that the welfare of country has been deteriorated to a greater extent. This assumption can be traced back to Viner (1950), and has been used in many empirical studies and policy recommendations. This paper investigates the validity of this assumption. We show that this assumption is not necessarily true, especially if imperfect competition exists in trade. Our results do not support Krishna's (1998) finding that a bigger trade volume diverted implies a higher likelihood of an FTA to be approved.

Keywords: Imperfect Competition, Preferential Trade Agreements, Trade Diversion

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1 Introduction

The welfare impacts of a new preferential trade agreement (PTA) such as a customs union (CU) or a free trade agreement/area (FTA) on the member countries and non-member countries has long been an important issue for economists and policy makers. In particular, how a country may be affected by a new FTA has been one of the key questions for policy makers when considering international economic integration.[1]

For a long time, economists had held the position that the welfare impact of a PTA is generally ambiguous as a PTA represents a movement of a second-best equilibrium to another second-best equilibrium, while it is argued that the first-best position of the world is free trade by all countries.[2] Viner, in his pioneering work (Viner, 1950), suggested an approach to identifying welfare-improving PTAs and welfare-deteriorating PTAs. He argued that a trade-creating PTA (one in which a member country imports more from a country where the cost of production is lower) is beneficial but that a trade-diverting PTA (one in which a member country switches its import from a country with a lower cost of production to a country with a higher cost of production) is detrimental.

Viner's approach has been criticized by many economists. First, it had been argued that a trade diverting PTA may still be beneficial to a member country (Gehrels (1956-57), Lipsey (1957), Wonnacott (1996), and Panagariya (1999)).[3] Second, it had been realized that Viner's criteria for welfare improvement are difficult to test, as it could be costly to estimate the costs of production of different goods in different countries. Third, since Viner's analysis is based on a partial equilibrium framework, it is not clear how the analysis can be extended to a multi-good economy. In particular, it is not clear how the welfare may change if one finds trade creation for some goods but trade diversion for some goods.

Because of these limitations, economists who tried to apply Viner's ap-

[1] Panagariya(1999) investigates the effects on member countries under four headings: (i) the welfare effects of a PTA based on Vinerian analysis, (ii) the implication of differences in transport costs, (iii) the implications of rules of origin, and (iv) nontraditional gains. In this paper, we only focus on the welfare effects on member coutries.

[2] By the Second-best Theory, two second-best positions *in general* cannot be ranked in terms of the welfare of the world or the welfare of a country.

[3] Panagariya (1999) says that unions which are primarily trade diverting are harmful to member countries taken together, however, an individual member of the union can be still be beneficial by shifting in intra-union terms of trade in its favor.

proach to examine the impacts of a PTA chose to focus on the change in the trade volumes to get hints on how welfare may change.[4] In the literature, it has been long and widely believed that a bigger trade volume diverted from a non-member country to another member country is an indication that the welfare of a member country has been deteriorated to a greater extent.

Surprisingly, however, theoretical studies do not provide rigorous analysis to support or test the validity of the assumption of negative relation between the changes in trade volumes and the changes in welfare levels. Nevertheless, a number of empirical studies tend to draw conclusions about welfare changes based on estimated trade volume changes with little caution.[5] For example, Jugurnath, Stewart, and Brooks (2007), which examine trade effect of five different RTAs, conclude that *"Although APEC, MERCOSUR, and NAFTA tended to expand intra-block trade, to some extent this was at the expense of their trade with the rest of the world, which implies 'trade diversion' and a loss of welfare."* Further, Clausing (2001), which tests the Canada-United states Free Trade Agreement, says *" In addition, there was little evidence of trade diversion from non-member countries.... These results suggest an encouraging assessment of the CUSFTA. Since the gains due to the agreement were not at the expense of other countries, it is less likely that the CUSFTA will discourage future efforts towards free trade worldwide. More likely, the CUSFTA increased the constituencies with an interest in free trade."*

As an exception of theoretical analysis, Krishna (1998) provides an examination of the volume of trade diverted and the profits of local firms in

[4]Most common way to test the e*x post* welfare effect of PTAs is to use a gravity model by including dummies which capture a change in trade flows between members, and/or a member country and a non-member country. Eicher, Henn, and Papageorgiou (2007) provide a nice summary of the literature. As different approaches, Balassa (1964) introduces income elasticities of demand for imports to estimate trade effects, and Winters (1984, 1985) uses systems of import demand equations.

[5]For instance, in a gravity model, it seems that more significant (negative) coefficient for the dummy brings more concern to researchers. As a different view, Kowalczyk (2000) argues that if a good from a non-member country is complementary to a good exported from a member country, a non-member country may end up exporting more to a member country even after the FTA, and a member country may increase the volume of trade with a non-member country due to increased income after eliminating tariffs. Freund (2000) also shows that PTAs yield trade creation effects between a member country and a non-member country (Open Bloc Trade Creation effects) so that we may observe a positve coefficient in the dummy. In the empirical literature, Eicher, Henn, and Papageorgiou (2007) find strong evidence for significant Open Bloc Trade Creation among PTAs in Europe and Asia.

a member country.[6] Using a model similar to the Brander-Krugman model of intra-industry trade with oligopoly, he argues that a larger trade volume diverted from non-member country to a member country represents a bigger increase in the profits of local firms, and thus makes a FTA more attractive and likely. Krishna's result, however, seems to be incompatible with the general belief that a larger trade volume diverted implies a higher likelihood of a drop in welfare.

This paper examines how the volume of trade diverted from a non-member country affects change in welfare (or profits of local firms) of a member country, and thus, try to sort out the seemingly conflicting results about what a bigger trade diversion may mean to welfare.We provide a systematic analysis of the relation between changes in trade volume diverted and changes in welfare in order to determine whether an FTA may be supported by the government and local firms. We find out that such a relation depends crucially on the type of trade one is considering. If inter-industry trade with perfect competition is assumed, then a rise in the trade volume diverted will generally imply a drop in the change in the welfare that a member country will get. This seems to be compatible with Viner's instinct about trade diversion and to confirm the belief in some recent studies about the welfare implications of volume of trade diverted. If, however, one examines intra-industry trade in the presence of oligopoly, the relation between trade volume diverted and profit change is more complicated, and the relation cannot positive or negative. In particular, we find that Krishna's conclusion about a positive relation may not hold. We also find that the relation between trade diversion and change in welfare is not straightforward in this model.

The rest of this paper is organized as follows. In Section 2, we introduce a framework that allows us to examine the relation between trade volume diverted and welfare change. In Section 3, the focus of the analysis is on intra-industry trade. To allow a comparison between our analysis and previous analysis, first we follow Krishna's approach and use the profits of local firms as a criterion for the formation of an FTA and then investigate the relation between trade diverted and change in (government) welfare. Section 4 concludes.

[6]Krishna (1998) follows the approach in Grossman and Helpman (1994, 1995) and assumes that the government of a member country put a big emphasis on the profits of local firms.

2 Inter-industry Trade: The Vinerian Analysis

We first examine the validity of Viner's approach in the presence of inter-industry trade. Consider a model of three countries labelled X, Y, and Z, each of which has initial tariffs on goods from other countries. Countries X and Y are forming a free trade area (FTA), removing the tariffs on the goods from each other while their tariffs on the goods from Z are not affected.[7] Country Z is the non-member country, and its tariffs on the goods from countries X and Y are not affected by the new FTA. For simplicity, goods can flow between any two countries without transport costs.[8]

Consider a competitive industry of a homogeneous product in country X. Denote its inverse import demand function by $P_x = A_x - M_x$, where P_x is the import price (including any possible tariff) and M_x is the import level.[9] The parameter $A_x > 0$ is a measure of the size of the market in X for importers. The country can import the good from countries Y and Z at constant marginal costs equal to C_y and C_z, respectively, $C_z < C_y$.

Initially, country X imposes a specific tariff of t_x on the good imported from Y and Z. Thus the total cost of importing one unit of the good from countries Y and Z are $C_y + t_x$ and $C_z + t_x$, respectively. To have the case to be examined in this paper, we assume that $C_z < C_y < C_z + t$. Thus country X chooses to import the good from Z, and the domestic price in X is $P_x = C_z + t_x$. Denote the corresponding import level by M_x^e.

The present situation can be illustrated in Figure 1. Curve AB is the import demand curve of country X. With the initial import price equal to $C_z + t$, the import level is M_x^e.

Countries X and Y now form an FTA. When exported to country X, the good from Y is no longer subject to the tariff, but the good from Z is.

[7] External tariffs are assumed not affected by the FTA. In reality, that may not be the case. See Panagariya and Findlay (1996), Cadot, de Melo, and Olarreaga (1999), and Ornelas (2006) for theoretical analyses, and Foroutan (1998), Limao (2005), and Karacaovali and Limao (2005) for empirical studies.

[8] The literature show the controversial views on the role of transport costs in the formation of PTAs. Krugman (1991) and Frankel, Stein and Wei (1995) suggest that transport costs are critical factor to choose a PTA partner. However, Bhagwati(1993), Bhagwati and Panagariya (1996) and Panagariya (1997b) argue that transport costs are no different than any other costs.

[9] We allow the possibility of positive production of the good in country X.

Because $C_y < C_z + t$, country X will choose to import the good from Y instead of from Z, with the new import volume equal to $M_x^g > M_x^e$, meaning that trade with Z has been diverted to Y. Denote the trade volume diverted by $D = M_x^e$.

We now examine how the trade volume diverted may represent a change in country X's welfare. From country X's import demand function,

$$D = D(A_x, C_z, t_x) = A_x - C_z - t_x. \tag{1}$$

Differentiating both sides of (1), we have:

$$\mathrm{d}D = \mathrm{d}A_x - \mathrm{d}C_z - \mathrm{d}t_x, \tag{2}$$

which an increase in A_x or a decrease in C_z or t_x will lead to a bigger trade volume diversion. This result is summarized by the following lemma.

Lemma 1: *The trade volume diverted (from Z to Y) as the X-Y FTA is formed will be bigger if market X is bigger, cost in Z is lower, or X's initial tariff rate is lower. The trade volume diverted is not affected by the cost in Y.*

We now turn to the welfare of this industry of country X, which can be represented by the sum of consumers' surplus, producers' surplus, and the tariff revenue. When countries X and Y establish an FTA, the market price of the product drops from $C_z + t$ to C_y. The resulting change in the welfare of this market of X, denoted by W_x, consists of two components, the change in net surplus equal to area $(a + c)$ in Figure 1 and the loss in tariff revenue equal to area $(a + b)$.[10] Thus

$$W_x = (a + c) - (a + b) = c - b. \tag{3}$$

Equation (3) shows that the change in welfare is in general ambiguous. Area c is the traditional gains from trade while b is the net loss in tariff revenue. Using Figure 1 further, the change in welfare reduces to

$$\begin{aligned} W_x &= W_x(A_x, C_y, C_z, t_x) \\ &= (C_z + t_x - C_y)(A_x - C_z - t_x) + \frac{1}{2}(C_z + t_x - C_y)^2 - t_x(A_x - C_z - t_x) \\ &= \frac{1}{2}(C_y^2 - C_z^2) + \frac{1}{2}t_x^2 - A_x(C_y - C_z). \end{aligned} \tag{4}$$

[10] Net surplus is the consumers' surplus less producers' surplus.

The dependence of the change in welfare can be given by differentiating both sides of (4) to give:

$$\mathrm{d}W_x = (A_x - C_z)\mathrm{d}C_z - (A_x - C_z)\mathrm{d}C_y - (C_y - C_z)\mathrm{d}A_x + t_x\mathrm{d}t_x, \qquad (5)$$

which means that an increase in C_z or t_x, or a decrease in C_y or A_x will lead to a bigger increase in W_x.

Lemma 2: *The increase in the welfare of market X caused by the X-Y FTA will be bigger algebrically if market X or the cost in Z is smaller, or the cost in Y or X's initial tariff rate is higher.*

Leamms 1 and 2 show how the trade volume diverted and the welfare increase may be affected by the parameters. The question we have is, is the trade volume diverted a reliable indicator of the change in welfare? Does a bigger trade volume diverted imply a bigger welfare damage? To answer thess questions, consider parameter i, where $i = A_x$, C_z, or t_x. From equations (1) and (4), the changes of D and W_x caused by a change in i (while all other exogenous variables are kept constant) is given by

$$\left.\frac{\mathrm{d}W_x}{\mathrm{d}D}\right|_i = \frac{\mathrm{d}W_x/\mathrm{d}i}{\mathrm{d}D/\mathrm{d}i} < 0. \qquad (6)$$

The sign of the expression in equation (6) comes from (2) and (5): a change in A_x, C_z, or t_x will affect D and W_x in opposite directions. This means that a bigger diverted trade volume, if caused by an appropriate change in A_x, C_z, or t_x, does suggest that the X-Y FTA is more detrimental. If, however, there is a decrease in C_y, by Lemmas 1 and 2, D will not change but W_x will drop. The latter case can be explained by using Figure 1: A rise in C_y will not affect the trade volume diversion, M_x^e, but will affect the sizes of aread c and b, and thus the change in welfare of market X.

These results are summarized as follows:

Proposition 1: *A bigger trade volume diverted (from Z to Y) caused by a X-Y FTA will be more detrimental to market X if the change in trade volume diversion is caused by a bigger market X or a small production cost in Z or a lower initial tariff rate of X. If the production cost in Y drops instead, the trade volume diversion will not change while the increase in the welfare of market X will be smaller (or the decrease in welfare bigger).*

To understand the above results further, we can consider the parameter C_z. Suppose that $\mathrm{d}C_z > 0$ while $\mathrm{d}A_x = \mathrm{d}C_y = \mathrm{d}t_x = 0$. Equations (2) and (5) can be combined to give:

$$\left.\frac{\mathrm{d}W_x}{\mathrm{d}D}\right|_{C_z} = -(A_x - C_z) < 0. \tag{7}$$

The relation between W_x and D is shown by curve DW in Figure 2. The slope of the curve is equal to $-(A_x - C_z)$. The vertical and horizontal intercepts can be obtained by making use of equation (1) and (4): When $D = 0$, the corresponding welfare change is $W_{x0} = (A_x - C_y)^2/2 > 0$ or when $W_x = 0$, the corresponding trade volume diverted is $D_0 = -t_x + \sqrt{(A_x - C_y)^2 + t_x^2} > 0$. In the present case, an FTA with a small diverted trade volume benefits country X.

3 Intra-industry Trade

We now consider the welfare impacts of an FTA in the presence of imperfect competition and intra-industry trade.

3.1 The Model

Consider again three countries labeled X, Y, and Z, and a homogeneous product.[11] In country i, i = X, Y, Z, there are n_i firms producing the product and competing in a Cournot fashion. Assume for simplicity that all firms face the same marginal cost of c, which is independent of output level. The demand for the product by the consumers in country i is $P_i = A_i - Q_i$, where P_i is the market price and Q_i is the demand.

Before the formation of any free trade area, each country imposes the same specific tariff rate, t, on the product imported, independent of the country of origin. We assume that the demand is sufficiently large and the tariff sufficiently small so that there is intra-industry trade in the good among the countries. (Brander and Krugman, 1983). Denote the sale of the product by a representative firm in country i to the market in j by q_j^i, i, j = X, Y, Z, which is subject to a specific tariff of t_j^i, where $t_j^i = t$ for $i \neq j$ or $t_j^i = 0$

[11] The present model is adopted from Krishna (1998).

for $i = j$. In equilibrium, $Q_j = \Sigma_i n_i q_j^i$. The profit of the firm, π_i, consists of the profit from market j, π_i^j, i.e., $\pi_i = \Sigma_j \pi_i^j$, where

$$\pi_i^j = q_j^i \left[A_j - Q_j - (c + t_j^i) \right]. \tag{8}$$

The firm chooses the outputs, q_j^i, to maximize its profit, taking the tariff rate and the outputs of all other firms are given. The first-order conditions (assuming intra-industry trade) are:

$$A_x - q_x^i - \sum\nolimits_j n_j q_x^j - c - t_x^j = 0 \tag{9a}$$

$$A_y - q_y^i - \sum\nolimits_j n_j q_y^j - c - t_y^j = 0 \tag{9b}$$

$$A_z - q_z^i - \sum\nolimits_j n_j q_z^j - c - t_z^j = 0. \tag{9c}$$

Denote the total number of firms by $n = n_x + n_y + n_z$. Solving the first-order conditions (9) for all the firms, we get the Nash equilibrium supply by a firm in country i to country j:

$$q_j^i = \frac{A_j - c + \Sigma_k n_k t_j^k}{n+1} - t_j^i, \tag{10}$$

where the summation is over X, Y, and Z. For example, condition (10) gives country X's import from a firm in country Z:

$$q_x^z = \frac{A_x - c - t(1 + n_x)}{n+1}. \tag{11}$$

From (8) and (10), we can get the profit received by a firm in country i from the market in country j :

$$\pi_i^j = \left[q_j^i \right]^2. \tag{12}$$

Condition (12) shows a monotonic positive relation between the profit of a firm in country i from a market and the output to that market. Condition (12) also gives the total profit received by a firm in country i:

$$\pi_i = \Sigma_j \pi_i^j = \Sigma_j [q_j^i]^2. \tag{13}$$

3.2 Formation of An FTA

Suppose now that countries X and Y form a free trade area (FTA), while maintaining the tariff on the good from Z. Let us use a subscript "xy" before a variable to represent it in the presence of the FTA; for example, ${}_{xy}q_x^z$ is the export of a firm in country Z to country X in the presence of the X-Y FTA. Applying (11), the Nash equilibrium FTA-volume of country X's import of the good from a firm in country Z is

$$ {}_{xy}q_x^z = \frac{A_x - c - t(1 + n_x + n_y)}{n+1}. \tag{14} $$

Condition (13) can be applied to find the resulting profit of a firm in country X after the formation of the FTA:

$$ {}_{xy}\pi_x = \Sigma_j [{}_{xy}q_j^x]^2. \tag{15} $$

We now compare the pre-FTA equilibrium with the post-FTA equilibrium. In particular, we want to see whether the FTA will likely to be accepted by country X. We assume a political-economic approach similar to the one in Grossman and Helpman (1994, 1995) and Krishna (1998), so that the decision of whether an FTA is chosen is based solely on whether the profits of local firms increase.[12] We will examine the relations between the volume of trade diverted and the local firms' profits.

We say that for country X trade is diverted from country Z to country Y if there is a drop in the volume of import from country Z, or if $q_x^z > {}_{xy}q_x^z$.[13] In this case, we define for country X the trade volume diverted from country Z, D, by

$$ \begin{aligned} D &= D(n_x, n_y, n_z, t) = n_z \left[q_x^z - {}_{xy}q_x^z \right] \\ &= t \left(\frac{n_y n_z}{n+1} \right). \end{aligned} \tag{16} $$

[12] The objective function of each government in the model of Grossman and Helpman (1994, 1995) is a weighted sum of campaign contributions from the lobbies and overall welfare of voters while the decision of an FTA solely depends on the local firm's profits in the model of Krishna (1998). Kowalczyk and Davis (1996) test the political-economy model with the United States data by finding that import-competing lobbies were the strongest in the sectors which were allowed the longest tariff phase out periods.

[13] For the purpose of this paper, we do not examine whether the volume of import from country Y will increase by the amount of volume of trade diverted.

The derivatives of D can be obtained from (16):

$$\frac{\partial D}{\partial t} = \frac{n_y n_z}{n+1} > 0 \tag{17a}$$

$$\frac{\partial D}{\partial n_x} = -\frac{t n_y n_z}{(n+1)^2} < 0 \tag{17b}$$

$$\frac{\partial D}{\partial n_y} = \frac{t n_z (1+n_x+n_z)}{(n+1)^2} > 0 \tag{17c}$$

$$\frac{\partial D}{\partial n_z} = \frac{t n_y (1+n_x+n_y)}{(n+1)^2} > 0. \tag{17d}$$

The intuition for the signs of the derivatives in (17) is simple. If the initial tariff rate is higher, it means a greater drop in the tariff on the good from country Y. Thus a higher initial tariff rate, or a larger number of firms in country Y or Z will result in a bigger impact on trade and thus a bigger volume of trade diverted. A larger number of firms in country X will have a smaller impact, however, because it will tend to diminish the impact of the FTA.

Subtracting condition (13) from (15), we get the change in the profit of a representative firm in X:

$$\begin{aligned} \Pi_x &= \Pi_x(A_x, A_y, n_x, n_y, n_z, t, c) \equiv {}_{xy}\pi_x - \pi_x \\ &= \left[({}_{xy}q_x^x)^2 + \left({}_{xy}q_y^x\right)^2 + ({}_{xy}q_z^x)^2 \right] - \left[(q_x^x)^2 + \left(q_y^x\right)^2 + (q_z^x)^2 \right] \\ &= \frac{t\Phi}{(n+1)^2}. \end{aligned} \tag{18}$$

where $\Phi = 2(A_y - c)(1+n_y+n_z) + t(n_z)^2 - t(1+n_y)^2 - 2(A_x - c)n_y - tn_y^2 - 2tn_y n_z$. Condition (18) can be used to derive how these exogenous variables may affect the change in profit. First, we get the effects of a change in the size of the markets:

$$\frac{\partial \Pi_x}{\partial A_x} = -\frac{2tn_y}{(n+1)^2} < 0 \tag{19a}$$

$$\frac{\partial \Pi_x}{\partial A_y} = \frac{2tn_y(1+n_y+n_z)}{(n+1)^2} > 0. \tag{19b}$$

Conditions (19) imply that a smaller local demand or a bigger demand in country Y will allow country X to gain more from the FTA. This result is not

surprising as a bigger market in a member country will allow the local firms to export more while a bigger local market will attract more competition from the firms in a member country.

We then turn to the effects of the number of firms in each of the countries.

$$\frac{\partial \Pi_x}{\partial n_x} = -\frac{2t\Phi}{(n+1)^3} \tag{20a}$$

$$\frac{\partial \Pi_x}{\partial n_y} = \frac{-2t[(A_x - A_y) + t(1 + 2n_y + n_z)]}{(n+1)^2} - \frac{2t\Phi}{(n+1)^3} \tag{20b}$$

$$\frac{\partial \Pi_x}{\partial n_z} = \frac{2t[(A_y - c) + t(n_z - n_y)]}{(n+1)^2} - \frac{2t\Phi}{(n+1)^3}. \tag{20c}$$

Note that for the purpose of our analysis, we assume that $\Pi_x > 0$, i.e., country X is willing to form an FTA with country Y. This implies that $\Phi > 0$, and that by (20a) $\partial \Pi_x / \partial n_x < 0$. For (20b), if it is further assumed that

$$A_x \geq A_y, \tag{21}$$

then $\partial \Pi_x / \partial n_y < 0$. For (20c), $\partial \Pi_x / \partial n_z < 0$ if and only if

$$n_z > \frac{n_y\{2(A_x - c) - (A_y - c) - t(1 + n_x)\} + (A_y - c)(n_x - 1) + t(1 + n_y)^2}{(A_y - c) - t(1 + n_x + 2n_y)}. \tag{22}$$

We now examine the impacts of a change in t or c.

$$\frac{\partial \Pi_x}{\partial t} = \frac{\Phi + t(n_z^2 - (1 + n_y)^2 - n_y^2 - n_y n_z)}{(n+1)^2} \tag{23a}$$

$$\frac{\partial \Pi_x}{\partial c} = -\frac{2(t + tn_z)}{(n+1)^2} < 0. \tag{23b}$$

The effect of a higher initial tariff rate t on the change in the profit of a firm in country X is complicated: If the initial tariff rate is larger, both countries X and Y will experience a substantial drop in the tariff rate. For firms in country X, it is good because it will be easily to invade into the market in country Y, but it is also bad because it will be easier for firms in country Y to invade into the local market. In general, the net effect is ambiguous. Condition (23a) can be rearranged to show that if

$$t > \frac{2(A_x - c)n_y - 2(A_y - c)(1 + n_y + n_z)}{2n_z^2 - 2(1 + n_y)^2 - 2n_y^2 - 3n_y n_z}, \tag{24}$$

then $\partial\Pi_x/\partial t > 0$. On the other hand, condition (23b) means that if the marginal cost of all firms is lower, the gain in the profit of each firm in country X will be higher.

The above results are summarized by the following proposition:

Proposition 1 *If the firms in country X would support an FTA with country Y, each of them will get a bigger profit improvement if*

1. *the size of country X's market A_x is smaller; or*
2. *the size of country Y's market A_y is larger; or*
3. *the number of firms in country X n_x is smaller; or*
4. *the number of firms in country Y n_y is smaller, if condition (21) is satisfied;*
5. *the number of firms in country Z n_z is smaller, if condition (22) is satisfied; or*
6. *the initial tariff rate t is higher, if condition (24) is satisfied; or*
7. *the common marginal cost c is lower.*

3.3 Trade Volume Diverted and Profit Change

Conditions (16) and (18) show that for country X the volume of trade diverted from country Z to country Y, D, and the change in the profit of each firm in country X, Π_x, are dependent on some exogenous variables. A change in some of exogenous variables could change D and Π_x simultaneously. We now examine how D and Π_x may change. The analysis in the previous section shows that the D-Π_x relationship depends on which exogenous variable is changing. A general theory can be provided as follows. Suppose that an exogenous variable v changes and that it may affect both Π_x and D. Thus the D-Π_x relations can be given by

$$\left.\frac{\mathrm{d}\Pi_x}{\mathrm{d}D}\right|_v = \frac{\partial\Pi_x/\partial v}{\partial D/\partial v}. \tag{25}$$

Condition (25) immediately gives the following lemma:

Lemma 2 *$d\Pi_x/dD|_v < 0$ if and only if sign$(\partial\Pi_x/\partial v) \neq$ sign$(\partial D/\partial v)$.*

We now make use of the lemma to see how trade volume diverted and the change in firm profit may be related to each other. We can consider the following cases:

(a) *The Smaller-Trade-Diversion-the-Better Case*

We note that an increase in the number of firms in Y or Z will enlarge the trade volume diverted, D, but will lower the profit improvement each firm in X will experience, under the conditions stated in Proposition 2. This means that

$$\left.\frac{\mathrm{d}\Pi_x}{\mathrm{d}D}\right|_v = \frac{\partial\Pi_x/\partial v}{\partial D/\partial v} < 0, \tag{26}$$

where $v = n_y$ or n_z. In these cases, a bigger volume of trade diverted from country Z to country Y is not good in terms of the profit of the firms in country X.

(b) *The Larger-Trade-Diversion-the-Better Case*

If there is a decrease in the number of firms in country X or a larger initial tariff rate, both the trade volume diverted and the profit improvement experienced by each firm in country X will go up. Thus we have

$$\left.\frac{\mathrm{d}\Pi_x}{\mathrm{d}D}\right|_u = \frac{\partial\Pi_x/\partial u}{\partial D/\partial u} > 0, \tag{27}$$

where $u = n_x$ or t. In these cases, a bigger volume of trade diverted from country Z to country Y represents a bigger profit improvement experienced by each firm in country X.

(c) *The Trade-Diversion-Does-Not-Matter Case*

If, however, there is a decrease in A_x or c, or there is an increase in A_y, then each firm in X will experience a bigger profit improvement but the volume of trade diverted will not be affected. This means that there is no direct relation between trade diversion volume and the profit improvement of the firms in country X.

In the present case with intra-industry trade, we can identify three types of relations between trade volume diverted and profit improvement. In the

case of inter-industry trade, we find only the smaller-trade-diversion-the-better case and the trade-diversion-does-not-matter case, but not the large-trade-diversion-the-better case.

The direct relation between the trade diversion volume and profit improvement was probably first pointed out by Krishna (1998). He argued that a country facing a non-member country with more firms producing the product is more likely to form an FTA because of a bigger profit improvement for local firms. Our results are quite different from his. First, we note that with inter-industry trade, profit improvement is likely negatively related to the welfare improvement. Second, with intra-industry trade, an increase in the trade diversion volume may indicate an increase, a decrease, or no change in the trade diversion increase, depending on the factor that causes a change in the trade diversion volume in the first place. Third, even if we consider only the case in which there is a change in the number of firms in the non-member country Z, we note that the relations between the trade diversion volume and the profit improvement is in general ambiguous, and is negative if condition (22) is satisfied.

3.4 Volume of Trade Diverted and Welfare Change

In this section we see how the volume of trade diverted is related to country X's welfare, not profits alone. This would be of help to show the difference more clearly between results from the model with perfect competition and those from the model with imperfect competition.

As the goverment welfare function is composed of the firms profit, consumers' surplus, and the tariff revenue from the imports, the welfare improvement with an FTA is equal to

$$
\begin{aligned}
W_x &= W_x(A_x, A_y, n_x, n_y, c, t) \equiv_{xy} w_x - w_x \\
&= n_x[\Pi_x(A_x, A_y, n_x, n_y, c, t)] \\
&\quad + \left[\left(\int_0^{{}_{xy}Q_x} p_{{}_{xy}Q_x}(v)\mathrm{d}v - p_{{}_{xy}Q_x}Q_x\right) - \left(\int_0^{Q_x} p_{Q_x}(v)\mathrm{d}v - p_{Q_x}Q_x\right)\right] \\
&\quad + t[n_z({}_{xy}q_x^z - q_x^z) - n_y(q_x^y)] \\
&= n_x\left[(({}_{xy}q_x^x)^2 + \left({}_{xy}q_y^x\right)^2 + ({}_{xy}q_z^x)^2) - ((q_x^x)^2 + \left(q_y^x\right)^2 + (q_z^x)^2)\right] \\
&\quad + \frac{1}{2}\left[(n_x({}_{xy}q_x^x) + n_y({}_{xy}q_x^y) + n_z({}_{xy}q_x^z))^2 - (n_x(q_x^x) + n_y(q_x^y) + n_z(q_x^z))^2\right] \\
&\quad + t[n_z({}_{xy}q_x^z - q_x^z) - n_y(q_x^y)] \\
&= \frac{tn_x\Phi}{(n+1)^2} + \frac{tn_z\{2n(A_x - c) - t(n_y + 2n_z)\}}{2(n+1)^2} \\
&\quad - \frac{tn_y\{(A_x - c) - t(n_x + 1 - n_z)\}}{n+1}.
\end{aligned} \tag{28}
$$

where w_x is the welfare of country X. In equation (28), the term with the first square bracket represents the change in all firms profits in country X, the second square bracket represents the improvement of consumers' surplus, and the last term is the change in the tariff revenue on the imiports from countries Y and Z.

Equation (28) can be used to derive how the exogenous variables may affect the change in welfare. First, we get the effects of a change in the size of markets:

$$
\frac{\partial W_x}{\partial A_x} = \frac{t(n_z^2 - n_y^2 - 3n_xn_y + n_xn_z - n_y)}{(n+1)^2}. \tag{29a}
$$

$$
\frac{\partial W_x}{\partial A_y} = \frac{2tn_xn_y(1 + n_y + n_z)}{(n+1)^2} > 0. \tag{29b}
$$

The sign of (29a) is not determined and depends on the number of firms in each of countries. From condtion (19a) we know that as the local demand increases the change in the profit of a firm in X declines. We also know that the bigger initial imports from a member country due to higher demand in local market implies greater loss of the tariff revenue with an FTA.[14] However,

[14]The country X's initial volume of trade with Y is $\frac{(A_x - c) - t(n_x + 1)}{n+1}$.In this model, if a

the consumers' gain increases in their demand. Thus, overall welfare impact due to an increase in the size of market is ambiguous.

Since A_y does not affect consumers' surplus and the government tariff revenue of a country X, the sign of (29b) is the same as that of (19b). For (29a), $\partial W_x/\partial A_x > 0$ if

$$n_z > \frac{n_y^2 + 3n_x n_y + n_y}{n_x + n_z}. \tag{30}$$

We then turn to the effects of the number of firms in each of the countries.

$$\begin{aligned}
\frac{\partial W_x}{\partial n_x} &= \frac{t\Phi(n_y + n_z + 1 - n_x)}{(n+1)^3} \\
&\quad - \frac{tn_z\{(n-1)(A_x - c) - t(n_y + 2n_z)\}}{(n+1)^3} \\
&\quad + \frac{tn_y\{(A_x - c) + (n_y + 2n_z)\}}{(n+1)^2}. \qquad (31a) \\
\frac{\partial W_x}{\partial n_y} &= -\frac{2tn_x[(A_x - A_y) + t(1 + 2n_y + n_z)]}{(n+1)^2} - \frac{2tn_x\Phi}{(n+1)^3} \\
&\quad - \frac{tn_z\{2(n-1)(A_x - c) - t(n_x - n_y - 3n_z + 1)\}}{2(n+1)^3} \\
&\quad - \frac{t(n_x - n_y + n_z + 1)\{(A_x - c) - t(n_x + 1 - n_z)\}}{(n+1)^2}. \qquad (31b) \\
\frac{\partial W_x}{\partial n_z} &= \frac{2tn_x[(A_y - c) + t(n_z - n_y)]}{(n+1)^2} - \frac{2tn_x\Phi}{(n+1)^3} \\
&\quad + \frac{t\{2(A_x - c)(n + n_z) - tn_y\}}{2(n+1)^2} - \frac{tn_z\{(2n(A_x - c) - t(n_y + 2n_z)\}}{(n+1)^3} \\
&\quad + \frac{tn_y\{(A_x - c) + (n_y + 2n_z)\}}{(n+1)^2}. \qquad (31c)
\end{aligned}$$

The relations of welfare change and the number of firms in each country are not very clear even though change in welfare levels is most likely to decline with an increase in the number of firms in partner country from (31b). As

member country forms an FTA, the tariff revenue of a member country always falls: First, it does not collect the tariffs from a partner country. Second, the tariff revenue from the non-member countries decreases along with the drop of the volume of trade with them.

the number of firms from each country increases, the quantitiy sold in the X's market goes up. It brings larger gains to consumers. However, the firms in country X lose more if there exist more foreign firms competing in the local markets while gains less in the other countries. After the formation of an FTA with Y, the impact (net loss) of profits due to change in the number of foreign firms would be larger in case of change in number of firms in Y. In addition, the tariff revenue declines the most with an increase in the number of firms in Y after an FTA.

We now examine the impacts of a change in t or c.

$$\begin{aligned}\frac{\partial W_x}{\partial t} &= \frac{n_x\{\Phi + t(n_z^2 - (1+n_y)^2 - n_y^2 - n_y n_z)\}}{(n+1)^2} \\ &\quad + \frac{n_z\{n(A_x - c) - t(n_y + 2n_z)\}}{2(n+1)^2} \\ &\quad - \frac{\{n_y(A_x - c) - 2t(n_x + 1 - n_z)\}}{n+1}. \qquad (32a)\\ \frac{\partial W_x}{\partial c} &= \frac{t(n_y(n_x + n_y + 1) - 2n_x - 3n_x n_z - n_z)}{(n+1)^2}. \qquad (32b)\end{aligned}$$

Tariff elimination on the imports from Y makes consumers better off, and if the initial tariff rate is higher, this effect increases while the tariff revenue drops more. The impacts on profits are ambigous as shown in (23a). It results in an undetermined sign of (32a). The marginal cost effect on welfare is also not clear. The firm's profits are negatively related to change in marginal costs as shown in (23a), and consumers' surplus is expected to increase less if the marginal cost is higher, but the goverment loses less tariff revenue due to the smaller initial imports from outside.

In summary, the signs of $\partial W_x/\partial v$ where v is an exogeneous varible, are not straightforward and hard to determine without pre-conditions in most of cases. Accordingly, the D-W_x relations which can be given by $\frac{\mathrm{d}W_x}{\mathrm{d}D}\big|_v = \frac{\partial W_x/\partial v}{\partial D/\partial v}$ are not straightforward.

3.5 Numerical Experiment

To provide better insights on ambigous relations between the volume of trade diverted and the change in welfare levels in the presence of imperfect competition, we simulate the economy with an FTA under the intra-industry trade

model. We assign values to each of the fixed exogenous variables as follows: $n_x = 2, n_y = 4, n_z = 2, A_x = 10,000, A_y = 15,000, t = 300,$ and $c = 1,500$.

Figures 3-6 illustrate the the relations between the volume of trade diverted and the change in firm's profts (D-Π_x) and the change in welfare levels (D-W_x) due to the change in one of exogenous variables, n_z, n_x, n_y,and t respectively. In each figure, section (a) depicts the relation between the volume of trade diverted and one of exogenous variables. Sections (b) and (c) show how welfare change (or profits of a local firm) is related to one of exogeous varibles and how it is related to the volume of trade diverted respectively. In sections (b) and (c), dashed lines represent change in the firm's profit (Π_x) and solid lines represent change in welfare (W_x).

Figure 3, section (a) shows the positive relation between the volume of trade diverted and n_z. In Figure 3, section (b) we see that the firm's profit change start to fall around the point when $n_z = 3$. Accordingly, in figure 3, section (c) the D-Π_x curve is down-ward sloping after $n_z = 3$. It indicates that the bigger trade diversion with larger n_z does not guarantee a positive improvement of the firm's profits of a member country and thus, a large trade diversion does not always imply a higher likelihood of an FTA to be approved as argued by Krishna (1998) in his political-eonomy model. In this example, however, the welfare improvement is positively related to the trade diversion as shown in Figure 3 section (c).

We also observe that the signs of D-Π_x and D-W_x are the same when n_z is small (positive) but different as n_z and the volume of trade diverted increase. Thus, the difference between these two become larger as the volume of trade diverted rises. Note that the change in profits *per se* could be positive while the change in profits falls. After an FTA, the change in profits become negative after the volume of trade diverted reaches $1,300$. More interestingly, if the volume of trade diverted is fairly small, the FTA is welfare-deteriorating (W_x is negative) while it is welfare-enhancing if the trade diverted is greater than 165. This result is opposite to that from the perfect competition model in section 2.

Figure 4, section (a) shows that the volume of trade diverted and n_x is negatively related. Because a larger number of firms from X brings less gain to a local firm, we see the upward-sloping D-Π_x curve in section (b), which says that the bigger trade diversion is better. Figure 4, section (c) shows that the change in welfare is positive and rises when the trade diversion is small, but it becomes negative and decreases as the volume of trade diverted reaches at some point.

In figure 5, sections (a) and (b) we see that the volume of trade diverted increases in n_y, and as the profit change and welfare improvement become smaller as n_y rises respectively. Accordingly, the profit change and welfare improvement decline as the trade diversion increases as shown in section (c).

Figure 6, section (a) illustrates the positive linear relation between the volume of trade diverted and the tariff rate. In sections (b) and (c) we observe that the profit changes increase initially and then decrease as t and trade diversion rise respeictively while the welfare change is always increasing. Also notice that the welfare change is always positive in all ranges in this case.

These figures clearly show that the D-Π_x and the D-W_x relations are not straightforward. The sign of the profit and welfare improvement depends on the exogenous variable which changes the level of the trade diversion and the conditions of other variables. We also find that the direction of their movement is not necessarily opposite.

4 Concluding Remarks

In this paper, we examine the relation between the trade volume diverted and the change in welfare (or profits of local firms) using two different types of trade models: inter-industry trade in the presence of perfect competition and intra-industry trade with oligopoly. We argue that the relation depends on the type of trade considered. We show that if trade is of the inter-industry trade type, a rise in the trade volume diverted in general is related to a smaller change in welfare. This is because a bigger trade diversion generally results in a larger drop in consumer's gains and/or a higher degree of tariff loss in the presence of perfect competition. However, if intra-industry trade with oligopoly is considered, then the relation between trade volume diverted and profit (welfare) change is not so straightforward. It can be either positive, negative or ambiguous depending on economic variables which affect the volume of trade diverted and the level of other variables. If imperfect competition exists, it is difficult to define how the change in profits, consumer's gains and tariff loss are affected by the trade diversion. These resutls show that Krishna's (1998) finding that larger trade diversion yield higher profits may not hold.

An interesting result is that if the trade volume diverted is small, the welfare change could be positive in the inter-industry trade.This means that

a trade diversion can be welfare improving if the volume of trade diverted is small. If the intra-industry trade model with imperfect competition is taken into account, a member country's welfare may drop in the presence of small trade diversion, but improve as the trade diversion increases. It presents a contrast to common belief that small trade diversion can be ignored if the trade-creating effect is significant.We also find that in the existence of imperfect competition profit and welfare improvement move to the same direction in some cases.This implies that a welfare-detioriating FTA commonly identified by a bigger trade volume diverted is not necessarily more likely to be approved as previously found in the political economic literature.[15]

[15]See Grossman and Helpman (1995) and Krishna (1998).

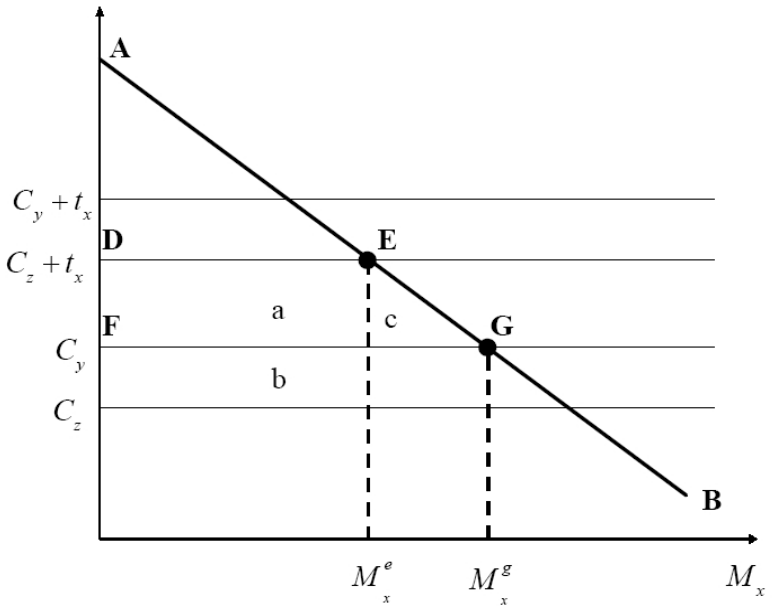


Figure 1 Equilibrium Prices

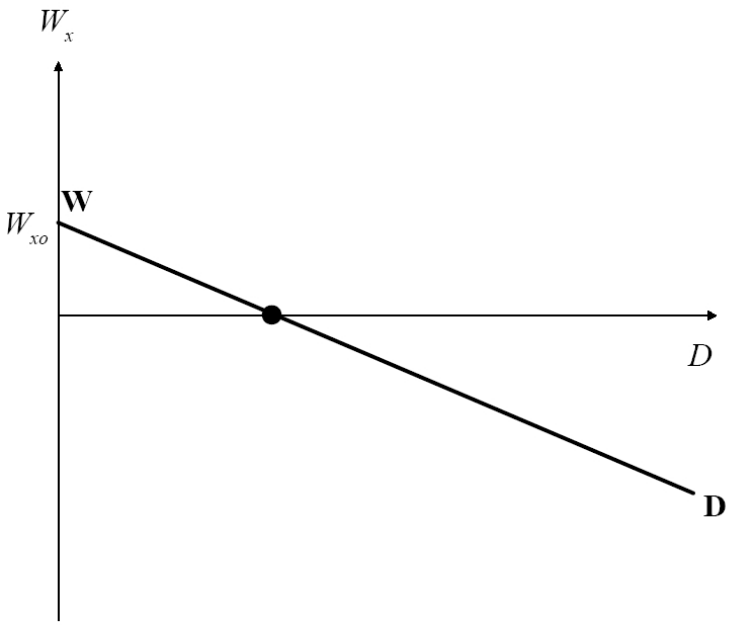
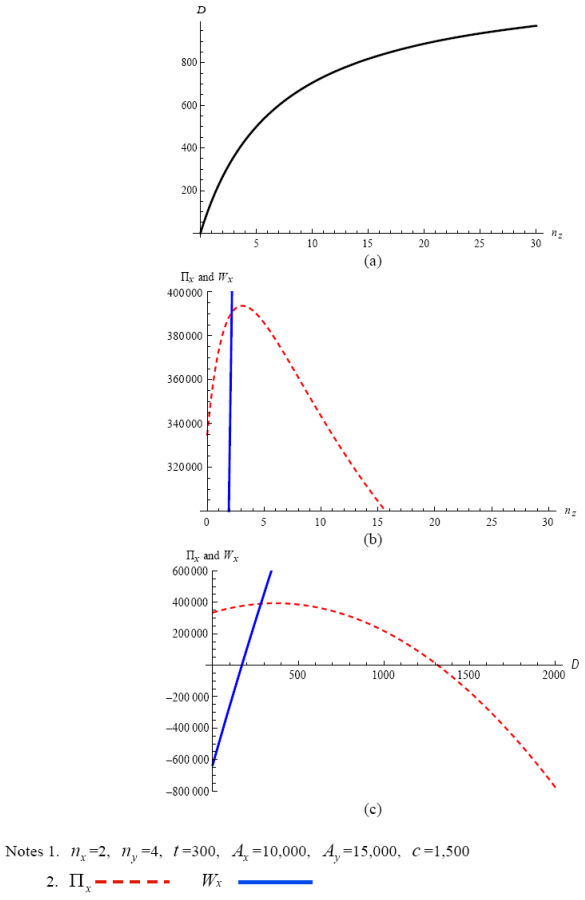


Figure 2 The Smaller-Trade-Diversion-the Better Case



Notes 1. n_x=2, n_y=4, t=300, A_x=10,000, A_y=15,000, c=1,500

2. Π_x - - - - W_x ——

Figure 3 Volume of Trade Diverted and Change in Welfare due to n_z

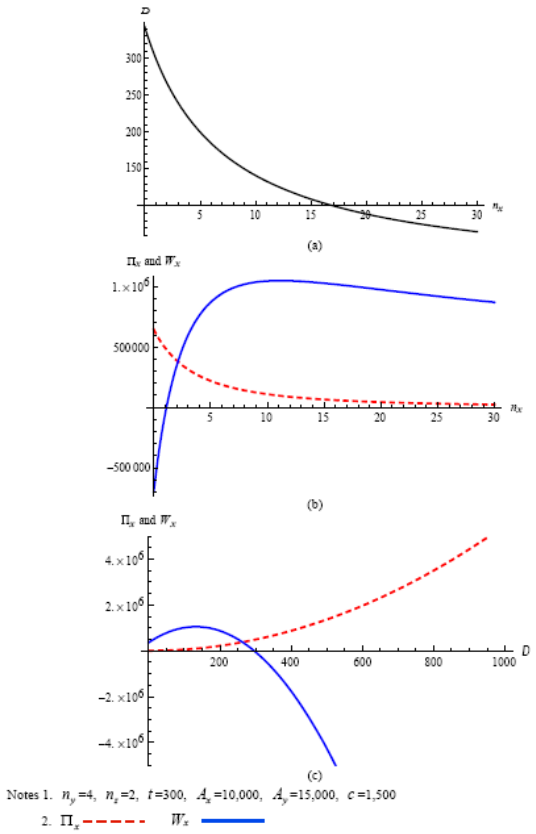
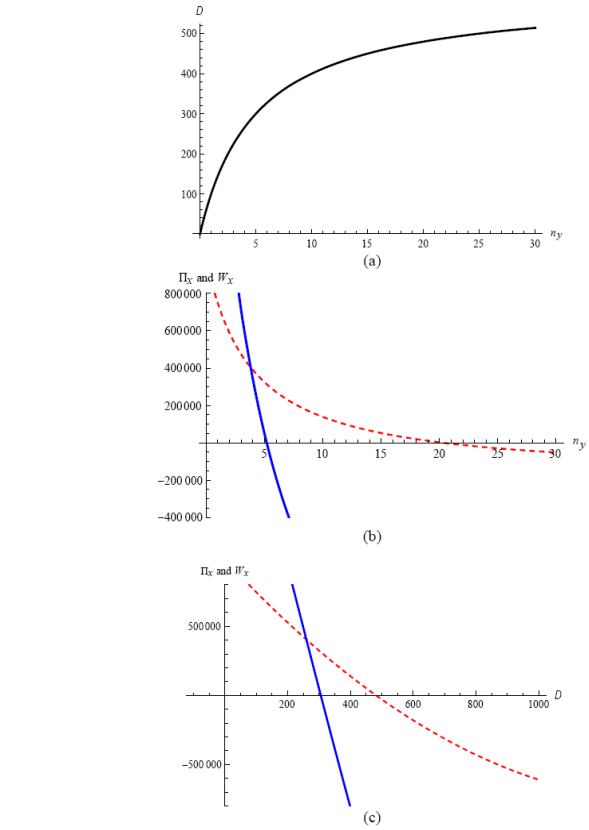


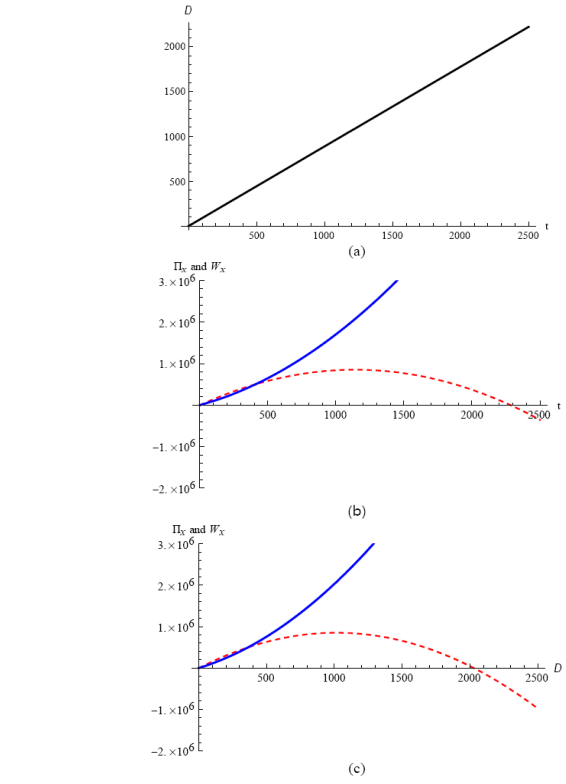
Figure 4 Volume of Trade Diverted and Change in Welfare due to n_x



Notes 1. n_x=4, n_z=2, t=300, A_x=10,000, A_y=15,000, c=1,500

2. Π_x ---------- W_x ——————

Figure 5 Volume of Trade Diverted and Change in Welfare due to n_y



Notes 1. n_x=2, n_y=4, n_z=2, A_x=10,000, A_y=15,000, c=1,500

2. Π_x - - - - W_x ——

Figure 6 Volume of Trade Diverted and Change in Welfare due to t

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