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Trade and Environmental Policies with Domestic and International Transportation

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Abstract

In this paper, we construct a two-country model with domestic and international transportations. We introduce the distance of domestic and international transportation, which affects the amount of emission. A final-good is consumed only in the home country. The final-good firms are in both the home and foreign countries. International transportation is needed for foreign products, while domestic transportation is required for both domestic and foreign products. Emissions are yielded from these transportations. The first-best policy can be non-zero tariffs and the emission tax on international transportation. If domestic transportation caused by the domestic product is sufficiently small (large), the sub-optimal tariff increases (decreases) by the rise in the emission tax on domestic transportation, and the sub-optimal emission tax on domestic transportation increases (decreases) by a raise in the tariff.

Keywords: International transportation; Domestic transportation; Distance; tariff; Emission tax.
JEL Classification: F18; Q53; Q54; Q56; Q58.

1. Introduction

Recently, the emissions from international transportation are overgrowing. CO_2 emissions from international maritime and aviation bunkers have risen by approximately 69 percent and 95 percent between 1990 and 2014, respectively. According to the International Energy Agency (2016), the international marine bunkers emitted 626 million tons of CO_2, and the international aviation bunkers emitted 504 million tons in 2014. CO_2 emissions from the sum of these transportations are more than those from the French and UK. For example, UNCTAD (2017) shows that the amount of the world seaborne trade was about 30,823 ton-miles in 2000, and it was increasing almost 53,339 ton-miles in 2015. In other words, it has been increased by more than 70 percent.

International trade induces domestic transportation since consumers purchase the imported products delivered from the port in their country. The imported products use both domestic and international transportations, while the domestic products use domestic transportation. The more the country's dependence on international trade and land area are large, the more domestic transportation caused by international transportation tends to be significant. Therefore, when we consider CO_2 emissions caused by international trade, we need to consider not only international transportation but also domestic transportation caused by international trade. According to The International Energy Agency (2016), world road transportation emitted about 5,660 million tons of CO_2 in 2014. In other words, CO_2 emissions from domestic transportation are approximately five times as large as the amount of CO_2 emission from the sum of the international maritime and aviation transportations. The emissions from domestic transportation can adapt to each country's regulations, such as emission tax on domestic transportation. In addition, the amount of domestic transportation caused by international trade is also affected by the import policy such as tariffs.

There exist a large number of studies relate to trade and environmental policies in a perfectly competitive market such as Markusen (1975), Krutilla (1991), Copeland (1994) and Neary (2006). However, they do not consider the emission from international transportation and its environmental policy. In addition, they show that the optimal trade policy does not achieve the first-best allocation. Neary (2006) is the most related to our paper. He considers the first-best tariff and emission tax combination, the second-best tariff and the second-best emission tax in a perfectly competitive small open economy without the transportation sector or distance.[1] Neary (2006) shows that the first-best policy combination is zero tariffs and the emission tax. He also obtains that the sub-optimal tariff (emission tax) increases the emission tax (tariff).

Some previous studies explicitly consider the trade policy with international transportation.[2] In addition, a few works of these studies are considering the environmental problem of international transportation. For example, Francois and Wooton (2001) analyze the role of competition in international transportation services. Andriamananjara (2004) explores the trade policy with international transportation. Ishikawa and Tarui (2018) also consider the international transportation market. They focus on trade policies with the

[1] Neary (2006) also analyze trade and environmental policies in oligopoly and monopolistic competition cases. Neary (1993) considers that relationship between two policy instruments, trade and investment taxes, using the potato diagram.
[2] In the new economic geography, Behrens et al. (2009) and Takahashi (2011) consider the transportation sector. They only consider the inter-regional transportation sector. Therefore, it can be interpreted as the international transportation sector.

capacity of international transportation services. These studies do not consider the domestic transportation sector and its emissions. Abe, Hattori and Kawagoshi (2014) analyze an imperfectly competitive final-good and international transportation market with an environmental externality from international transportation. They study the effects of trade liberalization and emission tax on the welfare and the emission amount. However, they only focus on environmental emissions from the international transportation sector.[3]

There are no trade policy analyses considering either the domestic transportation sector or emissions from domestic transportation caused by international trade. Therefore, our model sheds light on how domestic and international transportation and distance affect on resource allocation, tariffs and emission taxes. We construct a perfectly competitive two-country model with international and domestic transportations, which yield the emissions.[4] We assume that they are small countries. The final-good firms are in both the home and foreign countries and producing a homogeneous good. When the home final-good firms sell their products, they have to use domestic transportation. Whereas foreign firms sell their products, they have to use both domestic and international transportation. In this setting, we consider the effects of two policies: a tariff on the final-good and an emission tax on the domestic transportation since both transportations yield the emissions.

Since distances of domestic and international transportation are significant factors in terms of emissions, we also take into account those distances. Our study considers the three

[3] Takarada (2013) analyzes the emission trading system in the international transportation sector with perfectly-competitive final-good and international transportation markets.

[4] We only consider domestic transportation in home country. Then, we ignore domestic transportation in foreign country since it is regulated by the foreign government.

types of distances; distances of international trade, domestic transportation caused by international trade and caused by domestic products. This idea is related to Deardorff (2001). Deardorff (2001) demonstrates the international transportation service's role in logistics and mentions how the trade service is essential for international trade. His model only considers the distance of domestic transportation. He shows that transportation firms can operate their transportation services across the border if the transportation service is liberalized.

We obtain the following results. The first-best tariff is positive and determined by the marginal damage of emission from international transportation and the international emission tax. In contrast, the first-best emission tax on domestic transportation is equal to domestic transportation's marginal damage. Suppose a global emission regulation on international transportation is implemented so that the emission tax on international transportation is equal to international transportation's marginal damage.[5] In this case, the first-best policy combination is zero tariffs and the emission tax on domestic transportation. Therefore, the tariff can be used as a first-best policy instead of the emission tax on international transportation.

We also consider the sub-optimal tariff case. Suppose the distance of the domestic transportation caused by the foreign product is zero. In that case, a rise in the emission tax on domestic transportation increases the sub-optimal tariff. On the other hand, if domestic transportation caused by the imported product needs a long distance, the sub-optimal tariff may decrease by an increase in the emission tax on domestic transportation. In comparison,

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5 In the case of air transportation, however, all air transportation companies must participate in economic measures from 2030 by the ICAO's decision in 2016. Then, there exist no international regulations for the emission from international transportation.

Neary (2006) shows that a raise in emission tax unambiguously increases the sub-optimal tariff.

Lastly, we consider the sub-optimal emission tax. Suppose foreign products cause no domestic transportation. In that case, a raise in tariff increases the emission tax on domestic transportation. However, if domestic transportation caused by international trade needs a long distance, the emission tax on domestic transportation decreases by a raise in tariffs. On the contrary, Neary (2006) shows an increase in tariff always increases the sub-optimal emission tax.

This paper is organized as follows. Section 2 provides the model structure of the model and shows the market equilibrium conditions. In section 3, we decompose the welfare. Section 4 investigates the welfare effects of the tariff and the emission tax on sector domestic transportation. Section 5 concludes the paper.

2. The Model

There are home and foreign countries, called H and F. They are small countries. Final-good firms in each country produce a homogenous good and supply their products to the perfectly competitive market in country H. The home final-good firms have to use domestic transportation services to sell their products in the home market. On the other hand, the foreign final-good firms need to use both international and domestic transportation services to sell their products in the market in *H.* We assume that both the domestic and international transportation sectors are perfectly competitive.

There are emissions from both domestic and international transportation which depend on the amounts of transportation. The emissions yield the disutility of country H . We assume that the home government can impose an emission tax on domestic transportation and a tariff to control the resource allocation and welfare of country *H*. We also incorporate an emission tax on international transportation, but assume it fixed as constant.

The amounts of domestic and international transportation depend on the distances of both domestic and international transportation as well as on the volume of the transported final-good. So we introduce distances of domestic and international transportation. There exists distance α between the location of the home final-good firms and the market in country *H*. There also exists a distance between the location of the foreign final-good firms and the home market. We assume that a distance between the home port and the home market is β and a distance between the foreign and home ports is γ . Thus, α shows a distance of domestic transportation caused by domestic production in country *H*. On the other hand, β shows a distance of domestic transportation caused by international trade.

The world price of the final-good is defined as q^*, which is constant since we assume small countries. Then, the consumer price q_C and the producer price q_P of the final-good in country *H* become

$$q_C = q^* + \beta p_D + \gamma p_I + \tau \tag{1}$$

and

$$q_P = q_C - \alpha p_D = q^* + \beta p_D + \gamma p_I + \tau - \alpha p_D \tag{2}$$

where p_D is the domestic transportation price for one unit of final-good, p_I is the international transportation price for one unit of final-good and τ is the specific import tariff. Then, we define the domestic demand and supply functions in country *H* as $D(q_C)$

and $S_H(q_P)$, where $D' \equiv dD(q_C)/dq_C < 0$ and $S' \equiv dS(q_P)/dq_P > 0$. From these functions, we obtain the import demand function in country H: $M \equiv D(q_C) - S(q_P)$.

The demand for domestic transportation is the sum of demands for two types transportations. One is the distance of domestic transportation times the amount of domestic supply of the final-good. The other is the distance of the domestic transportation of imported products times the amount of the imported product. Then, we express the demand for domestic transportation as:

$$X \equiv \alpha S(q_P) + \beta M = (\alpha - \beta) S(q_P) + \beta D(q_C), \tag{3}$$

where X is the demand for domestic transportation.

In the same way, we define the demand for international transportation as the distance of the international transportation times the amount of the imported product. Then, we express it as

$$Y \equiv \gamma M = \gamma \left[D(q_C) - S(q_P) \right], \tag{4}$$

where Y is the demand for international transportation. We assume that X and Y are positive and finite for any consumer and producer prices.

The profit function of domestic transportation firms is

$$\pi_D = (p_D - e_D t_D) X,$$

where t_D is the emission tax on domestic transportation and e_D is the degree of emission from one unit of domestic transportation. On the other hand, the profit function of international transportation firms is

$$\pi_I = (p_I - e_I t_I) Y,$$

where t_I is the emission tax on international transportation and e_I is the degree of emission from one unit of international transportation. Hereafter, we assume that the emission tax on international transportation is fixed as constant.[6]

Since both transportation sectors are assumed to be perfectly competitive, the profit maximization conditions are $p_D = e_D t_D$ and $p_I = e_I t_I$. Notice that p_I becomes constant. By using those conditions, we have the following effects of the tariff and the domestic emission tax on the domestic demand and supply and the import of the final-good.

$$\frac{dD}{d\tau} = D' < 0 \tag{5}$$

$$\frac{dD}{dt_D} = \beta e_D D' < 0 \tag{6}$$

$$\frac{dS}{d\tau} = S' > 0 \tag{7}$$

$$\frac{dS}{dt_D} = (\beta - \alpha) e_D S' \tag{8}$$

$$\frac{dM}{d\tau} = \frac{1}{\gamma}\frac{dY}{d\tau} = D' - S' < 0 \tag{9}$$

$$\frac{dM}{dt_D} = \frac{1}{\gamma}\frac{dY}{dt_D} = e_D k \tag{10}$$

Furthermore, we obtain the effects on domestic and international transportations.

$$\frac{dX}{d\tau} = k, \tag{11}$$

$$\frac{dX}{dt_D} = -e_D \left[(\alpha - \beta)^2 S' - \beta^2 D' \right] < 0, \tag{12}$$

$$\frac{dp_D}{dt_D} = e_D, \tag{13}$$

where $k \equiv \alpha S' - \beta(S' - D')$. Since $dY = \gamma dM$ from eq. (4), eqs. (9) and (10) yield the

[6] In fact, the emission tax on the international transportation is not implemented in a real world. In order to describe that situation, we can set the international emission tax equal to zero.

comparative statics on the international transportation.

In our model, k plays a crucial role. Arranging the definition of k, we obtain

$$k \equiv \frac{dX}{dq^*} = \alpha \frac{\partial S}{\partial q^*} + \beta \frac{\partial (D-S)}{\partial q^*}. \tag{14}$$

Eq. (14) implies that k shows how the amount of domestic transportation changes by an increase in the world price. The first term of the right-hand side of eq. (14) is the change of domestic transportation caused by the domestic product. In contrast, the second term is the change in domestic transportation caused by international trade. In general, a raise in the world price increases the domestic price and the production of the final-good. Therefore, the domestic transportation caused by domestic production increases. In this model, however, a raise in the world price reduces the amount of import of the final-good, and decreases domestic transportation caused by international trade. As a result, the total amount of domestic transportation might be decreased.

If α is sufficiently large or β is sufficiently small, the total domestic transportation increases by a small increase in the world price. In this case, we have $k > 0$. If we do not consider the domestic transportation caused by international trade as is assumed in the previous papers, we always have $k > 0$ since $\beta = 0$. On the other hand, if α is sufficiently small or β is close to one, the amount of total domestic transportation decreases. That is, we have $k < 0$. We can rearrange eq. (11) as

$$k \equiv \frac{\beta \varepsilon_M S}{q^*} \left\{ \frac{\alpha \varepsilon_S}{\beta \varepsilon_M} - \frac{M}{S} \right\} \tag{11'}$$

where $\varepsilon_S \equiv (q^*/S)(\partial S / \partial q^*)$ and $\varepsilon_M \equiv -(q^*/M)(\partial M / \partial q^*)$. So k is positive (negative) if the ratio of import of the final-good to its domestic supply is sufficiently small (large).

4. Emission from Domestic Transportation and the Optimal Policies

4-1. The first-best policy

Now, we consider the first-best policy for country H. We can define the net benefit of country H as follows:

$$NB = \int_0^{S+M} B(z)\,dz - \int_0^{S} C(z)\,dz - q^* M - E\left[e_D X,\, e_I Y\right], \tag{15}$$

where $B(z) \equiv D^{-1}(z)$ is the inverse demand function and $C(z) \equiv S^{-1}(z)$ is the inverse domestic supply function in country H. $E\left[e_D X,\, e_I Y\right]$ is the disutility of environmental damage in country H. We assume that $E\left[e_D X,\, e_I Y\right] = \sigma\left(e_D X + e_I Y\right)$ where σ is the marginal damage of the emission, $X = \alpha S + \beta M$ and $Y = \gamma M$. Then, the first-order conditions for the first-best allocation with respect to S and M are

$$B\left(S+M\right) - C(S) - \alpha\sigma e_D = 0 \tag{16}$$

$$B\left(S+M\right) - q^* - \beta\sigma e_D - \gamma\sigma e_I = 0. \tag{17}$$

In the market equilibrium, we have $B\left(S+M\right) = q_C$ and $C\left(S\right) = q_P$. In addition, from eqs. (1) and (2) and the profit maximization condition, $p_D = e_D t_D$, eq. (16) becomes $\alpha e_D t_D - \alpha\sigma e_D = 0$. Thus, eq. (16) is satisfied if $t_D = \sigma$. On the other hand, substituting (1) into (17), we have $\beta p_D + \gamma p_I + \tau - \beta\sigma e_D - \gamma\sigma e_I = 0$. Since we have $p_D = e_D t_D = e_D \sigma$ when $t_D = \sigma$ and $p_I = e_I t_I$, eq. (17) becomes $\tau - \gamma e_I(\sigma - t_I) = 0$. Then, eq. (17) is satisfied if $t_D = \sigma$ and $\tau = \gamma e_I(\sigma - t_I)$. Therefore, we obtain the following proposition.

Proposition 1.

The first best allocation of the importing country is achieved by the following optimal combination of domestic emission tax and tariff.[7]

$$t_D{}^* = \sigma.$$

$$\tau^* = \gamma e_I \left(\sigma - t_I\right)$$

From proposition 1, the optimal emission tax on domestic transportation is determined by the marginal damage of domestic transportation, but the optimal tariff is affected by the marginal damage of emission and the international emission tax. In particular, if the international emission tax is not implemented, the positive tariff becomes optimal. This is a rather contrasting result compared with the previous literature as in Neary (2006) where a positive tariff causes domestic production and consumption inefficiency and cannot be a first best policy in an economy with environmental damages.

On the other hand, suppose that there is an international agreement so that emission tax on international transportation is the same as the marginal damage. In this case, the optimal tariff is equal to zero. Then, to achieve zero tariffs, an international agreement for the emission from international transportation is needed. Otherwise, fully trade liberalization cannot be the optimal policy.

4-2. The Sub-optimal Policies

4-2-1. Welfare Decomposition

Now, we define the social welfare of country H as follows.

[7] An asterisk shows the optimal policy combination.

$$W = CS + PS + TR - E\left[e_D X,\, e_I Y\right], \tag{18}$$

where $CS \equiv \int_{q_C}^{\bar{q}_C} D(z)dz$ is the consumers' surplus and $PS \equiv \int_{\underline{q}_P}^{q_P} S(z)dz$ is the producers' surplus of the final-good firms in H, respectively. TR is the tariff and the tax revenue, which is defined as $\tau M + t_D e_D X + t_I e_I Y$.[8] The last term of the RHS of eq. (18) shows the environmental damage function from both domestic and international transportations.

Total differentiation of eq. (18), we obtain:

$$\begin{aligned} dW &= -Xdp_D - \gamma M dp_I + \tau dM \\ &\quad + e_D X dt_D + e_I Y dt_I + e_D\left(t_D - \sigma\right)dX + e_I\left(t_I - \sigma\right)dY. \end{aligned} \tag{19}$$

The first, second and third terms of RHS are the sum of the effects on the consumers' surplus, producers' surplus, and tariff revenue. The rest of the terms of RHS show the effects of the tax revenue and environmental damage.

4-2-1. The Sub-optimal Tariff

In this sub-section, we investigate the welfare effects of the tariff. Rearranging eq. (19) using the first-best tariff and domestic emission tax, we obtain the first-order condition of the welfare of H with respect to τ:[9]

$$\begin{aligned} \frac{dW}{d\tau} &= \tau^S \frac{dM}{d\tau} + \left(t_D - \sigma\right)\frac{dX}{d\tau} + \left(t_I - \sigma\right)\frac{dY}{d\tau} \\ &= -\left(S' - D'\right)\left(\tau^S - \tau^*\right) + e_D k\left(t_D - t_D^*\right) = 0. \end{aligned} \tag{20}$$

The first term of the RHS of the first line in eq. (20) is the deadweight loss (DWL) by the tariffs; the second and third terms are environmental damages and their taxation.

Now we have the following proposition.

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[8] We assume that the emission tax revenue on the international transportation is financed by the H's government.

[9] The superscript of S means the sub-optimal level.

Proposition 2.

1. If $k > 0$ *and* $t_D > (<) t_D*$, *the sub-optimal tariff is greater (smaller) than the optimal one.*

2. If $k < 0$ *and* $t_D < (>) t_D*$, *the sub-optimal tariff is greater (smaller) than the optimal one.*

We Suppose $t_D > t_D*$ and $k < 0$ in eq. (20). In this case, the degree of domestic transportation emissions is weak since the amount of domestic transportation is smaller than the first-best level. At the same time, international trade decreases due to an increase in t_D. This effect enhances welfare. On the other hand, welfare reduces since the DWL increases by the reduction of the amount of international trade. By summing up these effects, the import is insufficient. The government sets the sub-optimal tariff smaller than the first-best one.

Whereas if $\beta = 0$, then $k > 0$. In this case, the government sets its sub-optimal tariff higher than the first-best one due to an increase in t_D. It occurs in the traditional model without domestic transportation caused by international trade.

Neary (2006) shows that the sub-optimal tariff is unambiguously increased by emission tax because he does not take into account the transportation sectors and their distances. Then, considering the transportation sectors and their distances is crucial to analyze the relationship between the sub-optimal tariff and emission tax on domestic transportation as in our model.

In addition, we focus on trade liberalization. If $k>(<)0$, the sub-optimal tariff is reduced by the emission tax reduction (increase). The government achieves full trade liberalization by choosing a suitable level of the domestic emission tax with considering k.

4-2-2. The Sub-optimal Emission Tax

Now, we study the effect of t_D on the welfare H. Rearranging (19) using the sub-optimal tariff and domestic emission tax, we obtain the first-order condition for the welfare maximizing problem of H with respect to t_D as follows:

$$\begin{aligned}\frac{dW}{dt_D} &= \tau^S \frac{dM}{dt_D} + \left(t_D - \sigma\right)\frac{dX}{dt_D} + \left(t_I - \sigma\right)\frac{dY}{dt_D} \\ &= e_D\left[k\left(\tau - \tau^*\right) - e_D\left(t_D{}^S - t_D{}^*\right)\left\{\left(\alpha - \beta\right)^2 S' - \beta^2 D'\right\}\right] = 0.\end{aligned}$$

Then, we have the following proposition.

Proposition 3.

1. If $k>0$ *and* $\tau>(<)\tau^*$*, the sub-optimal tariff is greater (smaller) than the optimal one.*

2. If $k<0$ *and* $\tau>(<)\tau^*$*, the sub-optimal tariff is smaller (greater) than the optimal one.*

We suppose that $\tau>\tau^*$ and $k<0$. The amount of import is smaller than the first-best level. Then, the emission from international transportation decreases. However, the DWL harms the welfare since the amount of the import reduces. In addition, the amount of domestic transportation increases so that welfare is reduced. As a result, the import is insufficient; the government sets the sub-optimal emission tax smaller than the first-best level.

If $\beta = 0$, then, $k > 0$. In this case, a raise in τ decreases due to an increase in the amount of international transportation. Then, the sub-optimal emission tax on domestic transportation increases to cancel out international transportation reduction. Neary (2006) shows that the sub-optimal emission tax is always an increased function of tariffs. Then, taking transportation sectors and the distance into account the model also brings us the other new result.

5. Concluding remarks

The emissions from various transportations are a serious problem. We divide transportation into domestic and international transportation. In addition, we also divide two kinds of domestic transportation; domestic transportation caused by the domestic final-good and domestic transportation caused by international trade. Then, the importing country controls each emission by its policies. We have studied the effect of the tariff and the emission tax on the domestic transportation sectors by constructing a simple trade model with domestic and international transportation sectors and distances.

We obtain that the first-best tariff is determined by emission from the international transportation sector. At the same time, the first-best emission tax on domestic transportation is equal to the marginal damage from domestic transportation. This result tells us that the first-best policy combination is non-zero tariffs and emission tax. The first-best tariff becomes zero when the environmental tax on international transportation is equal to the marginal damage of international transportation. Therefore, the combination of the tariff and emission tax on domestic transportation can be the first-best policy combination rather than emission taxes on international and domestic transportation.

We also consider sub-optimal policies. In the sub-optimal tariff case, if the distance the domestic transportation caused by the foreign product is short (long), a rise in the emission tax on the domestic transportation increases (decreases) the sub-optimal tariff. In the case of the sub-optimal emission tax on domestic transportation, if the distance of the domestic transportation caused by the foreign product is short (long), a raise in tariff increases (decreases) the emission tax on the domestic transportation. The sub-optimal policies are depending on the distances for both domestic products and international trade.

The rest of the tasks in this research is as follows. Firstly, we are interested in the behavior of the foreign country. Secondly, we are also interested in cooperation between the domestic and international transportation firms. Lastly, we consider the imperfect competitive transportation markets. However, these extensions are our future research.

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References

Abe K., K. Hattori and Y. Kawagoshi (2014) "Trade Liberalization and Environmental Regulation on the International Transportation," *Japanese Economic Review,* Vol.65, No.4, pp.468-482.

Andriamananjara, S. (2004) "Trade and International Transport Services: an Analytical Framework," *Journal of Economic Integration*, Vol.19, No. 3, pp.604-625.

Behrens, K., C. Gaigne and J.-F. Thisse (2009) "Industry Location and Welfare When Transport Costs are Endogenous," *Journal of Urban Economics*, Vol.65, No.2, pp.195-208.

Copeland, B. (1994) "International Trade and the Environment: Policy Reform in a Polluted Small Open Economy," *Journal of Environmental Economics and Management,* Vol. 26, No.1, pp.44-65.

Deardorff, A. (2001) "International Provision of Trade Services, Trade, and Fragmentation," *Review of International Economics*, Vol.9, No. 2, pp.233-248.

Francois, J. and I. Wooton (2001) "Trade in International Transport Services: The Role of Competition," *Review of International Economics*, Vol.9, No. 2, pp.249-261.

International Energy Agency (2016) *CO2 Emissions from Fuel Combustion Highlight*, OECD/IEA.

Ishikawa, J. and N. Tarui (2016) "Backfiring with backhaul problems: Trade and Industrial Policies with Endogenous Transport Costs," Journal of International Economics, Vo.111, pp.81-98.

Krutilla, K., (1991) "Environmental Regulation in an Open Economy," Journal of Environmental Economics and Management No.20, pp.127-142.

Markusen, J. R., (1975) "International externalities and optimal tax structures," *Journal of International Economics*, Vol.5, No.1, pp.15-29.

Neary, J. P., (1993) "Welfare Effects of Tariffs and Investment Taxes," in W. J. Ethier, E.

Helpman and J. P. Neary eds., *Theory, Policy and Dynamics in International trade: Essays in Honor of R. W. Jones, pp.131-156,* Cambridge: Cambridge University Press.

Neary, J. P., (2006) "International Trade and the Environment: Theoretical and Policy Linkages," *Environmental and Resource Economics*, Vol.33, No.1, pp.95-118.

Takahashi, T. (2011) "Economic Geography and Endogenous Determination and Transport Technology," *Journal of Urban Economics*, Vol.7, No.2, pp.87-93.

Takarada, Y. (2013) "International Transport and the Environment: Environmental Regulations and International Emissions Trading," *RIETI Discussion Paper Series* 13-J-016 (in Japanese).

UNCTAD (2016), *Review of Maritime Transport 2016*, UNCTAD.