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Trans-boundary Pollution, FTA/EPA and Economic Welfare: A Note

Kenji Kondoh[#]

Abstract

In this paper, using a simplified three-country Copeland and Taylor (1999) model, we analyse the welfare effects of a free trade agreement (FTA)/ economic partnership agreement (EPA), given the existence of trans-boundary pollution. We investigate the case where the developed home country J (Japan) concludes an FTA/EPA with one of the two developing foreign countries. Country C (China) generates trans-boundary pollution, while there is no pollution originating from country P (the Philippines). We determine the condition in which country J gains from the FTA/EPA; moreover, under certain conditions, country J should conclude the FTA/EPA with country C and not with P, which is exactly in contrast with the actual policy of the Japanese government.

[#]School of Economics, Chukyo University
101-2 Yagotohonmachi Showaku Nagoya 466-8666, Japan
Tel. & Fax No.: +81-52-835-7496 E-mail: kkondo@mecl.chukyo-u.ac.jp

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Trans-boundary Pollution, FTA/EPA and Economic Welfare: A Note

1. Introduction

Japan has already concluded free trade agreements (FTAs) with Singapore (2002), Mexico (2005), Malaysia (2006), Chile (2007) and Thailand (2007). In addition, it has signed economic partnership agreements (EPAs) with the Philippines and Indonesia. It is widely known that EPA implies not only the liberalization of the trade of goods but also the liberalization of factor mobility. Thus, Japan intends to permit entry to 400 nurses and 600 nursing caregivers from Indonesia in the next two years, starting from fiscal 2008; a similar agreement has already been signed with the Philippines. It should be noted that most of these countries are developing, and because of the differences in technology and resource allocation, they are starkly different from Japan in producing manufactured goods. Moreover, although these countries suffer from environmental pollution resulting from their own poor abatement technology, there is no trans-boundary pollution in Japan due to its distant location.

Environmental pollution due to industrial production has become one of the world's most serious problems. It is difficult to solve this problem because underdeveloped countries usually cannot control pollution well because of the lack of sufficient skills and funding. Moreover, their governments often prioritise economic growth over environmental protection. For Japan, China is practically the only source of trans-boundary pollution because it is located in close proximity to the west of Japan, and most of its developing areas are along the coast, i.e. the east end of China[1]. Due to the prevailing westerly winds that contain polluted air originating from China, the Japanese environmental capital stock suffers damage because of the acid rain. On the other hand, it is widely known that the total amount of trade between Japan and China has increased drastically since 1979, and at present, including the FDI from Japan to China, they are each other's most important business partners[2]. However, despite this significant trade relationship, no FTA or EPA negotiations have occurred between these two countries.

[1] For example, using the data of January 1999, Murano (2001) proved that 62% of SO_X originates from China, and 16%, from Korea.

[2] For Japan, the trade share of China (including Taiwan and Hong Kong) was 25.6%, while that of eight countries with which Japan has already concluded or signed an FTA/EPA was 13.6% (in 2006).

We will now examine this issue in further detail. Why did Japan choose to sign an EPA with the Philippines (or Indonesia) and not with China? Is this choice optimal? To answer this question, we analyse the welfare effects of FTA/EPA, given the existence of trans-boundary pollution.

Many studies examine the effects of environmental pollution resulting from international specialization and trade. The pioneering study by Copeland and Taylor (1999) extended the relative advantage model of David Ricardo to a dynamic model examining the natural recovery of environmental resources, and analysed the effects of international specialization and trade on economic welfare. Suga (2002) considered the differences in the rates of pollution between two countries and permitted the realistic possibility of trans-boundary pollution. Ito (2003) studied the effects of the transfer of pollution abatement technology from a developed country to an underdeveloped one.

There also exist a series of theoretical studies on FTA[3]. Viner (1950) and Johnson (1960) are pioneering works that defined two effects of trade union, trade creation effects and trade diversion effects. Batra (1973) and Yu (1981, 1982) studied the welfare effects of trade unions by introducing the standard Heckscher-Ohlin-Samuelson model. It should be noted that in these studies, before and after trade union is formed, the country with higher cost (including tax) will be alienated from international trade. This is not realistic because before and after the FTA between Japan and the Philippines, international trade between Japan and China and that between Japan and the Philippines has continued. In other words, although a country is excluded from an FTA or a trade union, it usually attempts to continue exporting the good by introducing a subsidy.

Moreover, three countries are usually considered in studies that focus on the welfare effects of FTAs, and the domestic country is always assumed to be a small country in order to investigate the various economic effects including the effects of trade creation, trade diversification or the intra-union terms of trade effect. While the FTA partner country can be assumed to be either a small or large country, the country that is alienated from the FTA is usually assumed to be a large country. Under the assumption that the FTA partner developing country is small, there is no symmetry between the two developing countries, which is essential to our study. On the other hand, if we assume that the two developing countries are large, we should assume that the developed country is also large. Under this assumption, we

will be able to apply the trans-boundary pollution model of Kondoh (2006), which is the extended version of Copeland and Taylor (1999); we will also be able to consider production specialization, which should satisfy the world trade balance condition.

Few studies have been conducted on the effects of FTA under the existence of trans-boundary pollution. Further, it is noteworthy that EPA implies not only the liberalization of the trade of goods but also that of factor mobility. In reality, the Japanese labour market has been opened legally only recently to both Filipino and Indonesian workers, particularly in the field of healthcare services. Kondoh (2006) studied the economic effects of international migration under the assumptions of the Ricardo-Copeland-Taylor two-country model with trans-boundary pollution. Some results of this study should be directly related with our three-country model. Applying a similar model, Kondoh (2007) focused on brain drain migration.

We present the basic model in Section 2. In Section 3, we consider three different cases regarding the specialization of production. In each case, we study the welfare effects of an FTA that can be concluded by the developed home country. This country can choose one of the two developing countries as its partner; one of them is the source of trans-boundary pollution, while the other is not. We also consider the case of an EPA with additional international migration, occurring from the developing EPA partner country to the developed country. The concluding remarks are presented in Section 4.

2. The Model

Consider a world comprising only three countries—*J*, *P* and *C*. Country *J* (Japan) is a developed country, while countries *P* (the Philippines) and *C* (China) are developing countries. There are two industries in each country. One is a smokestack ordinary manufacturing industry (e.g. the shipbuilding industry), and the other is an environmentally sensitive manufacturing industry (e.g. the computer industry). The two primary factors of production are labour and environmental capital.

In country i $(i = J, P, C)$, the production functions of the two types of manufacturing industries are represented as

$$M^i = L_M^i, \text{ and} \tag{1a}$$

$$A^i = \sqrt{E^i} L_A^i, \tag{1b}$$

[3] In chapter 2 of his study, Endoh (2005) surveyed various studies on the welfare aspects of the conclusion of FTAs.

respectively, where E^i denotes the stock of environmental capital; M^i and L_M^i, the output and labour input, respectively, in the ordinary manufacturing industry; and A^i and L_A^i, those in the environmentally sensitive manufacturing industry. The output in the ordinary manufacturing industry does not depend on the environmental capital stock, and one unit of output is produced by one unit of labour. On the other hand, the labour productivity of the environmentally sensitive manufacturing industry relies on the level of environmental capital stock; one unit of labour input can produce $\sqrt{E^i}$ units of output in the environmentally sensitive industry.

Production activity in the ordinary manufacturing industry generates pollution as per the following pollution function:

$$Z^i = \lambda^i L_M^i = \lambda^i M^i, \quad 0 < \lambda^i < 1. \tag{2}$$

Therefore, the magnitude of pollution, λ^i, caused by unit production is constant. Pollution reduces the level of environmental capital stock, and therefore, the production of the manufacturing industry results in negative externalities for the agricultural industry. Here, we assume $\lambda^J = 0$, which implies that the pollution abatement technology of country J is sufficiently advanced, and that there is no domestic pollution in country J. On the other hand, in the developing countries C and P, we assume that $\lambda^C > 0, \lambda^P > 0$.

Next, we model trans-boundary pollution, such as acid rain, which damages the agricultural industry of not only the domestic country but also that of the neighbouring foreign country. At first, following Kondoh (2006), let us consider the possibility that the environmental damage in the neighbouring country might be less significant than that in the country that generates pollution. For example, as China generates pollution, it suffers a seriously damaged industrial environment, and because of the westerly winds, the proportion of polluted acid air that comes to Japan is lesser than that in China. On the other hand, since country P is located far from the other two countries, and there are no westerly winds in South-East Asia, it suffers only domestic pollution, not trans-boundary pollution.

Then, the total amount of pollution in country i, D^i, can be denoted as follows:

$$D^J = bZ^C, \tag{3a}$$

$$D^C = Z^C, \tag{3b}$$

$$D^P = Z^P, \tag{3c}$$

where b is termed as the coefficient of trans-boundary spill-over; its value lies between zero and one.

We assume that one unit of the stock of environmental capital will be destroyed by one unit of pollution. Therefore, the total stock of environmental capital in country i, E^i, is given by

$$E^i = \overline{E}^i - D^i, \tag{4}$$

where $\overline{E}^i$ denotes the natural stock level of environmental capital with no pollution. It might be reasonable to consider that for the computer industry, the environmental capital includes not only clean water or comfortable weather but also infrastructures such as water service, highways, railroad lines and harbour facilities, which should be proportional to the social wealth or the per-capita GDP of each country. Thus, we assume

$$\overline{E}^J > \overline{E}^C > \overline{E}^P [4]. \tag{5}$$

Each sector comprises many firms operating in competitive equilibrium, and therefore, the profit of each firm is zero. Let π_M^i and π_A^i denote the total profits of the ordinary manufacturing industry and the environmentally sensitive manufacturing industry, respectively, in country i. Then, under the assumption that both goods are produced, we obtain the following two equations:

$$\pi_M^i = p_M^i M^i - w^i L_M^i = 0,$$
$$\pi_A^i = p_A^i A^i - w^i L_A^i = 0,$$

where p_M^i and p_A^i denote the prices of the goods M and A, respectively, and w^i, the wage rate in country i. The above two equations yield

$$p_M^i = w^i, \tag{6}$$

$$p_A^i \sqrt{E^i} = w^i. \tag{7}$$

The full employment condition of country i is denoted as follows:

$$L_M^i + L_A^i = L^i, \tag{8}$$

where L^i denotes the labour endowment of country i.

On the demand side, we assume that all the individuals in the three countries as identical, and thus, we define the aggregate utility function as

$$U = U(D_M, D_A),$$

where D_M and D_A denote the demands for goods M and A, respectively, and we assume that U is a homothetic function.

From equations (3) to (6), in the case of diversified production, the relative price in country i is

[4] In 2006, the nominal per-capita GDP of Japan, China and the Philippines were \$34,188, \$2,001 and \$1,363, respectively. If we consider the east coast industrial area of China, Shanghai city, Jiangusu province and Zhejiang province, the per-capita GDP would be approximately \$3530 on average.

$$p_M^i / p_A^i = \sqrt{E^i} = \sqrt{\overline{E}^i - D^i} \ . \qquad (9)$$

3. FTA and Economic Welfare

3.1 Autarky and Possible Specialization Pattern under International Trade

In this subsection, we first consider the autarkic equilibrium. In autarky, each country produces both goods and the following condition holds.

$$p_M^J / p_A^J = \sqrt{E^J} = \sqrt{\overline{E}^J - bD^C} \ , \qquad (10\text{-}1)$$

$$p_M^C / p_A^C = \sqrt{E^C} = \sqrt{\overline{E}^C - D^C} \ , \qquad (10\text{-}2)$$

$$p_M^P / p_A^P = \sqrt{E^P} = \sqrt{\overline{E}^P - D^P} \ . \qquad (10\text{-}3)$$

Although the Chinese population and territory are, in reality, quite large, all areas of China are not directly and strongly related with the Japanese economy. Thus, let us consider only the areas along the east coast of China including Shanghai city and two provinces Jiangsu and Zhejiang. In this case, we may assume that

$L^J = L^C = L^P$

to simplify our analysis[5]. Then, we can conclude that

$p_M^J / p_A^J > p_M^C / p_A^C > p_M^P / p_A^P$,

which implies that country J has an advantage in the production of the environmentally sensitive manufacturing good, country P has an advantage in the production of the ordinary manufacturing good and country C takes the middle position.

The main subject of this study is to determine the country, C or P, with which country J should conclude an FTA. Thus, we consider the case where international trade exists between countries J and C as well as countries J and P; that is, under international trade, country J exports good A, while both countries C and P export good M.

There are two possible cases of production, depending on the consumers' preferences. The first case (Case 1) is that the demand for good M is very strong, and country J produces both goods while countries C and P specialize in the production of good M. In this case, we have

[5] The populations of Japan and the Philippines are 128.2 and 84.5 million, respectively (2007). The total populations of Shanghai, Jiangsu and Zhejiang run up to 142.1 million. However, the growth rates of the Japanese, Chinese and the Philippine population are 0.01, 0.64 and 1.75%, respectively. Thus, roughly speaking, the gap of the per-capita GDP between those countries is sufficiently large, while the population gap could be ignorable.

$p^W \equiv p_M^W / p_A^W = \sqrt{E^J}$, where p_M^W and p_A^W denote the world price of goods M and A, respectively.

The second case (Case 2) is that the demand for good M is not very strong, and country J specializes in the production of good A while countries C and P specialize in the production of good M. In this case, we have $\sqrt{E^C} < p^W \leq \sqrt{E^J}$.

It might be worth mentioning that if the demand for good A is stronger, then $\sqrt{E^C} < p^W$ will be satisfied and not only country J but also country C will specialize in the production of good A. Now, there will be no international trade between countries J and C, which contradicts our original subject.

3.2 Case 1

3.2.1 Before concluding an FTA/EPA

First, we consider Case 1. Let us overview the equilibrium before an FTA. We assume that country J imposes a tariff t on one imported unit of good M[6]. Now, the domestic relative price in country J would be

$$p^t = (p_M^W + t) / p_A^W ,$$

and under the assumption that the government of country J distributes the tariff revenue among domestic consumers equally, we have the following trade balance equation:

$$p_A^W (A^J - D_A^J) + tD_M^J = (p_M^W + t) D_M^J ,$$

which implies that with respect to the world price, the total sum of imported good M is equivalent to the exported good A. Therefore, the consumption point is given by E_F^J , and the domestic social welfare level by U_F^J in Figure 1, where $J_0 J_0'$ is the production possibility frontier (PPF), which is linear with the slope of $-\sqrt{E^J}$. It is necessary to note that this slope depends on the production of country C because trans-boundary pollution affects the environmental capital stock of country J.

<Figure 1 should be around here>

[6] It may be reasonable to consider that the two developing countries also impose tariffs on the imported good A; however, to simplify our analysis, we did not consider this aspect. In the case that country J specializes in the production of good A, it is also possible and

On the other hand, both countries C and P trade with country J, and they do not impose any trade restrictions. As these countries specialize in the production of good M, their production points are denoted by C_0' and P_0' in Figures 2 and 3, respectively. It is worth noting that the PPF of country C, C_0C_0' and that of country P, P_0P_0', are both convex because of the pollution originating domestically. Moreover, the MRS of technology is decreasing because an increase in the production of good M affects the domestic environmental capital stock to a more significant extent. The consumption points are E_F^C and E_F^P, and the domestic welfare levels, U_F^C and U_F^P, respectively.

<Figures 2 and 3 should be around here>

The total amount of excess demand for good A and excess supply of good M by these countries are denoted by $E_F^C H_F^C + E_F^P H_F^P$ and $C_0'H_F^C + P_0'H_F^P$, respectively, which should be equal to the excess supply of good A and excess demand for good M in country J, respectively. Therefore, country J produces both goods, and the production point of country J is denoted by G_F^J in Figure 1, where $G_F^J H_F^J = E_F^C H_F^C + E_F^P H_F^P$ and $H_F^J E_F^J = C^{0'}H_F^C + P^{0'}H_F^P$.

3.2.2 FTA/EPA between countries J and P

Now, we consider that countries J and P conclude an FTA. The tariff imposed on the import of good M from country P decreases to zero, and free trade is realized. The relative price of good M in terms of good A in country J is now equivalent to the world price p^W.

The economic welfare of country P will not change after the conclusion of the FTA. This is because before and after the FTA, country P continues to trade with country J at the world price.

Country C will choose to continue trading with country J. Now, although the relative price in country J is equivalent to the world price and tariff continues to be imposed on the imported good M from country C, it is necessary for the government of country C to export good M at a discounted price. Therefore, the domestic price of good M in terms of good A in country C changes to $p^s = (p_M^W - t)/p_A^W$.

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reasonable to consider that country J imposes a tariff on the import of good M in order to earn tariff revenue.

As a result, the consumption point of country C is E_T^C and the social welfare level is U_T^C in Figure 2. Since $U_T^C < U_F^C$, country C incurs losses from the conclusion of the FTA between countries J and P.

In this case, the production point of country J will be denoted by G_T^J in Figure 1 due to the decreasing trade with country C. $H_T^J E_T^J = C_0' H_T^C + P_0' H_F^P$ and $G_T^J H_T^J = E_T^C H_T^C + F_F^P H_F^P$ should be satisfied according to the trade balance condition.

Finally, let us consider the case of EPA that includes permitting legal migration. Similar to Kondoh (2006), we have the following relations under international trade from (6) and (7),

$$p_A^W \sqrt{E^J} = w^J, \quad p_M^W = w^J, \tag{11-1}$$

$$p_A^W \sqrt{E^C} < w^C, \quad p_M^W - t = w^C, \tag{11-2}$$

$$p_A^W \sqrt{E^P} < w^P, \quad p_M^W = w^P. \tag{11-3}$$

The above equations imply that $w^J = w^P > w^C$, and thus, there is no motivation for international migration from country P to country J.

3.2.3 FTA/EPA between countries J and C

In this subsection, we consider the opposite case where an FTA is concluded between countries J and C. Similar to the former case, country J gains from the conclusion of the FTA with country C.

Similarly, country P incurs losses from the FTA, and there is no change in the production and consumption of country C.

Finally, let us consider international migration. We also have

$$p_A^W \sqrt{E^J} = w^J, \quad p_M^W = w^J, \tag{12-1}$$

$$p_A^W \sqrt{E^C} < w^C, \quad p_M^W = w^C, \tag{12-2}$$

$$p_A^W \sqrt{E^P} < w^P, \quad p_M^W - t = w^P. \tag{12-3}$$

The above equations imply that $w^J = w^C > w^P$, and thus, there is no motivation for international migration from country C to country J.

Hence, we can assert the following proposition.

PROPOSITION 1

Consider that the two developing countries specialize in the production of good *M*, while the developed country produces both goods. Then, the developed country will gain and the alienated country will incur losses from the FTA, while the FTA partner developing country will not experience any change in its welfare. Moreover, even in the case of EPA that includes international migration, no one would contemplate migration since there is no wage gap between the EPA countries.

3.3 Case 2

3.3.1 Before concluding an FTA/EPA

Next, let us consider Case 2, wherein country J specializes in the production of good A. The world equilibrium before the conclusion of FTA is similar to that of Case 1, but the production point of country J is now denoted by point J_0 in Figure 4. The consumption point is denoted by E_F^J, and the domestic social welfare level by U_F^J. Similar to Case 1, as countries C and P specialize in the production of good *M*, their production points are denoted by C_0' and P_0' in Figures 5 and 6, respectively. The consumption points are denoted by E_F^C and E_F^P, and the domestic welfare levels, by U_F^C and U_F^P, respectively. The international trade balance condition should satisfy $J_0H_F^J = E_F^C H_F^C + E_F^P H_F^P$ and $H_F^J E_F^J = C_0'H_F^C + P_0'H_F^P$.

<Figures 4, 5 and 6 should be around here>

3.3.2 FTA/EPA between countries J and P

Now, we consider that countries J and P conclude their FTA. Similar to Case 1, the relative price of good M in terms of good A in country J is now equivalent to its world price p^W.

Similar to Case 1, country C should export good M at the discounted price that is equivalent to the amount of tariff, and thus, the domestic price would be p^s. Before and after the FTA, country P continues to trade with country J at the world price.

However, in Case 2, as the optimal trade scale of country C decreases while that of country J increases, it results in an excess supply of good A and excess demand for good M after the FTA. Thus, p^W will increase because country J specializes in the production of good A, and in contrast to Case 1, it cannot change the production point in this case. Therefore, the world price

would now be given by $p^W{}'(> p^W)$. The consumption point of country J will be E_T^J, and the social welfare U_T^J in Figure 4. As a result, there are two effects of FTA on the welfare of country J. The first is the positive trade creation effect from the realization of free trade. The second is the negative terms of trade effect due to the decreasing p^W. The consumption point of country J is given by E_T^J, and the social welfare level by U_T^J in Figure 4. It is possible that both $U_F^J < U_T^J$ and $U_F^J > U_T^J$, which implies that it is unclear whether or not country J gains from the FTA with country P.

The consumption point of country C will be denoted by $E_T^C{}'$, and the social welfare by $U_T^C{}'$ in Figure 5. It is possible that both $U_F^C < U_T^C{}'$ and $U_F^C > U_T^C{}'$, which implies that it is unclear whether or not country C gains from the FTA between countries J and P.

Moreover, country P will gain from the FTA because p^W increases, and the consumption point will be given by $E_{T'}^P$, and social welfare by $U_T^P{}'(> U_F^P)$ in Figure 6.

Finally, let us consider the case of EPA and that international migration is permitted between the EPA countries. In this case, we have

$$p_A^W \sqrt{E^J} = w^J, \quad p_M^W < w^J, \tag{13-1}$$

$$p_A^W \sqrt{E^C} < w^C, \quad p_M^W - t = w^C, \tag{13-2}$$

$$p_A^W \sqrt{E^P} < w^P, \quad p_M^W = w^P. \tag{13-3}$$

Moreover, this implies $w^J > w^P > w^C$. Therefore, workers in country P migrate to country J if permitted, and of course, they must gain from migration. As the population of each country changes, the total world production of good A increases, while that of good M decreases. Thus, the world price of good M in terms of good A, p^W, should increase. Therefore, for country J, the terms of trade decline and social welfare must decrease. On the other hand, workers in countries P (those remaining behind) and C gain from the migration from country P to country J because of the improved terms of trade.

3.3.3 FTA/EPA between countries J and C

The results of another FTA case, between countries J and C, are quite similar. It is unclear whether country J gains or not because after the FTA, both the trade creation effect and the income effect would enhance social welfare; however, the declining terms of trade could reduce the social

welfare of country *J*. Country *C* gains because of the improved terms of trade. Moreover, it is unclear whether or not country *P* gains from the FTA. Country *P* is alienated from the FTA and must export good *M* at the discounted price, which causes negative effects on its welfare; however, the changing terms of trade improve its social welfare.

The only difference is in the case of EPA. Here, we have $w^J > w^C > w^P$, and in the case of migration from country *C* to country *J*, the terms of trade will be worse for country *J*, while it will be better for the two developing countries because of the trade balance condition. Moreover, apart from the EPA between countries *J* and *P*, the outflow of workers from country *C* implies a decrease in the smokestack production of good *M* in country *C*, and it could expand the PPF of country *J* from J_0J_0' to J_1J_1' in Figure 7 because of the less damaged environmental capital stock. Therefore, as the above two effects—the change in the terms of trade and in PPF—are in opposite directions, immigration will not always lead to negative effects on the welfare of country *J*. Thus, if the other conditions remain the same, an EPA with country *C* should be more beneficial than that with country *P*.

<Figure 7 should be around here>

Now, we can assert the following proposition.

PROPOSITION 2

Consider that the two developing countries specialize in the production of good *M*, while the developed country produces good *A*. Then, the FTA partner developing country will gain; however, it is not clear whether or not both the developed country and the alienated developing country will gain from the FTA. Moreover, in the case of EPA, migration could improve the social welfare in both the developing countries. A change in the terms of trade due to migration causes a negative effect on the developed country *J*; however, in the case of the EPA between country *C* that is the source of trans-boundary pollution, migration reduces the pollution level, which has a positive effect on welfare.

3.4 Case 3

Now, we discuss the third possible case that has not been considered yet. In contrast to Kondoh (2006), let us consider the possibility that the environmental damage in the neighbouring country might not always be

larger than the damage in the country that originally emits pollution. For example, Chinese industrial areas are located on the east coast of the country; thus, because of the westerly winds, at least in winter, most of the polluted air appears to come directly to Japan without causing serious damage to China. We may also consider the general case that country C is located at the upstream of a river, and the factory of M industry is located at the border. Then, the polluted water flows to downstream country J without any damage to the environmental capital of country C. To emphasize this aspect, let us assume that there is no domestic origin pollution in country C, while the neighbouring country J suffers from trans-boundary pollution originating from country C.

Now, we have

$$p_M^C / p_A^C = \sqrt{E^C} = \sqrt{\overline{E}^C}\ , \qquad \text{(10-2')}$$

instead of (10-2), which implies that the PPF of country C is now linear and constant as shown in Figure 8. From (5), if the spill-over parameter b is not large enough to satisfy

$$b < (\overline{E}^J - \overline{E}^C)/L^C\ ,$$

we can also conclude that

$$p_M^J / p_A^J > p_M^C / p_A^C > p_M^P / p_A^P\ ,$$

which implies that country J has an advantage in the production of environmentally sensitive manufacturing goods, country P has an advantage in the production of ordinary manufacturing goods and country C takes the middle position.

<Figure 8 should be around here>

This new case (Case 3) occurs if the demand for good M is moderate. Then, country J specializes in the production of good A, country P specializes in the production of good M and country C produces both goods. In this case, we have $\sqrt{E^C} = p^W$.

3.4.1 Before Concluding an FTA/EPA.

As in Case 2, before the conclusion of an FTA, the production point of country J is denoted by point J_0 in Figure 4. The consumption point is given by E_F^J, and the domestic social welfare level by U_F^J. Similarly, as country P specializes in the production of good M, the production point is given by P_0'

in Figure 6. The consumption point is denoted by E_F^P, and the domestic welfare level by U_F^P.

On the other hand, the production point of country C is denoted by $\tilde{G}_F^C$, and the consumption point by $\tilde{E}_F^C$ in Figure 8. The international trade balance condition requires to satisfy $J_0 H_F^J = \tilde{E}_F^C \tilde{H}_F^C + E_F^P H_F^P$ and $H_F^J E_F^J = \tilde{G}_F^C \tilde{H}_F^C + P_0' H_F^P$.

3.4.2 FTA/EPA between countries J and P

Now, we consider that countries J and P conclude their FTA. In contrast to Cases 1 and 2, country C will not trade with country J anymore and will maintain a closed economy. Thus, both the production and consumption points are denoted by $\tilde{E}_F^C$ in Figure 8, and the social welfare does not change after the FTA. Now, similar to Cases 1 and 2, the relative price of good M in terms of good A in country J is now equivalent to the world price p^W.

Without country C, there would be an excess supply of good A and an excess demand for good M, and the trade balance requires p^W to increase. This implies a declining terms of trade for country J, resulting in a negative effect on this country's social welfare. As a result, country J gains from the trade creation effect but incurs losses due to the declining terms of trade. Therefore, it is ambiguous whether or not country J gains in this situation.

On the other hand, country P will gain from the FTA because of the improved terms of trade.

Finally, let us consider the case of EPA, and that international migration is permitted between the EPA countries. In this case, we have

$$p_A^W \sqrt{E^J} = w^J, \quad p_M^W < w^J, \tag{14-1}$$

$$p_A^W \sqrt{E^C} = w^C, \quad p_M^W = w^C, \tag{14-2}$$

$$p_A^W \sqrt{E^P} < w^P, \quad p_M^W = w^P. \tag{14-3}$$

Moreover, these imply that $w^J > w^P = w^C$. Therefore, the workers in country P migrate to country J if permitted, and of course, they must gain from migration. As the population of each country changes, the total world

production of good A increases, while that of good M decreases. Similar to Case 2, the world price of good M in terms of good A, p^W, should increase. Therefore, for country J, the terms of trade decline, leading to a decrease in social welfare. On the other hand, the workers in country P (those left behind) gain from migration to country J because of the improved terms of trade, while there is no change in the social welfare of workers in country C.

3.4.3 FTA/EPA between countries J and C

The results of another FTA between countries J and C, are not similar. Country J gains from both the trade creation effect by introducing free trade and the income effects from the tariff revenue. Country P continues to trade with country J by exporting good M at the discounted price. Due to this distortion, country P incurs losses.

The production point of country C should shift to $\tilde{G}_T^C$ in Figure 8 to coincide with world trade balance. Therefore, there will be no change in the terms of trade. Instead, country J suffers due to the increased trans-boundary pollution generated by the increased production of good M in country C. Due to this negative effect, we cannot conclude whether or not country J will gain in this case. On the other hand, as mentioned above, country P incurs losses, while country C remains unaffected in terms of its social welfare.

Finally, let us consider the case of EPA, and that international migration is permitted between the EPA countries. In this case, we have the following equations.

$$p_A^W \sqrt{E^J} = w^J, \quad p_M^W < w^J, \tag{15-1}$$

$$p_A^W \sqrt{E^C} = w^C, \quad p_M^W = w^C, \tag{15-2}$$

$$p_A^W \sqrt{E^P} < w^P, \quad p_M^W - t = w^P. \tag{15-3}$$

The above equations imply $w^J > w^P = w^C$. Therefore, the workers in country C migrate to country J if permitted, and of course, they must gain from migration. As the population of country J increases, the total world production of good A increases. Now, the world trade balance requires country C to produce a smaller amount of good A and a larger amount of good M. Therefore, the production point would be denoted by $\tilde{\tilde{G}}_T^C$ in Figure 8. This would result in a negative effect of trans-boundary pollution on the

PPF of country *J*. Thus, country *J* incurs losses by permitting immigrants from country *C*. On the other hand, countries *P* and *C* remain unaffected in terms of their level of social welfare.
Let us summarize the above results.

PROPOSITION 3

Consider a developing country *C* that generates trans-boundary pollution and produces both goods and another developing country *P* that specializes in the production of good *M*, while a developed country *J* produces good *A*. Then, the FTA will not result in any welfare change in country *C*. Country *P* gains (incurs losses) from the FTA between countries *J* and *P* (*C*), respectively. It is unclear whether or not the developed country *J* will gain from the FTA. Moreover, migration occurs from the EPA partner country to the developed country, and in the case of EPA between countries *J* and *P*, the host country incurs losses while the home country gains. On the other hand, in the case of EPA between countries *J* and *C*, country *J* incurs losses, while no welfare change occurs in country *C*.

Now, we consider that the tariff reduction is relatively small. Then, country *J* will incur losses from the FTA with country *P* more than that with country *C*. The reasons are as follows. First, in the case of the FTA with country *P*, the negative terms of trade effect might be larger than the positive trade creation effect. Excluding country *C* from world trade would cause a relatively significant change in the terms of trade. Second, in the case of FTA with country *C*, trans-boundary pollution does not increase significantly. This is because the magnitude of tariff reduction is small enough, and therefore, the production point of country *C* will not shift significantly.

4. Concluding Remarks

The established propositions are summarized in Table 1, and we have several important suggestions.

<Table 1 should be around here>

First, for the developed country *J*, an FTA with developing countries could be certainly welcomed if and only if both the goods are produced in country *J*.

Second, there are two possible cases in which country J should conclude an FTA/EPA with country C and not P. The first case is that country J produces only good A, other countries produce good M, and the EPA includes legal immigration permission. The second case is that the tariff reduction caused by the FTA/EPA is small enough, and country C produces both goods while country J (P) produces only good A (M). This suggestion is in contrast with the actual behaviour of the Japanese government, as mentioned in the introduction.

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Figures

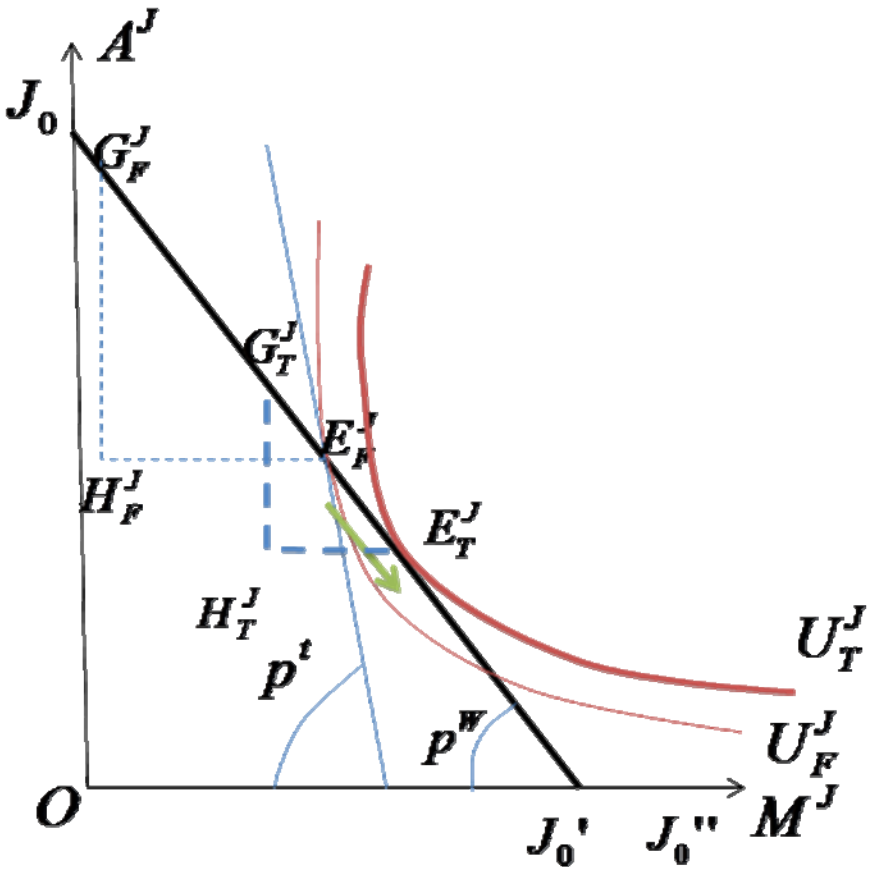


Figure 1

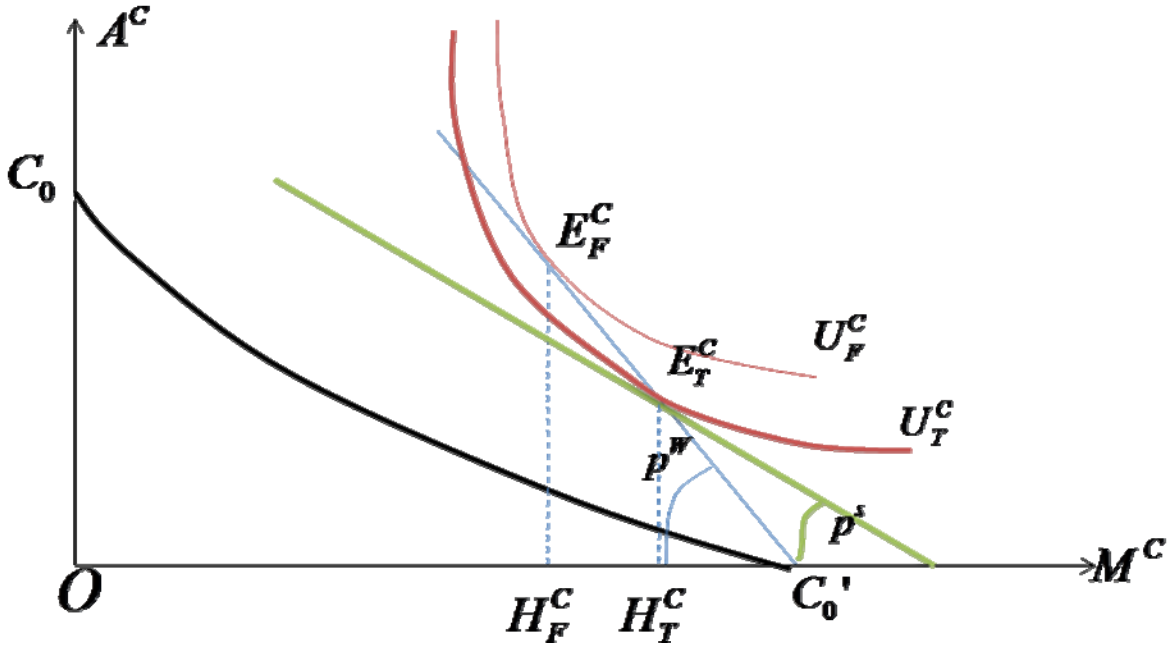


Figure 2

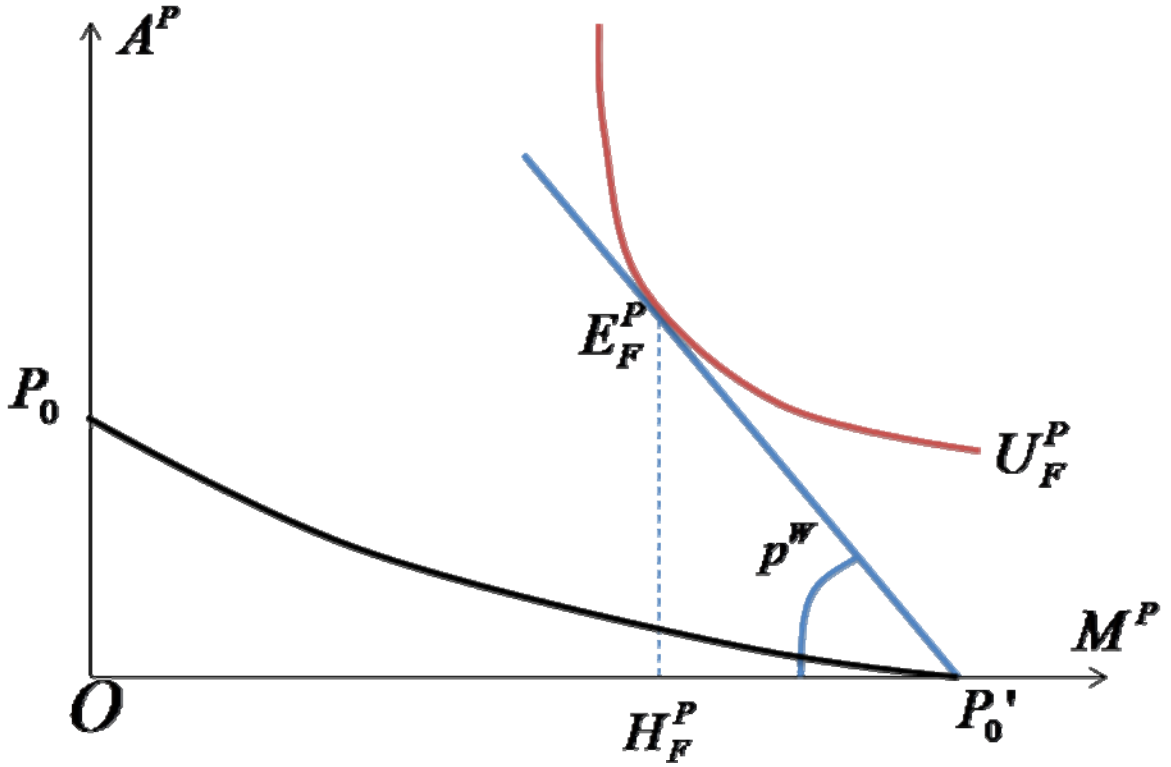


Figure 3

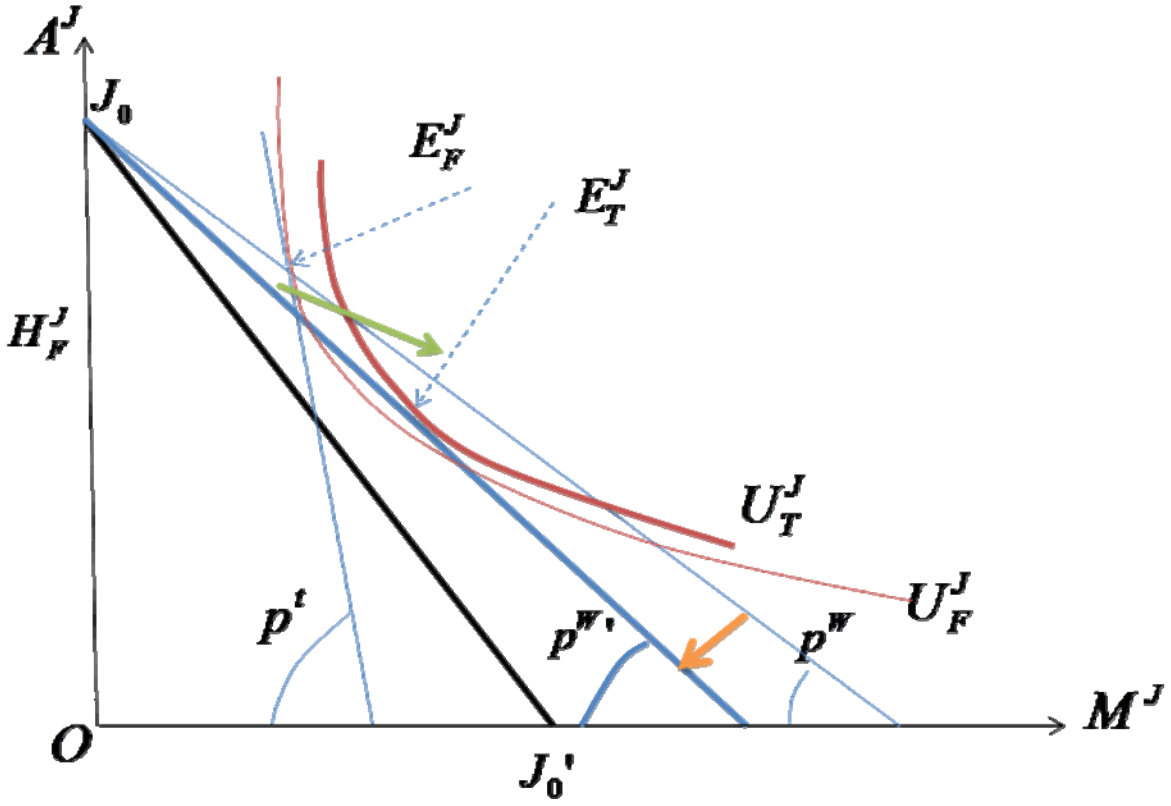


Figure 4

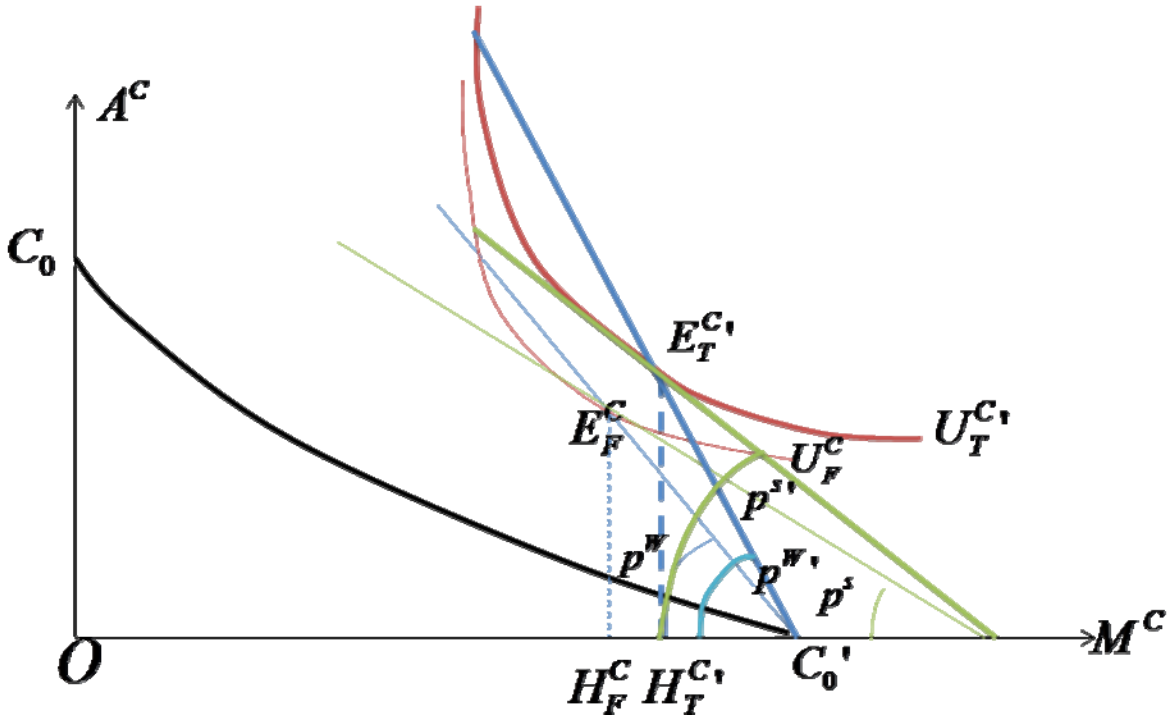
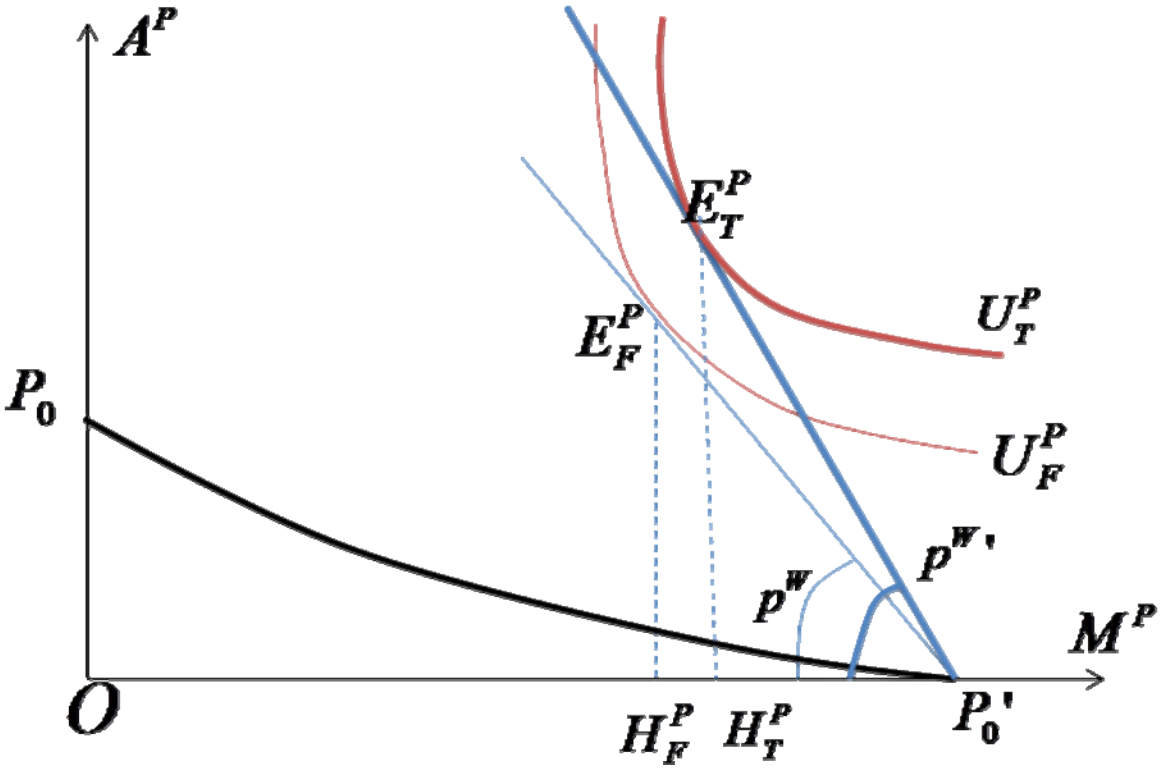


Figure 5



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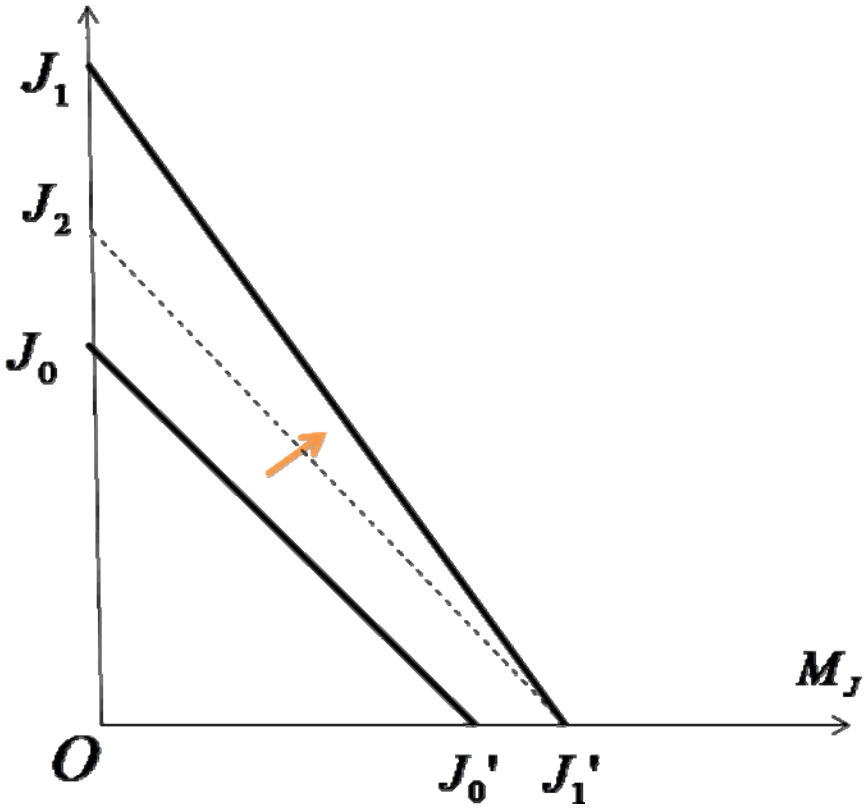

Figure 7

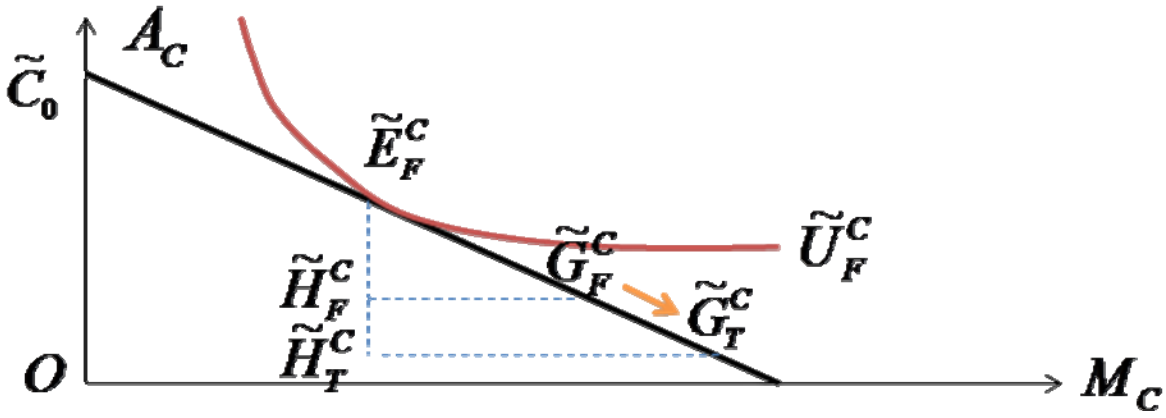

Figure 8

Table 1

	Case 1 $p^W = \sqrt{E^J}$			Case 2 $\sqrt{E^C} < p^W < \sqrt{E^J}$			Case 3 $p^W = \sqrt{E^C}$		
	J	P	C	J	P	C	J	P	C
FTA J&P	↑	–	↓	↕	↑	↕	↕	↑	–
+Migration	⟋	⟋	⟋	↓	↑	↑	↓	↑	–
FTA J&C	↑	↓	–	↕	↕	↑	↕	↓	–
+Migration	⟋	⟋	⟋	↕	↑	↑	↓	–	–