Hub and spoke trade agreements under oligopoly with asymmetric costs

Yildiz, Halis Murat

Ryerson University

2 October 2011

Hub and Spoke Trade Agreements under Oligopoly with Asymmetric Costs

Halis Murat Yildiz*

October 4 2011

Abstract

Using an oligopoly model of trade with asymmetric costs, we study the individual and world welfare implications of a hub and spoke trade agreement where the hub country is more efficient than spoke countries. Under a hub and spoke trade regime, the hub country can benefit at the expense of the spokes relative to free trade. Furthermore, if the hub is sufficiently efficient compared to the spokes, such a regime can yield higher global welfare than free trade. Preferential treatment of the efficient hub country in its export markets improves world welfare because it helps allocate a larger share of the world's output to a low cost location.

Keywords: oligopoly, hub and spoke trade agreements, global free trade.

JEL Classifications: F12, F13.

*Department of Economics, Ryerson University, 350 Victoria Street, Toronto, ON, Canada M5B 2K3. Phone: 416-979-5000 (ext 6689); fax: 416-979-5289; e-mail: hyildiz@ryerson.ca.

1 Introduction

One of the striking features of today's global policy landscape is the widespread prevalence of preferential trade agreements (PTAs). As per the World Trade Organization's (WTO) official website, as of 2011, all but one of the WTO 153 members is a party to at least one PTA (Mongolia is the exception), and on average each WTO member country belongs to 13 PTAs. We even observe today that PTAs are in discussion with each other regarding mutual liberalization. While the existing customs unions involve some of the major economies of the world, Free Trade Areas (FTAs) constitute an overwhelming majority of PTAs, accounting for 83 percent of all PTAs.[1] Since FTA members impose individually optimal tariffs on non-members, a member country of a bilateral FTA is free to form an independent bilateral FTA with an existing non-member and create a hub and spoke type trading regime.[2] For example, Mexico, as a member of North American Free Trade Agreement (NAFTA), has FTAs with the European Union (EU), European Free Trade Association (EFTA), Chile, Israel, Japan, and many others. This difference has important implications given the fact that countries belong to several PTAs in today's world trading system. The goal of this paper is to contribute to the literature by deriving the individual and world welfare implications of hub and spoke regimes relative to global free trade under an oligopoly model of trade when costs are asymmetric.

We employ an n-country oligopoly model of trade under a reciprocal dumping framework of Brander and Krugman (1983). Under the hub and spoke regime, there is one hub country and the other countries are spokes. We assume that hub country has lower marginal cost of production relative to symmetric spoke countries. We find that the hub country benefits so much from such preferential liberalization that it is better off relative to global free trade.[3] This results stems from two facts: (i) relative to free trade, export profits of the hub country increase in spoke countries' markets due to preferential treatment; (ii) due to market segmentation, the domestic surplus of the hub country does not change relative to free trade since its own tariff equals zero under both regimes. The flip side of this result is that the spoke countries are worse off relative to global free trade. This result formally validates the intuition that the hub can benefit at the expense of the spokes. Kowalczyk and Wonnacott (1992) shows a similar result for economies under perfect

[1] In the extensive literature on FTAs, welfare effects of FTAs are generally discussed in the form of tariff complementarity effects these agreements yield. See Bagwell and Staiger (1997, 1998), Yi (2000), and Ornelas (2005) for further details. See Richardson (1995) on the incentives for member countries of FTAs to reduce their external tariffs. See Bhagwati et. al. (1999) and Kowalczyk (1999) for a collection of many important articles in the PTA literature.

[2] If a PTA is a customs union, due to joint determination of external tariffs, expansion can only take the form of new membership. When the PTA is a free trade area, however, each member can negotiate individually with outside countries. Using a network formation game, Furusawa and Konishi (2007) points out this important difference in a model of endogeneous formation of PTAs.

[3] Similar result arises in Goyal and Joshi (2006) that endogenizes the FTA formation with exogenous tariffs and Mukonoki and Tachi (2006) in a setting of sequential negotiations of bilateral free trade agreements. Unlike the present paper, both of these papers assume symmetry across countries

competition: a large country may prefer hub and spoke regime to global free trade. Kowalczyk (2000) shows that a small country has incentives to seek access to many large country-free trade areas thereby becoming a hub itself.[4] We complement these results by using an oligopoly model of trade with asymmetric costs.

Further analysis under cost asymmetry yields a remarkable result that has been overlooked in the existing literature: *hub and spoke trading arrangement can yield higher global welfare than free trade*. This result obtains when the hub country is sufficiently low cost relative to spoke countries. Under such a scenario, preferential treatment of the hub country in its export markets improves world welfare because it helps allocate a larger share of the world's output to a low cost location. In other words, the gains from allocative efficiency may exceed the losses stemming from the persisting tariffs between spoke countries. Note that this result is closely linked to the Industrial Organization literature: helping inefficient firms may reduce social welfare (e.g., Lahiri and Ono, 1988).[5] However, to the best of our knowledge, no previous papers have pointed out the role of a hub and spoke trade system to enhance the allocative efficiency.

The existing literature on the economic effects of hub and spoke trade systems generally approach these agreements in a pessimistic way because of their discriminatory nature and less-discriminatory PTAs, such as CUs, are argued to be more preferable (see Kowalczyk and Wonnacott, 1992; Blackhurst and Henderson, 1993 and Krueger, 1997). Here, we argue that global reallocation of production towards efficient sources can reverse these arguments. In a similar framework as ours, Mukunoki and Tachi (2006) studies sequential negotiations of bilateral free trade agreements and examines the implications of hub and spoke agreements for the multilateral free trade. We complement Mukonoki and Tachi (2006) and Kowalczyk and Wonnacott (1992) by examining the scenario where countries are asymmetric with respect to production cost.

2 Model

We employ an oligopoly model of international trade where each country has a unilateral incentive to impose rent extracting tariffs (unless it commits not to do so via an FTA). There are n countries and two goods: x and y. We assume that preferences over the two goods are quasilinear: $U(x, y) = u(x) + y$. Good x is produced by a single firm in each country at a constant marginal cost (in terms of the numeraire good y). Given our focus, we initially consider a hub and spoke trading regime where country i is the hub country while the other $n-1$ countries are spokes that impose external tariffs on each other. Such a regime is denoted by $\langle\{ih\}\rangle$ while global free trade is denoted by $\langle\{F\}\rangle$. Let $c > 0$ denote spoke firms' marginal cost of producing good x and marginal cost of

[4] Similarly, in Puga and Venables (1997), due to agglomeration effects, the formation of a hub and spoke arrangement benefits the hub whereas it can hurt the spoke nations by making location in the hub more attractive to firms. For further discussion see Wonnacott (1996).

[5] Collie (1993) and Lahiri and Ono (1997) apply the similar argument in an international trade context.

the hub country's firm is normalized to zero: $c_z = c \geq c_i = 0$, where $z \neq i$. Using Most Favoured Nation (MFN) Clause, each spoke country imposes a symmetric tariff on the other spoke countries. We employ a two-stage game under the hub and spoke trade regime. In the first stage, spoke countries impose their optimal tariffs. Then, taking the trade policy regime and the associated tariffs as given, firms compete in Cournot fashion.[6]

For simplicity in notation, while each spoke country has an $n-1$ dimensional tariff vector, we write profit, domestic surplus and total welfare as a function of the tariff it imposes on the hub country (zero tariff) and the symmetric MFN tariff spoke countries impose on each other. It is useful to clarify our notation with an example: in the export profit function $\pi_{jz}(0,\, t_z)$, the first argument is the tariff faced by the hub country i in spoke country z's market while the second argument is the tariff faced by all other spoke exporters, where $z \neq i$ and $z \neq j$. Moreover, at the risk of slight abuse of notation, we will sometimes write profit, domestic surplus, and total welfare as a function of the policy regime itself. For example, $s_i(F)$ denotes country i's welfare under free trade. Finally, let $\Delta w_i(ih) \equiv w_i(ih) - w_i(F)$, $\Delta \pi_i(ih) \equiv \pi_i(ih) - \pi_i(F)$ and $\Delta s_i(ih) \equiv s_i(ih) - s_i(F)$.

3 Hub and Spoke Regime

Under the hub and spoke regime $\langle\{ih\}\rangle$, due to market segmentation, it is sufficient to focus on the hub country and only one of the spoke country's market (say country z). Let x_{jz} denote country j's exports to country z where $z \neq j$; x_{zz} the sales of firm z in country z; and $x_z = x_{zz} + \sum_{j \neq z} x_{jz}$ denote total sales of good x in country z. While a spoke country's (say country j) exports of good x to another spoke country (say country z) are subject to a specific tariff t_z per unit, the hub firm has a free access.[7] Let country z's tariff vector be denoted by $\mathbf{t}_z$ and the global tariff vector be denoted by $\mathbf{t}$. Then, the hub country's (country i) and a spoke country's (country j) profit functions for exports to country z (another spoke country), denoted by π_{iz} and π_{jz} respectively, can be written as:

$$\pi_{iz} = p_z(x_z)x_{iz},\ z \neq i \tag{1}$$

$$\pi_{jz} = [p_z(x_z) - c - t_z]x_{jz},\ z \neq i \text{ and } z \neq j \tag{2}$$

Similarly, a spoke country's export profit function in the hub country can be written as:

$$\pi_{ji} = [p_i(x_i) - c]x_{ji} \tag{3}$$

[6] It is immediate under global free trade that the two stage game is reduced to a one stage game and the tariffs we use in the below discussion disappear.

[7] It is important to note from the literature on trade policy under imperfect competition that results are highly sensitive to the choice and functional form of policy instruments. For example, as shown by Brander and Spencer (1984), and further discussed by Jørgensen and Schröder (2005), whether the policy is ad-valorem or specific could matter even for the sign of welfare improving intervention.

First order conditions (FOCs) for profit maximization for exporters are

$$p_z + p_z' x_{iz} = 0,\ p_z + p_z' x_{jz} = c + t_z, \text{ and } p_i + p_i' x_{ji} = c,\ z \neq i, j \tag{4}$$

The above FOCs together with an analogous condition for the local firms determine the equilibrium output levels of all firms. Summing the FOCs for all firms in country i gives

$$np_i + p_i' x_i = (n-1)c \text{ and } np_z + p_z' x_z = (n-1)c + (n-2)t_z,\ z \neq i \tag{5}$$

Using the second order conditions (S.O.Cs) of profit maximization problems and the strategic substitutability, we can derive:[8]

$$\frac{\partial x_{jz}}{\partial t_z} < 0; \frac{\partial x_{iz}}{\partial t_z} > 0 \text{ and } \frac{\partial x_{zz}}{\partial t_z} > 0,\ z \neq i, j$$

In other words, an increase in t_z lowers a spoke country j's exports to another spoke county z (x_{jz}) while it increases the sales of the hub firm (x_{iz}) and that of the local sales denoted by x_{zz}.Welfare of a spoke country z can be written as the sum of its domestic surplus $s_z(t_z)$ (sum of consumer surplus, tariff revenue, and the domestic firm's local profits) and total export profits:

$$w_z(\mathbf{t}) \equiv \underbrace{u(x_z) - p_z x_z + \sum_{j \neq z,i} t_z x_{jz} + \pi_{zz}}_{s_z(t_z)} + \pi_{zi} + \sum_{k \neq i,z} \pi_{zk}(t_k) \tag{6}$$

while the welfare of the hub country is the sum of consumer surplus, domestic firm's local profits and total export profits:

$$w_i(\mathbf{t}) \equiv \underbrace{u(x_i) - p_i x_i + \pi_{ii}}_{s_i} + \sum_{k \neq i} \pi_{ik}(t_k) \tag{7}$$

Finally, world welfare under $\langle\{ih\}\rangle$ is defined as:

$$ww(\mathbf{t}) = \sum_{k=1}^{n} w_k(\mathbf{t}) \tag{8}$$

Welfare maximization problem of a spoke country (say country z) is as follows:

$$t^f = \arg\max\ s_z(0, t_z),\ z \neq i \tag{9}$$

so that

$$\left.\frac{\partial s_z(0,t_z)}{\partial t_z}\right|_{t_z = t^f} = 0,\ z \neq i \tag{10}$$

Next, we show a new interesting possibility that arises under oligopoly model of trade with asymmetric cost: *the hub and spoke trading regime $\langle\{ih\}\rangle$ can yield higher world welfare than global free*

[8] If we replace the local startegic substitutability with its global counterpart, then many of the assumptions about the demand function can be consolidated under this new assumption. See Lahiri and Ono (2004) for further details.

trade and the optimum tariffs spoke countries impose can be optimal from the viewpoint of global welfare maximization. To this end, consider the impact of spoke countries' external tariffs under the trade regime $\langle\{ih\}\rangle$ on world welfare. Using market segmentation and equation (10) we can write

$$\left.\frac{\partial ww(t)}{\partial t}\right|_{t=t^f} = \left.\sum_{z\neq i}\frac{\partial \pi_{iz}(0,t_z)}{\partial t_z}\right|_{t_z=t^f} + \left.\sum_{j\neq i,z\neq i,j}\sum\frac{\partial \pi_{jz}(0,t_z)}{\partial t_z}\right|_{t_z=t^f} \tag{11}$$

In other words, *when tariffs are optimally chosen by spoke countries, a further increase in the external tariffs increases world welfare iff they increase the total export profits in the world economy.*

Note that

$$\frac{\partial \pi_{iz}(0,t_z)}{\partial t_z} = p'\frac{\partial x_z}{\partial t_z}x_{iz} + p\frac{\partial x_{iz}}{\partial t_z} = p'x_{iz}\sum_{k\neq i}\frac{\partial \pi_{kz}(0,t_z)}{\partial t_z} > 0 \tag{12}$$

i.e. an increase in the tariff on its rival exporters increases hub country's export profits in its export markets**.**

Similarly,

$$\frac{\partial \pi_{jz}(0,t_z)}{\partial t_z} = \left[p'\left(\sum_{k\neq j}\frac{\partial \pi_{kz}(0,t_z)}{\partial t_z}\right) - 1\right]x_{jz} < 0,\ j\neq i,z \tag{13}$$

i.e. an increase in t_z lowers its export profits in other spoke countries**.** Since spoke countries are completely symmetric, from the hub country's perspective, a small increase in the tariff faced by one of its exporting rivals is the same as an equivalent increase in the tariff faced by the other rival exporter. Therefore, at $t_z = t^f$, the first order condition for world welfare maximization in (11) can be written as

$$\frac{1}{n-1}\left.\frac{\partial ww(\tau)}{\partial \tau}\right|_{\tau=\tau^f} = \underbrace{p'x_{iz}\left[\sum_{k\neq i}\frac{\partial \pi_{kz}(0,t_z)}{\partial t_z}\right]_{t_z=t^f}}_{\Omega>0} + \underbrace{x_{jz}\left[p'\left(\sum_{k\neq j}\frac{\partial \pi_{kz}(0,t_z)}{\partial t_z}\right) - 1\right]_{t_z=t^f}}_{\Psi<0},\ j\neq i,z \tag{14}$$

which is of ambiguous sign if countries are asymmetric.[9] If the first term in the above expression (denoted by Ω) exceeds the second term (denoted by Ψ), an increase in tariffs inefficient spoke countries impose on each other improves world welfare. Moreover, FTA tariffs (t^f) under $\langle\{ih\}\rangle$ are optimal from the viewpoint of *global* welfare maximization iff $\Omega = \Psi$.

We next provide an illustration of this result and the related ones using linear demand.

[9] Under symmetry, it is clear that $\frac{dww(0,\tau)}{d\tau}_{\tau=\tau^F} = -(n-1)x_{ij} < 0$.

4 A linear demand illustration

Suppose $u(x_z) = x_z - \frac{x_z^2}{2}$ so that $p_z(x_z) = 1 - x_z$, where $x_z = \sum_{j=1}^{n} x_{jz}$. Under a hub and spoke regime $\langle\{ih\}\rangle$, first order conditions for profit maximization yield the following equilibrium output levels in the hub country (country i) and spoke countries:

$$x_{ii}(ih) = \frac{1+(n-1)c}{n+1} \text{ and } x_{zi}(ih) = \frac{1-2c}{n+1},\ z \neq i. \tag{15}$$

and

$$x_{iz}(ih) = \frac{1+(n-1)c+(n-2)t_z}{n+1}; x_{zz}(ih) = \frac{1-2c+(n-2)t_z}{n+1}; x_{jz}(ih) = \frac{1-2c-3t_z}{n+1},\ z \neq i \text{ and } j \neq i, z \tag{16}$$

Given these output levels, equilibrium prices are immediate:

$$p_i(ih) = \frac{1+(n-1)c}{n+1} \text{ and } p_z(ih) = \frac{1+(n-1)c+(n-2)t_z}{n+1},\ z \neq i \tag{17}$$

Next, we find the welfare of the hub and spoke countries and the aggregate world welfare as follows:

$$w_i(ih) = \underbrace{\frac{1}{2}\left[\frac{n-(n-1)c}{n+1}\right]^2}_{CS_i(ih)} + \underbrace{\left[\frac{1+(n-1)c}{n+1}\right]^2}_{\pi_{ii}(ih)} + \underbrace{(n-1)\left[\frac{1+(n-1)c+(n-2)t_z}{n+1}\right]^2}_{\sum_{z\neq i}^{n}\pi_{iz}(ih)} \tag{18}$$

$$w_z(ih) = \underbrace{\frac{1}{2}\left[\frac{n-(n-1)c-(n-2)t_z}{n+1}\right]^2}_{CS_z(ih)} + \underbrace{\left[\frac{1-2c}{n+1}\right]^2}_{\pi_{zi}(ih)} + \underbrace{\left[\frac{1-2c+(n-2)t_z}{n+1}\right]^2}_{\pi_{zz}(ih)} + \underbrace{(n-2)\left[\frac{1-2c-3t_z}{n+1}\right]^2}_{\sum_{z\neq i,j}^{n}\pi_{jz}(ih)} + \underbrace{(\frac{n-2}{n+1})t_z(1-2c-3t_z)}_{TR_z(ih)} \tag{19}$$

$$ww(ih) = w_i(ih) + (n-1)w_z(ih) \tag{20}$$

Then, the following tariff maximizes each spoke country's welfare:

$$t^f = \frac{1}{(n+4)} - \frac{(n+7)c}{3(n+4)} \tag{21}$$

Note that as c rises, the spoke countries become less efficient, becoming a less important rent extraction source and the optimum tariffs they impose on each other fall. From hereon, in order to

guarantee non-negative tariff rates and the market access of spoke firms in their export markets, we assume that $c < \overline{c} = \frac{3}{n+7}$ holds.

Do the individual countries benefit from a hub and spoke trade agreement relative to free trade? To address this question, we first argue below that a hub and spoke trade agreement $\langle\{ih\}\rangle$ makes the hub country better off and the spoke countries *worse off* relative to global free trade. To see why, first note that starting at free trade, if spoke countries were to switch to *independent* bilateral FTAs with only country i, export profits of the hub country would *increase* in all its export markets because in each of its export markets, country i's rival exporters would face the tariff t^f whereas it itself would not. Furthermore, the domestic surplus of country i under $\langle\{ih\}\rangle$ is the same as that under free trade since it has a bilateral FTA with all of its trading partners: $\Delta s_i(ih) = 0$. As a result, country i's welfare under $\langle\{ih\}\rangle$ is necessarily *higher* than that under free trade:

$$\Delta w_i(ih) \equiv \Delta \pi_i(ih) = \frac{(n-1)(n-2)[3-c(n+7)][9(n+2)+c(5n^2+13n-10)]}{[3(n+1)(n+4)]^2} > 0 \tag{22}$$

The flip side of this result is that the spoke countries are worse off under $\langle\{ih\}\rangle$ relative to global free trade:

$$\Delta w_z(ih) = -\frac{(n-2)[3-c(n+7)][9(n+3)+c(n^2-7n-26)]}{6[(n+1)(n+4)]^2} < 0 \tag{23}$$

This result provides a confirmation for the argument that the hub country benefits at the expense of the spoke countries. These welfare results are important because most countries belong to multiple FTAs and focusing only on a bilateral FTA is unlikely to yield a complete picture regarding their welfare effects. These results also shed light on how the formation of independent FTAs affects incentives for multilateral trade liberalization. Since spoke countries' welfare under $\langle\{ih\}\rangle$ is lower than that under free trade, they would surely gain from a move to global free trade.

Next, we compare the world welfare under the hub and spoke regime $\langle\{ih\}\rangle$ and free trade $\langle\{F\}\rangle$ and find that the hub and spoke regime yields higher global welfare relative to free trade when spoke countries are sufficiently high cost:

$$\Delta ww(ih) = ww(ih) - ww(F) \geq 0 \text{ iff } c \geq \underline{c} = \frac{9(n+2)}{7n^2+47n+58} \tag{24}$$

Note that the above possibility is more likely to arise as the number of spoke countries rises: $\frac{\partial \underline{c}}{\partial n} < 0$. Figures 1a, 1b, and 1c plot $\Delta ww(ih)$ as a function of c for three distinct numbers of spoke countries.

— Figures 1a, 1b, and 1c here —

We also find under $\langle\{ih\}\rangle$ that there exists a positive world welfare maximizing tariff level (t^w) that spoke countries impose on each other when spoke countries are sufficiently high cost:

$$t^w = \frac{(n+3)c-1}{(n-2)} \tag{25}$$

More interestingly, at $t = t^f$, the first order condition for world welfare maximization in (14) can be rewritten as

$$\left.\frac{\partial ww(t)}{\partial t}\right|_{t=t^f} \geq 0 \text{ iff } x_{iz} \geq 3x_{jz}, \text{ where } z \neq i \text{ and } j \neq i, z \tag{26}$$

so that, under linear demand, FTA tariffs under $\langle\{ih\}\rangle$ are optimal from the viewpoint of *global* welfare maximization iff the hub country's export in a spoke country is exactly three times more than that of another spoke country: $x_{ik} = 3x_{jk}$, where $z \neq i$ and $j \neq i, z$:

$$\tau^w - \tau^f \geq 0 \text{ iff } c \geq \widetilde{c} = \frac{3}{2n+11} \tag{27}$$

Figures 2a, 2b and 2c compare τ^f under $\langle\{ih\}\rangle$ with τ^w under $\langle\{ih\}\rangle$ for three distinct number of spoke countries. The intersection of the two lines shows that under $\langle\{ih\}\rangle$ the external tariff of each spoke can indeed equal its globally optimal value. And when such is the case, the hub and spoke regime $\langle\{ih\}\rangle$ yields higher welfare than global free trade.

— Figures 2a, 2b and 2c here —

The following proposition summarizes our findings regarding the individual and world welfare effects of hub and spoke trade regime $\langle\{ih\}\rangle$ relative to free trade $\langle\{F\}\rangle$ under linear demand:

Proposition 3b: *Suppose* $\overline{c} \geq c_z = c \geq c_i = 0$, *where* $z \neq i$ *and demand is linear. Then, the following obtains: (i) the hub country is better off under the hub and spoke trade regime* $\langle\{ih\}\rangle$ *relative to free trade whereas the spoke countries are worse off relative to free trade; (ii) the hub and spoke trading regime* $\langle\{ih\}\rangle$ *yield higher world welfare than global free trade when* $c \geq \underline{c}$, where $\frac{\partial \underline{c}}{\partial n} < 0$ *and (ii) optimum FTA tariffs under* $\langle\{ih\}\rangle$ *are also optimal from the viewpoint of global welfare maximization:* $\tau^w = \tau^f$ *if and only if* $c = \widetilde{c}$.

Given that the intuition and the implications of the first part of the above proposition was explained before, we next focus on the intuition behind the last two parts of the proposition. The first point to note for these striking results is that the assumption that firms compete in quantities plays a crucial role in delivering these results. As is well known, under quantity competition firms with different production costs can remain active in production so long as demand is big enough. From a world welfare perspective, the external tariffs under $\langle\{ih\}\rangle$ have two conflicting effects on world welfare. On the one hand, such tariffs tend to lower world welfare relative to free trade since they adversely affect the exports of spoke countries. On the other hand, FTA tariffs shift production in favor of the low cost country i and this improves *allocative efficiency*. What the above proposition argues and Figures 1 and 2 confirm is that it is quite possible for the latter effect to dominate the former. It is immediate from figure 2 that τ^f is decreasing in c while the opposite is true for τ^w. The intuition is as follows: as c rises, spoke countries' incentives to impose tariffs on each other decreases since they become less important sources of rent-extraction and thus τ^f falls.

On the other hand, τ^w maximizes world welfare and thus internalizes allocative efficiency effect leading to higher tariffs as c rises.

Here, it is important to note that FTA between the spoke countries always increases their welfare. Although the hub country suffers from the spoke-spoke FTA, it can not directly prevent the spoke-spoke FTA and thus the realization of global free trade. Hence, even if a hub and spoke trade system realizes higher world welfare, the system is not stable and the equilibrium outcome would be global free trade if we consider endogenous formation of FTAs. Taking the sustainability problem into account, the policy implications of this result needs further attention. This result may suggest that international transfers from the hub country to the spoke countries are useful to prevent the spoke-spoke FTA and improve world welfare. The result also indicates that, even if global free trade is realized in the long run, a temporary formation of a hub and spoke trade system may lead to an interim improvement of world welfare.

5 Concluding remarks

One of the striking features of today's global policy landscape is the widespread prevalence of PTAs. Most of the countries simultaneously participate in several such agreements leading to several hub-and-spoke trading systems. In this paper we aim at shedding light on the welfare implications of hub and spoke trade regimes relative to free trade. We show that, under an oligopoly model of trade with asymmetric costs, a hub and spoke trading arrangement increases the efficient hub country's welfare even beyond what it can obtain under global free trade while making inefficient spokes worse off. Second, such an arrangement can be welfare-preferred to global free trade if the hub country is sufficiently low cost compared to the spoke countries since the trade diversion inherent to such a regime enhances the efficiency of global production. It is important to note that since a CU member *cannot* form an additional PTA with non-members without a consent of the other member, such an outcome is never possible under a customs union. The major results of the paper obtain in a framework where independent FTAs in the form of a hub and spoke regime are exogenously given. In order to obtain more complete picture, one should endogenize trade agreement formation. We intend to pursue this research in near future.

6 Appendix

References

[1] Bagwell, Kyle, and Robert W. Staiger (1997). "Multilateral Tariff Cooperation during the Formation of Free Trade Areas," *International Economic Review*, **38**, 291-319.

[2] Bagwell, Kyle, and Robert W. Staiger (1998). "Will Preferential Agreements undermine the Multilateral Trading System?," *Economic Journal*, **108**, 1162-1182.

[3] Bhagwati, Jagdish, Arvind Panagariya, and Pravin Krishna, eds., 1999. *Trading Blocs*, The MIT Press, Cambridge, MA.

[4] Blackhurst, Richard and David Henderson, 1993. "Regional Integration Agreements, World Integration and the GATT" in Kym Anderson and Richard Blackhurst (eds.), Regional Integration and the Global Trading System, London: HarvesterWheatsheaf, 408–35.

[5] Brander, James A., Paul R. Krugman, 1983. "A 'Reciprocal Dumping' Model of International Trade," *Journal of International Economics* 15, 313-323.

[6] Brander, James and Barbara Spencer, 1984. "Trade warfare: Tariffs and cartels," *Journal of International Economics* 6, 227-242.

[7] Collie, David, 1993. "Strategic Trade Policy under asymmetric oligopoly," *European Journal of Political Economy* 9(2), 275-280.

[8] Furusawa, Taiji and Hideo Konishi, 2007, "Free Trade Networks," *Journal of International Economics* 72, 310-335.

[9] Goyal, Sanjeev and Sumit Joshi, 2006. "Bilateralism and Free Trade," *International Economic Review* 47, 749-778.

[10] Jørgensen, Jan G. and Philipp Schröder, 2005. "Welfare-Ranking Ad Valorem and Specific Tariffs under Monopolistic Competition," *Canadian Journal of Economics* 38, 228-241.

[11] Kowalczyk, Carsten, ed., 1999. *Economic Integration and International Trade*. International Library of Critical Writings in Economics. Edward Elgar Publishing Ltd., Cheltenham, U.K.

[12] Kowalczyk, Carsten 2000. "Welfare and Integration," *International Economic Review* 41(20), 483-494.

[13] Kowalczyk, Carsten and Ronald Wonnacott, 1992. "Hubs and Spokes, and Free Trade in the Americas," National Bureau of Economic Research Working Paper No. 4198.

[14] Krueger, Anne O., 1997. "Free Trade Agreements versus Customs Unions," *Journal of Development Economics* 54, 169–87.

[15] Lahiri, Sajal and Yoshiyasu Ono, 1988. "Helping Minor Firms Reduces Welfare," *Economic Journal* 98, 1199–1202.

[16] Lahiri, Sajal and Yoshiyasu Ono, 1997. "Asymmetric Oligopoly, International Trade, and Welfare: A Synthesis," *Journal of Economics* 65(3), 291–310.

[17] Lahiri, Sajal and Yoshiyasu Ono, 2004. *Trade and industrial policy under international oligopoly*. Cambridge University Press, Cambridge.

[18] Mukunoki, Hiroshi and Kentaro Tachi, 2006 "Multilateralism and Hub-and-Spoke Bilateralism," *Review of International Economics* 14, 658-674.

[19] Ornelas, Emanuel, 2005, "Endogenous Free Trade Agreements and the Multilateral Trading System," *Journal of International Economics* 67, 471-497.

[20] Puga, Diego and Anthony Venables, 1997. "Preferential Trading Arrangements and Industrial Location," *Journal of International Economics* 43, 347-368.

[21] Richardson, Martin, 1995. "Tariff Revenue Competition in a Free Trade Area," *European Economic Review* 39(7), 1429-1437.

[22] Wonnacott, Paul, 1996. "Beyond NAFTA – The Design of a Free Trade Agreement of the Americas." In *The Economics of Preferential Trade Agreements*, Bhagwati, Jagdish and Arvind Panagariya, eds. Washington, DC: American Enterprise Institute.

[23] Yi, S.-S., 2000. "Free-Trade Areas and Welfare: An Equilibrium Analysis," *Review of International Economics* 8, 336-347.

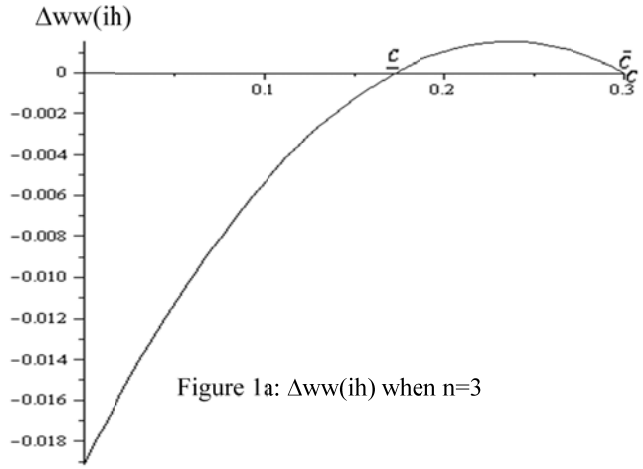

Figure 1a: Δww(ih) when n=3

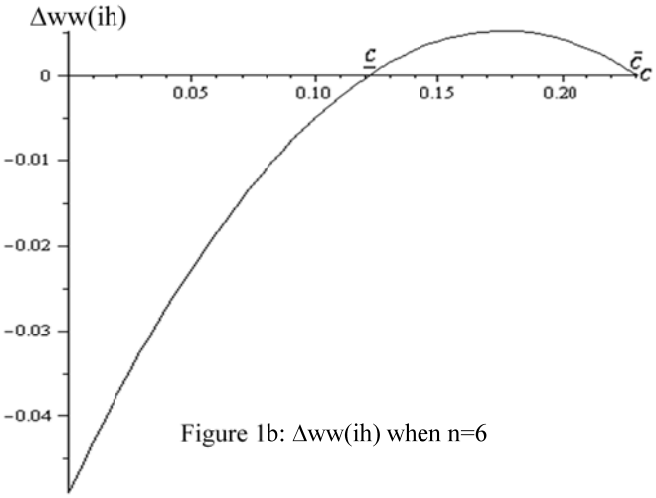

Figure 1b: Δww(ih) when n=6

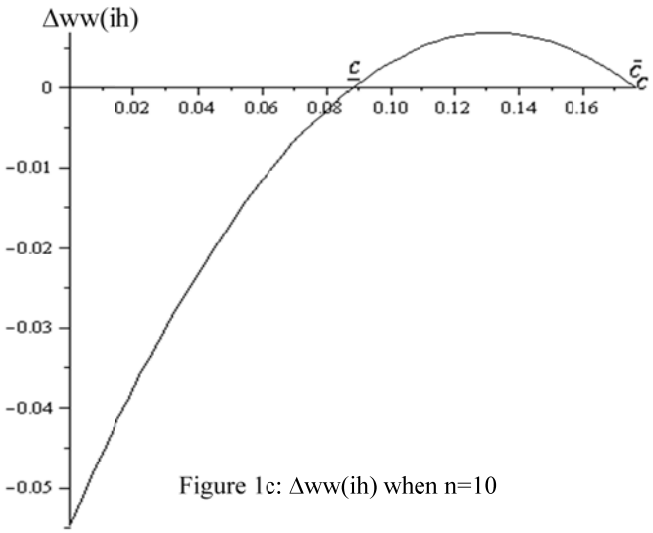

Figure 1c: Δww(ih) when n=10

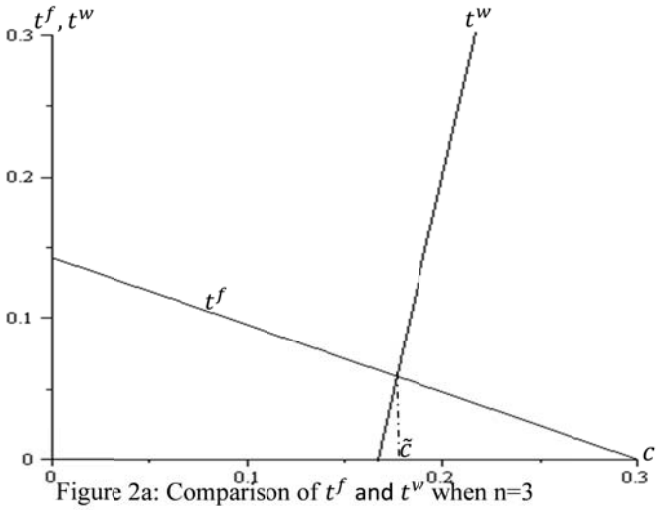

Figure 2a: Comparison of t^f and t^w when n=3

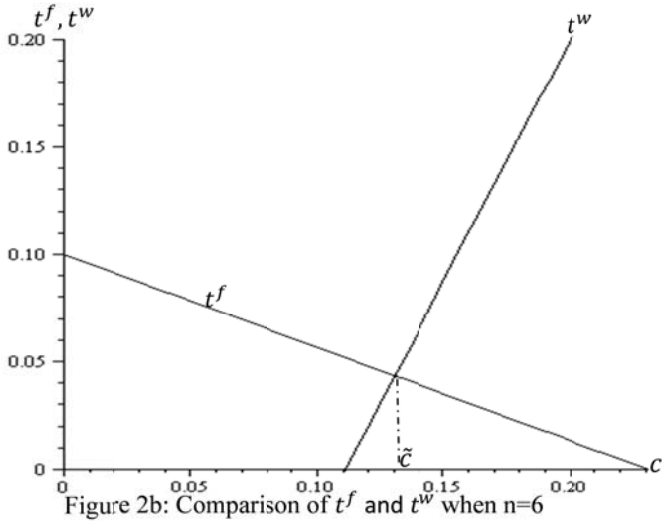

Figure 2b: Comparison of t^f and t^w when n=6

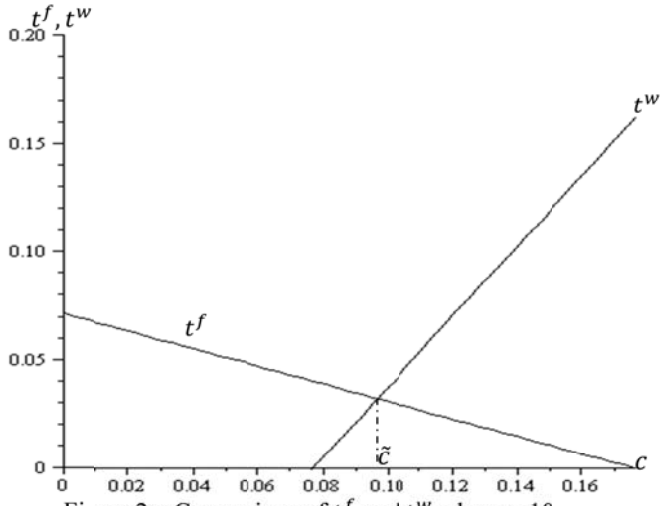

Figure 2c: Comparison of t^f and t^w when n=10