



Welfare effects of competition for FDI between technologically asymmetric countries with varying trade costs[☆]

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ABSTRACT

Given the traditional argument that host countries' excessive competition for FDI (foreign direct investment) deteriorates the host countries' welfare, this paper examines the impact of policy competition for FDI on social welfare considering varying trade costs. Based on a model where two technologically asymmetric countries compete for FDI, we determine an equilibrium where a multinational firm relocates to a less efficient country. Moreover, we demonstrate that the policy competition for FDI between less integrated economies might improve social welfare when the multinational firm relocates to a country with a lower technology and a less competitive market. Nonetheless, we show that the traditional argument can be true when the policy competition for FDI between highly integrated economies deteriorates host countries' welfare, as supported by the empirical evidences of moderated competition for FDI within EU member countries.

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1. Introduction

Tax competition is a situation in which governments provide various tax favors to multinational corporations to induce foreign direct investment (FDI) inflows. Competition for FDI has been trending upward since the 1990s, and various countries, across continents, engage in corporate tax competition for FDI as shown in the following examples.

The competitive element to the phenomenon is mostly intra-regional. For instance, there has been a domino effect in the Asia-Pacific nations, alongside their peers around the world, who have lowered their corporate tax rates to compete for investment. This is an on-going situation, as addressed by a recent Ernst & Young briefing on the issue as follows:

Hong Kong's corporate tax rate was 16% until 2003 when sluggish revenue prompted a rate hike to 18.5%. In 2008, after Singapore cut its rate to 18%, Hong Kong reversed course and lowered its corporate rate to 16.5%. Singapore reacted in 2010 with another reduction to 17%, its sixth corporate cut since 2000. Taiwan is the newest nation to compete in this cluster of ultra-low corporate tax rates, cutting its statutory rate from 25% to 17%, effective in 2010 (Asia Pacific Tax Policy Outlook, Ernst & Young, 2011).

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Tax competition may cause distortions in trade and investment patterns as well as difficulties in securing sources of taxation. The G7 and OECD countries have expressed concerns about these undesirable consequences, and refer to them as 'Harmful Tax Competition.' Given that the tax benefits provided by the host country to the foreign investor cause tax competition among host countries, there have been traditional concerns and different perspectives on the welfare effects of tax competition in terms of possible distortion and inefficiency caused by the tax competition.

Among numerous empirical evidences for wide-spread tax competition for FDI, [Devereux et al. \(2008\)](#) provide well organized empirical evidences showing that tax competition for FDI has steadily increased based on data from 21 countries between 1982 and 1999.¹ More interestingly, [Mendoza and Tesar \(2005\)](#) show the case where tax competition for FDI is not changed to a 'race to the bottom' in EU where the trade costs are significantly reduced as a result of economic integration and the removal of trade barriers in contrary to the general pattern of intense competition among countries with high trade costs.

Motivated by these interesting features of intense tax competition for FDI among prospective host countries while the competition is significantly reduced among countries with low trade costs, this paper examines the welfare effects of tax competition considering

¹ For detailed discussions on the empirical evidences for increasing tax competition for FDI, see [Ghinamo et al. \(2010\)](#), [Simmons \(2006\)](#), and [Bellak and Leibrecht \(2009\)](#).

asymmetric features of host countries. More specifically, we determine when countries compete more intensely for FDI and what factors reduce the competition for FDI focusing on asymmetric trade costs and technology asymmetry of the prospective host countries.

There are previous studies that suggest that tax reductions create negative externalities but can enhance the welfare of countries under certain conditions. King et al. (1993) and Rauscher (1995) show that the use of subsidies to “bid” for individual firms can have desirable efficiency properties, but that this is not always true. Janeba (1998) illustrated that tax competition under imperfect competition raises welfare by eliminating wasteful subsidies. Kehoe (1989) and Janeba (2000) argued that tax competition can also solve government commitment problems. Such studies suggest that tax competition can have positive effects mainly due to the strategic effects while significant distortion caused by the tax competition might deteriorate general efficiency of the economies. This paper differs from existing literatures in that we demonstrate that policy competition for FDI inflows can improve economic and social efficiency when there are technology asymmetries and cross-border transaction costs among competing host countries that are relatively high.

The purpose of this paper is to analyze the impact of policy competition on the location decision of foreign investors and the social welfare of the countries involved. More specifically, we focus on a situation in which competing host countries show technological asymmetry with one country having lower marginal production costs than another competitor. In addition, a country with a higher technology has a higher level of market competition with incumbent firms, while another country with a lower technology shows lower level of market competition. For the simplicity of the discussion without loss of generality in discussing different levels of market competition, we assume that there is a competing incumbent firm in a country with higher technologies while there is no competing firm in another country with lower technologies. Through this model, we assess policy competition between asymmetric countries such as a country with a higher technology and intense competition and a country with a lower technology and less intense competition, and consider the welfare implications.

This paper relates closely to Bjorvatn and Eckel (2006), which studies policy competition for FDI between two countries of different sizes. They consider a region consisting of two countries wherein there is a trade cost that separates the region into two markets. The equilibrium policy may be either a subsidy or a tax, depending on the location advantages offered by the two countries. This paper differs from theirs in the degree of asymmetry present in its two modeled countries. We assume that differences in production cost between the two countries make the low-cost country a relatively more attractive location to investors: in the absence of trade barriers, that is if the intra-regional trade cost is zero, a foreign investor will always invest in the lower-cost country. In Bjorvatn and Eckel's model, however, the foreign investor is indifferent between two countries in terms of location when the intra-regional trade cost is zero. More important difference from Bjorvatn and Eckel (2006) lies in that this paper demonstrates that the intense competition for FDI between closely integrated countries might deteriorate social welfare, while the competition for FDI with location changes between less integrated countries improves social welfare, which was not considered in earlier literatures.

Other related literatures include Haaparanta (1996) and Fumagalli (2003). Haaparanta (1996) models subsidy competition between two countries with exogenous wage differences, and shows that the high-wage country may attract the foreign firm under subsidy competition. Moreover, Fumagalli (2003) considers bidding competition for FDI between two countries with exogenous cost differentials, and analyzes the implications of this competition for aggregate welfare. Although these literatures share the similar research interests in the impact of competition for FDI between asymmetric countries, they did not consider the welfare effects of competition for FDI considering different levels of economic integration reflected in differing trade costs.

Raff and Srinivasan (1998) also studied policy competition in a situation of incomplete information. Specifically, investors are assumed to be incompletely informed about the cost of doing business in the host country: they do not know whether this will be high-cost or low-cost. This study focuses on the signaling role of tax incentives rather than on welfare analysis. Incomplete information forces high-productivity governments to grant tax incentives in order to signal a favorable investment climate. The model in this paper is, by contrast, characterized by complete information, i.e. the economic agents involved are fully informed about which decisions will maximize their payoffs. Thus, the equilibrium policies of the high-productivity country do not involve any signaling effect in this paper.

Based on a model where a country, *A*, which has a higher technology with more intense market competition, competes for FDI with another host country, *B*, under cross-border trade costs, we demonstrate that an intense policy competition for FDI between highly integrated countries with a significantly low trade cost deteriorates social welfare. On the other hand, the competition for FDI between less integrated countries with higher trade costs might improve social welfare when FDI location is changed to a country with lower technologies with a less competitive market. The world welfare gains from policy competition are created mainly because the relocation of FDI after policy competition reduces the deadweight loss caused by cross-border trade costs. In addition, we show that the traditional argument that excess competition for FDI might deteriorate host countries' welfare might be true when trade costs are relatively low as in the case of integrated economies. The empirical evidences for wide-spread policy competition for FDI in general and the moderated competition for FDI within EU and other integrated economies as shown in Devereux et al. (2008) and Mendoza and Tesar (2005) might be good examples that can be explained by the major findings in this paper.

The remainder of this paper is organized as follows: Section 2 describes the basic model, which is a game between an investor and two host countries. Then, in Section 3, the equilibrium of the game is derived, with no government intervention case and then endogenous policy competition case. Section 4 analyzes welfare effects and Section 5 concludes.

2. The model

We examine the tax competition between asymmetric countries in terms of technologies reflected in asymmetric marginal production costs between prospective host countries. To focus on the impact of technology asymmetries, market sizes are assumed to be symmetric. Consider a region consisting of two potential host countries: *A* and *B*. The marginal production cost in countries *A* and *B* is respectively *c* and *c* + α . To focus on the role of cost difference between two countries, α , ‘*c*’ is assumed to be zero simplifying the notation. Demand in the two countries is given by $z^i = 1 - P^i$, $i = A, B$, while two markets are segmented. There exists an incumbent firm that serves the whole regional market in country *A*, while there is no incumbent firm in country *B*. A foreign firm is now considering FDI in the region. The purpose of the FDI is to serve consumers in both countries *A* and *B*. The fixed investment cost is assumed to be the same in both countries. Let *t* be the per unit trade cost associated with cross-border trade. Therefore, lower *t* implies that trading countries are closely integrated with the removal of trade barriers while higher *t* denotes that trading countries are less integrated.

After the foreign firm's market entry, there is Cournot competition between the foreign firm and the incumbent firm. X_j^i denotes the foreign multinational firm's output produced in country *j* and consumed in country *i* via export. The output of the incumbent firm in country *A* is denoted by x_j^A where the subscript *j* implying the location of the foreign multinational firm. The industry output provided in country *i* is $z^i = x_j^i + X_j^i$ ($j = A, B$ and $i = A, B$).

Additionally, Π_j ($j = A, B$) denotes the operating profits that the foreign multinational firm earns by selling the final good to all consumers of the region when the foreign firm locates its production plant in country j , while π_j denotes the operating profits that the incumbent firm in country A earns when the foreign multinational firm is located in country j .

The profit functions of the foreign multinational firm, referred to below as firm f , are defined respectively as follows:

$$\Pi_A = P_A X_A^A + (P_B - t) X_A^B \quad \text{when firm } f \text{ is located in country } A \quad (1)$$

$$\Pi_B = (P_A - \alpha - t) X_B^A + (P_B - \alpha) X_B^B \quad \text{when firm } f \text{ is located in country } B. \quad (2)$$

The profit functions of the incumbent firm, referred to as firm d , are

$$\pi_j = P_A X_j^A + (P_B - t) X_j^B \quad \text{when firm } f \text{ is located in country } j (j = A, B). \quad (3)$$

The social welfare in country A consists of the consumer surplus and the producer surplus of firm d . If firm f has invested in country j , country A 's welfare is given by:

$$SW_j^A = \pi_j + \sigma_j^A, \quad (4)$$

where the first term is the producer surplus of firm d and the second term is consumer surplus in A .²

If the multinational firm f invests in country j , country B 's welfare is only consumer surplus as follows because there is no incumbent firm in country B :

$$SW_j^B = \sigma_j^B. \quad (5)$$

There will be a three-stage game with complete information, characterized by the following sequence of decisions:

- In stage 1, the governments of countries A and B simultaneously decide subsidy policies to induce FDI inflows.
- In stage 2, the foreign firm decides whether to establish its production plant in countries A or in B .
- In stage 3, the foreign firm and the incumbent firm simultaneously choose quantities to serve the regional market.

We solve this three-stage game by backward induction to find the subgame perfect Nash equilibrium. To analyze the effect of policy competition, we first consider the multinational firm's investment decision under no government intervention. We then consider a case where each government makes endogenous policy decision to induce the FDI inflows, and discuss the impact of the policies on the location decision of the multinational firm in sequence.

3. Equilibrium in the policy competition game for FDI inflows

3.1. A benchmarking case: the case of no government intervention

As a benchmarking discussion, we examine the case of no government intervention, which reduces to a two-stage game. The two-stage game formally is stated as follows. At the first stage, the multinational firm f decides on production location, and then both firm f and firm d choose the production quantities at the second stage.

The Cournot competition outcome after entry of the multinational firm f in country A is obtained as follows:

$$X_A^A = x_A^A = \frac{1}{3}, \quad X_A^B = x_A^B = \frac{1-t}{3} \quad (6)$$

where X_j^i is the foreign multinational firm's output, while x_j^i is the output of the incumbent firm located in country A . The subscript j denotes the location of firm f , while the superscript i denotes the consuming country.

The equilibrium outputs when the multinational firm f is located in country B are given as follows:

$$X_B^A = \frac{1-2t-2\alpha}{3}, \quad X_B^B = \frac{1+t-2\alpha}{3} \quad \text{and} \quad x_B^A = \frac{1+t+\alpha}{3}, \quad x_B^B = \frac{1-2t+\alpha}{3}. \quad (7)$$

In addition, the condition for non-negative demand is

$$\bar{t} < \frac{1-2\alpha}{2}. \quad (8)$$

Substituting the above optimal quantities into Eq. (1) yields operating profits as follows. If firm f invests in country A , the operating profits of both firms are:

$$\Pi_A = \pi_A = (2-2t+t^2)/9. \quad (9)$$

When firm f invests in B , its operating profits are given as:

$$\Pi_B = (2+8\alpha^2+4\alpha(-2+t)-2t+5t^2)/9. \quad (10)$$

And those of firm d are:

$$\pi_B = (5t^2-2t-2\alpha t+2\alpha^2+4\alpha+2)/9. \quad (11)$$

In the absence of policy competition between the host countries, firm f compares the operating profits, Π_A and Π_B . Hence, there exists a critical level of the cross-border transaction cost, t^* , where $\Pi_A = \Pi_B$ as follows:

$$t^* = \frac{1}{2}(-\alpha + \sqrt{8\alpha-7\alpha^2}). \quad (12)$$

It is shown straightforwardly in Proposition 1 that the dominant strategy for a foreign multinational firm f is to invest in country A if the cross-border transaction cost is lower than the critical level, and vice versa. The intuition behind this result is that if the cross-border transaction cost is low, it is more efficient to produce in a technologically more efficient country, A , and serve country B . However, if the cross-border transaction cost is significantly high, it is optimal for firm f to locate in country B to take advantage of the semi-monopoly rent in country B due to the high cross-border transaction costs. These findings are summarized in the following proposition.

Proposition 1. In the absence of policy intervention, there exists a critical t^* for which the foreign firm is indifferent between investing in A and B , so that $\Pi_A = \Pi_B$. For $t < t^*$, $\Pi_A > \Pi_B$, and the firm decides to locate in A . For $t > t^*$, $\Pi_A < \Pi_B$, and therefore, it is optimal for firm f to locate in country B .

Proof. At $t = t^*$, $\Pi_A = \Pi_B$. Moreover, $\frac{\partial(\Pi_A - \Pi_B)}{\partial t} = -\frac{4}{9}(\alpha + 2t) < 0$. Therefore, if $t < t^*$, $\Pi_A > \Pi_B$, and for $t > t^*$, $\Pi_A < \Pi_B$. QED.

Fig. 1 shows the equilibrium location strategies of a multinational firm considering the varying cross-border transaction costs and technology difference between two host countries, and the dash line shows

² The profits of the multinational firm are assumed to be transferred to the home country based on the assumption of full cross-border ownership of the invested firm in the host country.

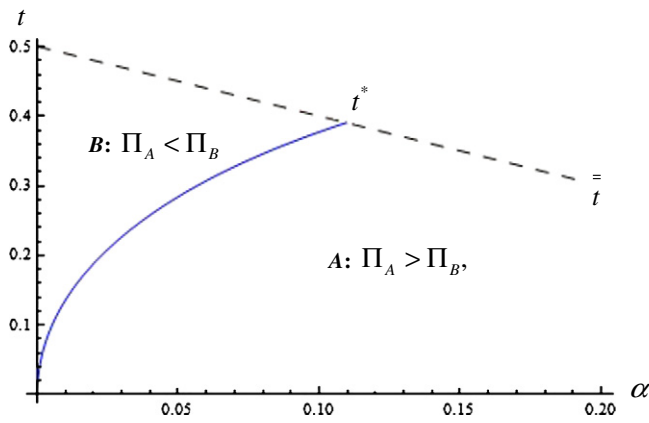


Fig. 1. Multinational firm's location decision under non-intervention policy.

constraints for non-negative demand. The location decision in the absence of government policy intervention is determined by a trade-off between α and t , that is between the difference of the marginal production cost and the intra-regional trade cost. As α increases, the difference of the marginal production costs between the two host countries increases and the foreign investor will prefer countries A to B. As t increases, that is as the intra-regional trade cost increases, the foreign investor will prefer country B rather than country A. In this case, there is no competitor in country B and the firm can take the majority of the market share in country B with a semi-monopoly power in B because the quantity exported by the incumbent firm in A is significantly lowered as the cross-border transaction costs, t , increases.

When host countries can introduce policy intervention to induce FDI inflows, they are willing to participate in policy competition for FDI only when the net benefit from FDI inflows to them is positive.

Country A's net benefit³ from hosting a foreign investor is defined as $w^A \equiv SW_A^A - SW_B^A$. Country B's net benefit from the entrance of the foreign investor is defined as $w^B \equiv SW_B^B - SW_A^B$.

By substituting Eqs. (4) and (6), the net benefits from hosting the multinational firm are given as:

$$w^A = (-9t^2 + 2\alpha t + 4t - 5\alpha^2 - 4\alpha)/18, \quad (13)$$

$$w^B = (-3t^2 + 4t + 2\alpha t + \alpha^2 - 4\alpha)/18. \quad (14)$$

The critical levels of trade costs where the net benefit equals zero are given as follows:

$$\tilde{t}^A = (2 + \alpha \pm 2\sqrt{1 - 8t - 11\alpha^2})/9 \text{ from } w^A = 0 \quad (15)$$

$$\tilde{t}^B = \alpha \text{ from } w^B = 0. \quad (16)$$

Proposition 2. If (t, α) is inside of the \tilde{t}^A curve as in Fig. 2, $w^A > 0$ and country A's net benefit is positive when foreign firm invests in A. Otherwise, $w^A < 0$ and country A loses from hosting FDI. If $t > \tilde{t}^B$, that is if the trade cost between countries A and B is higher than α , $w^B > 0$ and country B benefits from FDI. If $t > \tilde{t}^B$, country B has no incentive to induce FDI inflows since she suffers losses from FDI inflows.

Proof. Let us denote $\tilde{t}^A_+ = \frac{2+\alpha+2\sqrt{1-8t-11\alpha^2}}{9}$ and $\tilde{t}^A_- = \frac{2+\alpha-2\sqrt{1-8t-11\alpha^2}}{9}$.

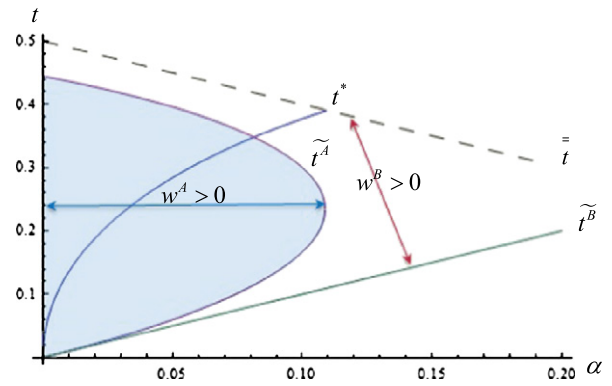


Fig. 2. Equilibrium under non-intervention policy: location and welfare.

At $t = \tilde{t}^A_+$, $w^A = 0$ and $\frac{\partial w^A}{\partial t}|_{t=\tilde{t}^A_+} = (2 + \alpha - 9t)/9 < 0$ for $t > \frac{2+\alpha}{9}$ while $\tilde{t}^A_+ > \frac{2+\alpha}{9}$.

On the other hand, at $t = \tilde{t}^A_-$, $w^A = 0$ and $\frac{\partial w^A}{\partial t}|_{t=\tilde{t}^A_-} = (2 + \alpha - 9t)/9 > 0$ for $t < \frac{2+\alpha}{9}$ while $\tilde{t}^A_- < \frac{2+\alpha}{9}$. Therefore, country A has an incentive to host FDI since her welfare with FDI inflows is dominant to the welfare without FDI inflows inside \tilde{t}^A curve in Fig. 2.

At $t = \tilde{t}^B$, $w^B = 0$ and $\frac{\partial w^B}{\partial t}|_{t=\tilde{t}^B} = (-3t + 2 + 2\alpha)/9 > 0$ for $t < \frac{2+2\alpha}{3}$ while the non-negative demand condition, \hat{t} , always satisfies the inequality: $\hat{t} = \frac{1-\alpha}{2} < \frac{2+2\alpha}{3}$. Therefore, country B has an incentive to host FDI if $t > \tilde{t}^B$. QED.

Fig. 2 extends Fig. 1 by adding \tilde{t}^A and \tilde{t}^B , which are the critical trade costs where the net benefit from the foreign firm's entrance is zero. When $t > \tilde{t}^A$, the foreign firm invests in country B and country B always benefits. For $t < \tilde{t}^A$, the foreign firm invests in country A. However, country A benefits from FDI inflows only inside the curve, \tilde{t}^A . Outside of the curve, \tilde{t}^A , country A's net benefit from hosting FDI is negative.

In case (t, α) is inside of the \tilde{t}^A curve and $t > \tilde{t}^B$, both host countries are willing to participate in policy competition for FDI inflows. Country A does not have incentives to participate in the policy competition if α is high enough, because the multinational foreign firm f will locate in country A even without any incentive policy by country A. Moreover, because Country A has an incumbent domestic firm, it should consider producer surplus while country B only has to consider consumer surplus. Hence, country B has a larger incentive to host FDI with a higher α , i.e., a lower technological level of country B.

3.2. Equilibrium with endogenous policy competition for FDI inflows

We now investigate the case where countries compete for FDI inflows with policy intervention. In the first stage of the policy intervention game, governments offer lump sum subsidies to host FDI when they expect welfare gains from FDI inflows while they impose lump sum taxes if they expect losses from the FDI inflows. In the second stage, the foreign firm makes a location decision between countries A and B. The last stage of the game is Cournot competition between the foreign firm, (firm f), and the incumbent firm, (firm d). The Cournot outcome in the final stage is the same as in the previous model.

To assess how a location decision will be made, the host countries' policies should be considered. The concept of the net benefit that was referred to in the previous section, w^A and w^B , can be expressed as the maximum subsidy when the host country derives benefit from FDI or the minimum tax required to place production facilities in the host country when the net benefit for the host country is negative.

³ The concept of the net benefit is from Bjorvatn and Eckel (2006).

Definition 1. If $w^A > 0$, country A has an incentive to compete for FDI inflows, and w^A is the maximum amount of subsidy that can be offered by country A, $w^A = S^{A,max}$. If $w^A < 0$, country A has an incentive to prevent the FDI inflows, and w^A denotes the minimum amount of tax on the multinational firm f imposed by country A. Similarly, w^B represents country B's maximum subsidy when the w^B is positive, $w^B = S^{B,max}$. If $w^B < 0$, w^B is the amount of tax that can be imposed on the multinational firm by country B.

The foreign firm will compare total profits in countries A and B, $\Pi_A + w^A$ and $\Pi_B + w^B$, which are the sum of the operating profit and the subsidy. The threshold level of the transaction cost that satisfies the condition $\Pi_A + w^A = \Pi_B + w^B$ is given as:

$$t^{**} = \frac{1}{7} \left(-2\alpha + \sqrt{-73\alpha^2 + 56\alpha} \right). \quad (17)$$

When the cross-border transaction cost is higher than the threshold level, the optimal location strategy for the multinational firm is to invest in country B since the multinational firm obtains a higher payoff from investing in country B and vice versa in the opposite case. These results are summarized in Proposition 3.

Proposition 3. When host countries compete for FDI with the policy intervention, if $t > t^{**}$, the multinational firm will locate in country B since $\Pi_A + w^A < \Pi_B + w^B$. If $t < t^{**}$ the multinational firm will locate in country A since $\Pi_A + w^A > \Pi_B + w^B$.

Proof. At $t = t^{**}$, $\Pi_A + w^A = \Pi_B + w^B$ and $\frac{\partial(\Pi_B + w^B - \Pi_A - w^A)}{\partial t} \Big|_{t=t^{**}} = \frac{1}{18} (28t + 8\alpha) > 0$.

Therefore, if $t > t^{**}$, the multinational firm will locate in country B since $\Pi_A + w^A < \Pi_B + w^B$. QED.

Fig. 3 illustrates the optimal location decision of the multinational firm f when host countries compete to host FDI with the government intervention. When governments intervene, if the cross-border cost is higher than the threshold level, t^{**} , the multinational firm will locate in country B while it will locate in country A if $t < t^{**}$. The curve t^{**} , denoting the threshold level of the cross-border transaction cost under the government intervention, is located to the lower right side to the curve t^* which denotes the critical level without government intervention. Therefore, when countries compete to host FDI with the policy intervention, the multinational firm will change its location strategy from countries A to B if the transaction cost and the technology asymmetry, (t, α) , are in the range between curve t^* and curve t^{**} .

As Fig. 2 illustrates, country B has a strong incentive to offer subsidies to attract foreign firms because the net benefit from FDI is positive where $t > t^B$. By contrast, country A's producer surplus is deteriorated by hosting FDI while the consumer surplus might be improved with

the FDI. In short, country B's incentive to attract foreign firms is stronger than that of country A, $w^B > w^A$. This suggests that country B's locational disadvantage relative to A is reduced via policy competition. These results are summarized in Proposition 4.

Proposition 4. Policy competition affects the location decision-making of foreign investors and increases the attractiveness of the initially less desirable country.

Based on the above observation, we examine the optimal policy for each host country with respect to FDI. Country B has an incentive to offer a positive subsidy for FDI inflows if she expects a positive benefit from FDI, $w^B > 0$. Therefore, country B can host FDI when she offers a subsidy that makes the payoffs of the multinational firm locating in country B to be higher than the payoffs from locating in country A marginally.

Definition 2. Country B's winning subsidy that will defeat A in policy competition for FDI is defined as follows:

$$S^{B,win} = \Pi_A + w^A - \Pi_B. \quad (18)$$

$\Pi_A + w^A$ is the total profit in country A when A offers a positive subsidy. Thus, the required amount of subsidy is $S^{B,win}$ which makes the payoffs to the multinational firm from locating in country B to be the same or higher than the payoffs from locating in country A. If the winning subsidy is positive, $\Pi_A + w^A - \Pi_B > 0$, this means that country B has to offer a positive subsidy by the amount of $S^{B,win}$ in order to host foreign investment. If the winning subsidy is negative, $\Pi_A + w^A - \Pi_B < 0$, country B can attract foreign investment without offering a subsidy. That is, foreign firms will invest in country B even if B imposes tax.

Hence, country B will choose a positive subsidy policy at the amount of when $w^B > 0$ and $\Pi_A + w^A - \Pi_B > 0$. If $w^B < 0$ and $\Pi_A + w^A - \Pi_B < 0$, country B will offer a negative subsidy at the amount of $S^{B,win}$, which is equivalent to a positive tax.

We define the critical level of the trade cost which equates the multinational firm's payoffs from locating in country A with country A's subsidy to be equal to the firm's profit from locating in country B without government subsidy as t^B . t^B is derived from $\Pi_A + w^A - \Pi_B = 0$ as follows:

$$\hat{t}^B = \frac{1}{17} \left(2 - 3\alpha + 2\sqrt{1 + 48\alpha - 87\alpha^2} \right). \quad (19)$$

The critical level of transaction cost which makes country B's net benefit from hosting FDI to be zero is defined as t^B , at which $w^B = 0$, is defined in Eq. (16).

Fig. 4 shows country B's equilibrium policy to host FDI. If the trade cost is higher than t^B , $t > t^B$, country B will offer a positive subsidy. However, if trade

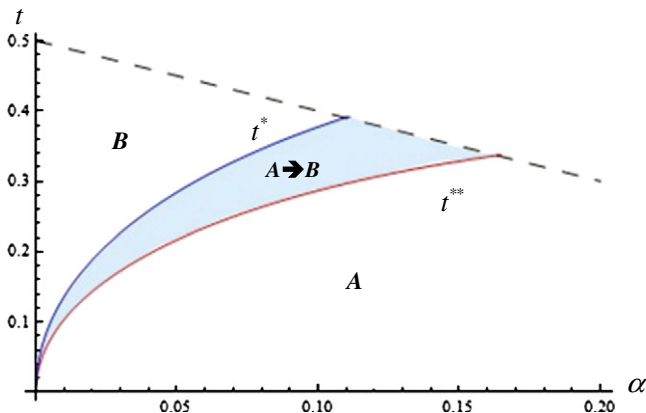


Fig. 3. Multinational firm's location decision after government intervention.

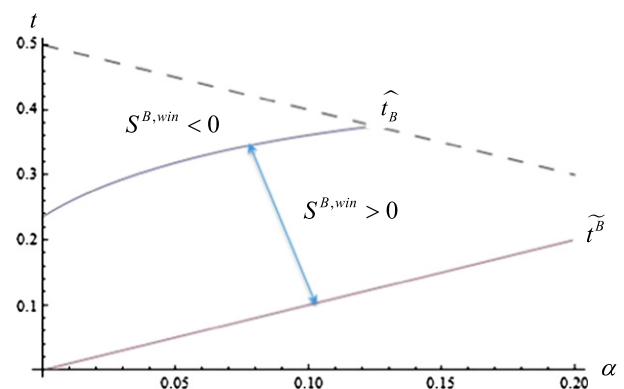


Fig. 4. Country B's equilibrium policy to host FDI.

costs are higher than \hat{t}^B , $t > \hat{t}^B$, the multinational firm will locate in country B without any subsidy. Therefore, country B will offer a positive subsidy to host FDI only when the transaction costs and technology asymmetry are in the intermediate range as $\hat{t}^B < t < \hat{t}^A$. These findings are summarized in Proposition 5.

Proposition 5. If $\hat{t}^B < t < \hat{t}^A$, it is optimal for country B to offer a positive subsidy at the amount of $S^{B,win}$.

Proof. At $t = \hat{t}^B$, $\Pi_A + w^A - \Pi_B = 0$ and $\frac{\partial(\Pi_A + w^A - \Pi_B)}{\partial t} \Big|_{t=\hat{t}^B} = \frac{1}{18}(4 - 6\alpha - 34t) < 0$.

if $t > \frac{1}{17}(2 - 3\alpha)$, while $\hat{t}^B > \frac{2-3\alpha}{17}$. Therefore, country B will offer a positive subsidy only when the transaction cost is in the intermediate range as $\hat{t}^B < t < \hat{t}^A$. QED.

We now consider the equilibrium policy of country A. Whether or not country A will be willing to offer a positive subsidy depends on the level of w^A . If country A's net benefit from FDI is positive, $w^A > 0$, country A will participate in policy competition to host FDI.

Definition 3. To host FDI in the policy competition, country A should offer a subsidy as:

$$S^{A,win} = \Pi_B + w^B - \Pi_A. \quad (20)$$

Country A can host FDI when she offers a subsidy, $S^{A,win}$, which makes the multinational firm's payoffs from locating in country A to be the same or higher than the payoffs from locating in country B.

We define the critical level of the trade cost which equates the multinational firm's payoffs from locating in country B with a subsidy to be equal to the firm's profit from country B without subsidy as \hat{t}^B . \hat{t}^B is derived from $\Pi_B + w^B - \Pi_A = 0$ as follows:

$$\hat{t}^A = \frac{1}{5}(2 - 5\alpha + 2\sqrt{1 + 30\alpha - 15\alpha^2}). \quad (21)$$

The critical level of transaction cost which makes country A's net benefit from hosting FDI to be zero is defined as \hat{t}^A , at which $w^A = 0$, is defined in Eq. (16).

Hence, country A offers a positive subsidy when $w^A > 0$ and $\Pi_B + w^B - \Pi_A > 0$.

If $w^A < 0$ or $\Pi_B + w^B - \Pi_A < 0$, country A will choose a negative subsidy, which is equivalent to a tax imposed on the multinational firm.

If (t, α) is inside of the \hat{t}^A curve, country A obtains a net welfare gains from hosting FDI as $w^A > 0$. Therefore, country A has an incentive to offer a positive subsidy to host FDI. If $t < \hat{t}^A$, the multinational firm has

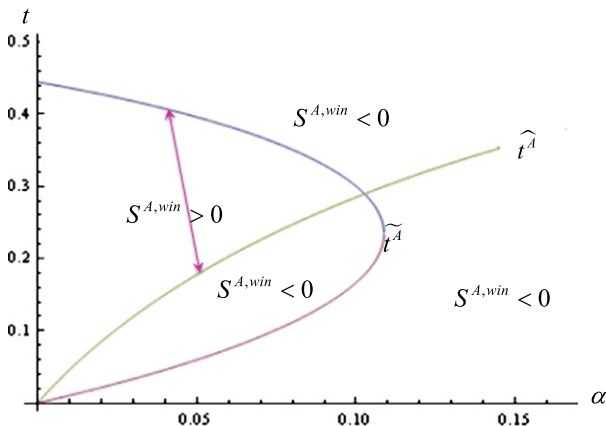


Fig. 5. Country A's equilibrium policy to host FDI.

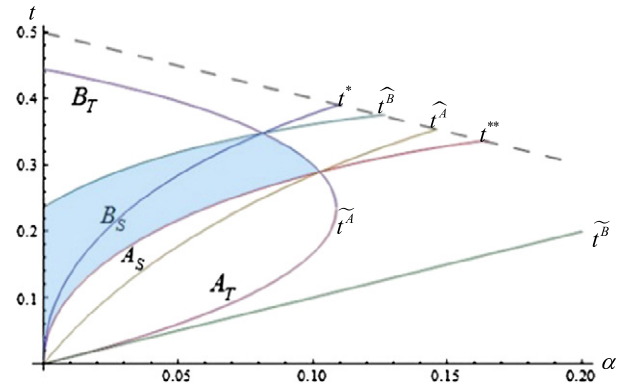


Fig. 6. Equilibria with policy competition for FDI.

an incentive to locate in country A even if country A offers a negative subsidy, i.e., a positive tax since country A is attractive enough as $\Pi_B + w^B - \Pi_A < 0$.

If trade costs are high, $t < \hat{t}^A$, country A has to offer a positive subsidy at the amount of $S^{A,win}$, since the multinational firm will locate in country B without a subsidy offered by country A as $\Pi_B + w^B - \Pi_A > 0$.

Thus, the optimal policy for country A is to offer a positive subsidy at the amount of $S^{A,win}$ to attract the multinational firm when $\hat{t}^A < t < \hat{t}^B$. If (t, α) is outside of the \hat{t}^A curve, $w^A < 0$, and country A's net benefit will be negative when the foreign firm invests in A. Hence, in this case, country A will impose a tax to recover their loss as shown in Fig. 5.

Proposition 6. If $\hat{t}^A < t < \hat{t}^B$, country A will offer a positive subsidy at the amount of $S^{A,win}$.

Proof. At $t = \hat{t}^A$, $\Pi_B + w^B - \Pi_A = 0$ and $\frac{\partial(\Pi_B + w^B - \Pi_A)}{\partial t} \Big|_{t=\hat{t}^A} = \frac{1}{18}(10t + 4 + 10\alpha) > 0$.

Therefore, country A will offer a positive subsidy only when the transaction cost is higher than \hat{t}^A and within the curve \hat{t}^A as in the intermediate range of $\hat{t}^A < t < \hat{t}^B$. QED.

Country B offers a positive subsidy when $\hat{t}^B < t < \hat{t}^A$ and country A offers a positive subsidy when $\hat{t}^A < t < \hat{t}^B$. Consequently, there will exist intense subsidy competition if $\hat{t}^A < t < \hat{t}^B$ and (t, α) are inside of the \hat{t}^A curve. When host countries compete to host FDI with policy intervention, the multinational firm decides to locate in country A if $t < \hat{t}^{**}$ and in country B if $t > \hat{t}^{**}$ as shown in Fig. 3.

The above findings are summarized to 4 equilibria with the optimal location strategy of the multinational firm and the optimal policies of the host countries to compete for FDI inflows depending on different ranges of (t, α) as shown in Fig. 6 and Table 1 below.

In the first equilibrium denoted as B_T , with the highest trade cost area $\hat{t}^B < t < \hat{t}^A$ as shown in Fig. 6, a tax imposition by country B is the equilibrium policy with the multinational firm locating in country B. The intuition is that when the trade cost is very high, the multinational firm's profit from locating in country B is very high due to a monopoly power in country B. Consequently, the multinational firm is ready to locate in country B even if country B imposes a tax because the total payoff after the tax payment in country B is higher than the payoff from country A with the country A's subsidy.⁴

⁴ The policy competition between countries A and B can occur only within the area inside the arc, \hat{t}^A . Each government decides the policy with respect to the multinational firm, and therefore, commands the power for the residual rents. Therefore, when the multinational firm's profit from locating in country B is higher than the payoff from locating in country A with the subsidy offered by country A, the government of country A extracts the extra profits by imposing a tax in equilibrium B_T . The opposite case is observed in equilibrium A_T .

Table 1

Equilibria with policy competition for FDI inflows between host countries.

The range of trade costs and technology asymmetry	Equilibrium policies of host countries	Equilibrium location strategy of the multinational firm
i) $\widehat{t}^B < t < \widehat{t}^A$: (B_T)	Country B imposes a tax: ($S^{B,win} < 0$)	To invest in country B
ii) $t^{**} < t < \widehat{t}^B$: (B_S)	Country B offers a positive subsidy: ($S^{B,win} > 0$)	To invest in country B
iii) $\widehat{t}^A < t < t^{**}$: (A_S)	Country A offers a positive subsidy: ($S^{A,win} > 0$)	To invest in country A
iv) $\widehat{t}^A < t < \widehat{t}^A$: (A_T)	Country A imposes a tax: ($S^{A,win} < 0$)	To invest in country A

In the second equilibrium denoted as B_S , with the trade cost in the upper intermediate range, $t^{**} < t < \widehat{t}^B$, the equilibrium policy is a subsidy by country B with the multinational firm's location in country B.

In the third equilibrium denoted as A_S with the trade cost in the lower intermediate range, $\widehat{t}^A < t < t^{**}$, which is located lower to the second equilibrium, B_S , the equilibrium policy is a subsidy by country A with the multinational firm's location in country A. With a lower trade cost, it is more profitable for the multinational firm to locate in country A with a positive subsidy offered by country A.

In the fourth equilibrium A_T with the lowest trade cost in the range, $\widehat{t}^A < t < \widehat{t}^A$, which is located at the bottom of the 4 equilibria in Fig. 6, a tax is imposed by country A and the multinational firm locates in country A. The intuition behind this equilibrium is that when the trade cost is very low, the multinational firm locates in country A because the firm's profit from locating in more efficient country A even after the tax payment is higher than the profit from locating in country B with the subsidy. In other words, the profit gains from locating in an efficient country A is dominant to the cost of tax payment and the opportunity cost of locating in country B.

4. Welfare implications for policy competition for FDI

This section examines the welfare effects of policy competition for FDI inflows. We analyze first the implications for aggregate world welfare and then investigate whether the introduction of policy competition may enhance regional welfare by influencing a multinational foreign firm's investment decision.

To analyze the impact of policy competition for FDI on the welfare, we focus on two cases, B_S and A_S , where two countries compete intensively for FDI with positive subsidies.

Definition 4. Aggregate world welfare is defined as sum of the two countries' welfare and the multinational firm's profits as follows:

$$AW_i = SW_i^A + SW_i^B + \Pi_i \quad (22)$$

where the subscript indicates the location of the foreign firm and the superscript indicates the host country ($i = A, B$). Note that aggregate world welfare between the endogenous policy case and the no-

intervention case is the same only when subsidy competition did not change the foreign firm's location decision because the subsidy is equivalent to a simple income transfer from governments to the multinational firm.

The cases where two countries compete with positive subsidies can be divided into three parts by t^* and t^{**} , I, II and III as follows in Fig. 7.

We focus on the area II that exists between t^* and t^{**} , that is when subsidy competition has changed the location of foreign investment.⁵ We examine whether or not subsidy competition in this case improves aggregate world welfare.

Proposition 7. A change of FDI location from A to B because of policy competition in area II improves aggregate world welfare, $AW_B - AW_A > 0$.

Proof. From Eq. (23), we obtain $AW_B - AW_A = \frac{1}{9}(11\alpha^2 + 4\alpha(-2 + t) + 7t^2)$. From Eq. (18), it is shown that $AW_B - AW_A|_{t=t^{**}} = \frac{1}{9}(11\alpha^2 + 4\alpha(-2 + t) + 7t^2)|_{t=t^{**}} = 0$.

Because $t > t^{**}$ in area II where the multinational firm changes its location, $AW_B - AW_A > 0$. QED.

The intuition behind the improvement of the global world welfare due to the policy competition for FDI in area II is given as follows: In area II, without policy competition for FDI between two countries, the multinational firm is attracted to invest in country A mainly due to country A's technological efficiency although trade cost is relatively high with an intense competition with the incumbent firm in country A.

However, when both countries compete for FDI, country B's welfare gains from hosting FDI is large enough to offer an outbidding subsidy to the multinational firm since there is no incumbent firm in country B. Moreover, the multinational firm's gains from the increased market power in country B in addition to the subsidy is dominant to the possible disadvantage from country B's less efficient technology. The source of the aggregate world welfare gains is that the relocation of the multinational firm from country A to B enhances the efficiency since the dead-weight loss caused by the relatively high trade cost in area II is removed due to the policy competition for FDI.

In addition, we examine the impact of the policy competition for FDI on regional welfare of host countries without considering the profit of the multinational firm.

Definition 5. Regional welfares are defined as follows both cases of policy intervention and no-intervention.

- i) The case where country B attracts foreign investment with positive subsidies:

$$RW_B^{B,S} = SW_B^B - S^{B,win} + SW_B^A. \quad (23)$$

- ii) The case where country A attracts foreign investment with positive subsidies:

$$RW_A^{A,S} = SW_A^A - S^{A,win} + SW_A^B. \quad (24)$$

⁵ Aggregate welfare in areas I and III does not change compared with aggregate welfare in the case of non-intervention policy.

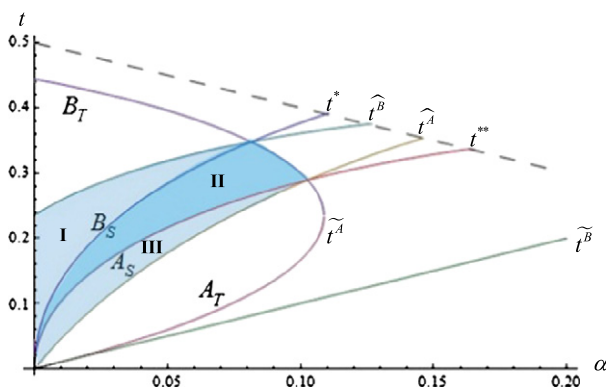


Fig. 7. Equilibria with intense policy competition for FDI.

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