Market Size, Cannibalization and Policy Competition for a Multiproduct Multinational Firm[1]

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Abstract

This paper studies policy competition for a foreign-owned multiproduct monopolist firm producing two products that are horizontally differentiated between two countries of different size. We show that the equilibrium outcome of FDI competition is determined by the interaction between the market size effect and the cannibalization effect, and countries' subsidy policies. Welfare effects of competition for FDI are derived; in particular, we show that the competing countries may Pareto strictly gain from or Pareto strictly lose from FDI competition.

Key Words: Foreign direct investment (FDI); Policy competition; Market size; Cannibalization; Welfare

JEL Classification: F12; F23; H25; H73; L12

1 Introduction

Foreign direct investment (hereafter FDI) has joined international trade as a primary driving force of globalization and it grows much faster than either trade or income in recent decades.[1] As key players in globalized economies, multinational firms typically produce a vast range of consumer goods. For instance, Volkswagen Group, via its Volkswagen Group China division, has 14 subsidiaries in China, with Shanghai Automotive Industry Corporation (SAIC), and First Automobile Works (FAW) being the two major Chinese partner companies. Volkswagen Group China enjoys sales of about 1.9m cars in the Chinese market in 2010 and is the largest foreign carmaker. The products of SAIC include VW brands: Tiguan LWB, Touran, Passat New Lingyu, Lavida, Polo (hatchback and notchback), Cross Polo, Santana B2 and Santana Vista; and Škoda brands: Octavia, Fabia and Superb. The products of FAW consist of VW brands: Jetta A2, New Bora, Golf, Sagitar, Magotan and Volkswagen CC; and Audi brands: A6L, A4L and Q5.[2] On the other hand, policy competition for attracting FDI has become commonplace during the past twenty years.[3] For instance, Changchun and Shanghai fiercely competed for the location of Toyota's ninth joint venture plant in China in 2009. Shanghai won the plant and it will produce economy family cars, possibly Aygo and iQ, for China and Thailand from 2012.

Regions or countries have an economic incentive to attract foreign investors since possible benefits of FDI include job creation, technological spillover and import substitution effects. In addition, when a region or a country succeeds in attracting FDI in one sector, it can help encourage other manufacturing industries to follow and unleash a flow of new investments to that region or that country. Thus, the beneficial effects of FDI will be reinforced. At the same time, there are a number of reasons why multinational firms wish

[1] See Barba Navaretti and Venables *et al.* (2004), Chapter 1.

[2] See http://en.wikipedia.org/wiki/Volkswagen_Group_China. Both SAIC and FAW are stated-owned enterprises. The head office for SAIC is in Shanghai, while that for the FAW is in Changchun, the capital city of Jilin Province, China.

[3] For an overview of policy competition for FDI, see UNCTAD (1996), Oman (2000), Charlton (2003) and Barba Navaretti and Venables *et al.* (2004).

to launch new overseas plants. The investments may be driven by the market seeking motive. The access to cheap inputs and resources, such as labor, both unskilled and skilled, land, raw materials and parts and components for assembling into final goods is also relevant. When evaluating possible investment locations, multinational firms may also have a logistical concern.[4] The outcome of FDI competition is determined by the interaction between these factors.

In this paper, we study policy competition for a multiproduct multinational firm in the following situation. There is a region consisting of two countries. One country, the big country, has a larger economy than the other country, the small country, does. A multinational firm from the rest of the world, which provides two horizontally differentiated products, intends to make investments in the region in order to service the regional demand. It can choose to produce both goods in the big country, or in the small country, or to allocate the production of different goods in different countries. Two markets are segmented and as a result when the multinational firm locating the production of a particular good in one country and selling it in the other country, it needs to pay transportation costs.[5] Two countries and the multinational firm play a two-stage game of complete information. In the first stage, two countries simultaneously announce lump-sum subsidies to the multinational firm conditional on it locating part or all of production in their territories. In the second stage, the multinational firm makes its investment decisions. We address the following questions. On the positive side, (i) under what condition will a country win part or all of production of the multinational firm? (ii) how is the equilibrium subsidy for attracting FDI determined? On the normative side, (i) is allocative efficiency achieved? (ii) what are the distribution effects of competition for FDI? (iii) compared with the case when countries do not provide any financial incentive to attract FDI, whether does FDI competition Pareto improve or Pareto deteriorate national

[4]For instance, see the case of Intel's investment in China, Wall Street Journal Asia, March 23-25, 2007.

[5]Note that we may reinterpret the two horizontally differentiated goods as two product lines, which consist of one good respectively. In addition, "countries" can be easily reinterpreted as "regions" or "jurisdictions" in our paper.

welfare of the competing countries?

We show that whether a country will win part or all of production of the multinational firm is determined by the interaction between the market size effect, the cannibalization effect and the import substitution effects. The market size effect says that other things being equal, the multinational firm prefers producing both goods in the big country to producing them in the small country since shipping goods from one country to the other country incurs transportation costs. However, when both goods are produced in the big country, they cannibalize each other sales both in the big country and in the small country. All else being equal, the multinational firm should allocate the production of different goods in different countries in order to alleviate this cannibalization effect. These two effects determine the multinational firm's investment premium of a particular location of production. On the other hand, when a good is locally produced, its price is lower than when it is imported due to transportation costs; hence, countries enjoy more consumption surplus when they host more product lines. The import substitution effects simply indicate this fact; and they determine two countries willingness to pay to attract part or all of production of the multinational firm. In an equilibrium outcome, either the big country attracts both product lines, or the big country and the small country attracts one product line respectively, depending on these three effects together. We also characterize the condition under which the winning country will subsidize/tax the multinational firm. In particular, the small country is able to tax the multinational firm when the cannibalization effect is sufficient. On the welfare effects of FDI competition, we first show that allocative efficiency is achieved when countries engage in competition to attract the multinational firm. After analyzing its distribution effects, we show that the competing countries may Pareto strictly gain from or Pareto strictly lose from competition for FDI.

Our analysis has important implications for international investment policy. There is a policy debate about the possible effects of "bidding war for firms" on the competing countries. The advocates of FDI competition argue that tax competition is better than

tax harmonization since the latter is a governmental tax and spending cartel, which is as objectionable as a private cartel. On the other hand, the opponents argue that competition for FDI results in a pure waste of resources of the competing countries. In addition, it may weaken public finances and distort the location of investment. Our analysis suggests that the welfare effects of competition for multiproduct multinational firms may go either way. Hence, whether there is a need for calling for tax competition or tax harmonization is dependent on particular economic conditions.

Related Literature

This paper is among the first papers studying policy competition for multiproduct multinational firms and relates to several strands of literature.[6] There have been interesting contributions, which consider two asymmetric countries competing for a profit-maximizing single product multinational firm from the rest of the world, and have trade costs and imperfect competition as the basic building blocks for the partial equilibrium analysis. Haufler and Wooton (1999) consider the case where two countries differ in size. In Barros and Cabral (2000), besides difference in size, a new asymmetry that the small country suffers from problems of unemployment, while the large country does not, is introduced into the analysis. Bjorvatn and Eckel (2006) consider the situation where two countries not only differ in size, but also differ in market structure, i.e., there is a domestic firm located in the large country, which produces the same good as the foreign firm does, while this is not the case in the small country. Fumagalli (2003) examines the case where two countries of different levels of technology compete for the location of a foreign-owned firm.[7] Raff (2004) extends the above two-country framework to consider how free-trade agreements and customs unions affect the location of FDI and social

[6] Based on recent empirical evidence that has highlighted how the export patterns of multiproduct firms dominate world trade flows, and how they respond to different economic conditions across export markets by varying the number of products they export, Mayer *et al.* (2011) study the effects of export market conditions on the relative export sales of products: they refer to this as the firm's product mix choice. Also see references that they cite.

[7] She assumes that the market size is equal in both countries, and hence does not consider the market size effect in the paper.

welfare, taking into account that governments may adjust taxes and external tariffs to compete for FDI. Haufler and Wooton (2006) also extend the two-country framework to analyze the effects of a regionally coordinated profit tax or location subsidy in a model with three active countries, one of which is not part of the union, and a globally mobile firm.

Behrens and Picard (2008), and Bucovetsky and Haufler (2008) study bidding war for firms in the context of the endogenous presence of horizontal multinational firms.[8] Behrens and Picard (2008) develop a two-country model of subsidy competition in which utilitarian governments non-cooperatively bid for firms by taxing/subsidizing setup costs in order to maximize their residents' consumption surplus and profit claims. Firms choose both the number and the location of the plants they operate, and the equilibrium market structure is affected by governments' subsidy policies. Bucovetsky and Haufler (2008) present a model where firms endogenously choose a national or a multinational form, in response to the tax advantage accord to a multinational status. Governments are able to commit to long-term tax discrimination policies before firms' decisions are made and before statutory capital tax rates are chosen non-cooperatively.[9]

Our paper differs from the above contributions mainly in that we consider policy competition for a multiproduct rather than a single product multinational firm; and study FDI location choice, the equilibrium subsidy policy and welfare.[10]

This paper is also related to the literature of tax competition for mobile capital in traditional public finance, such as Bucovetsky (1991), Wilson (1991), Kanbur and Keen

[8] In these papers, national firms refer to the firms producing goods only in the domestic countries, while multinational firms refer to the firms producing goods both in the domestic country and in the foreign country. They are single product firms irrespective of their organizational form.

[9] Amerighi and Peralta (2010) consider the situation where a firm serving two unequally-sized jurisdictions must choose the location of its first production plant, and decide whether to open a second plant to serve the other market through local sales rather than exports. As an exporter, it pays taxes only to the region where it locates its production plant. A double-plant multi-regional firm pays taxes in both regions; however, it may shift taxable profits across two regions at a cost. Note that the firm they consider is a single product firm.

[10] Haaparanta (1996) uses a common agency approach to studying competition for FDI between two countries with unequal wage rate. He treats FDI as being perfectly divisible and considers the impact of policy competition on how the foreign firm allocates its capital between the competing countries. This differentiates his paper from our paper and other previous contributions cited.

(1993) and Trandel (1994).[11] In a perfectly competitive environment, it introduces asymmetries between countries and studies the interaction of different tax instruments. However, since profit-maximizing firm is different from mobile capital, thus, as Fumagalli (2003) notes, this approach is more appropriate when dealing with competition for portfolio investments rather than for FDI.

The structure of the paper is as follows. We set out the model in section 2. Equilibrium analysis and welfare analysis are contained in sections 3 and 4 respectively. In section 5, we compare our results with those established in previous contributions on policy competition for FDI. Section 6 concludes. Some proofs are contained in the Appendix.

2 Model

A region consists of two countries of different size. The number of households in country B is N^B, while that in country S is N^S, with $N^S < N^B$.[12] Representative households of the two countries share the same utility function:

$$u^i\left(q_1^i, q_2^i, z^i\right) = q_1^i + q_2^i - \frac{1}{2}\left[b\left(q_1^i\right)^2 + 2q_1^i q_2^i + b\left(q_2^i\right)^2\right] + z^i, \tag{1}$$

where q_1^i and q_2^i are consumptions of two differentiated products, and z^i is the consumption of a numeraire good, $i \in \{B, S\}$; $b > 1$ measures the degree of product differentiation. In each country, each household provides one unit of labor and receives a wage. Assume that wage rates across two countries are equal and the common wage rate is denoted by w. Household wage income may be subject to a lump-sum tax.[13] Hence, the representative household expenditure cannot exceed its wage income minus/plus taxes/subsidies.

[11] See Wilson (1999) and Wilson and Wildasin (2004) for surveys of tax competition literature.

[12] Note that we may normalize the market size of the small country to 1, and hence interpret the market size of the big country as the relative market size of the two countries. See later discussion.

[13] If it is negative, then it is a lump-sum subsidy.

The inverse demands of country i's representative household are given by:

$$p_1^i = 1 - bq_1^i - q_2^i,\ p_2^i = 1 - bq_2^i - q_1^i;$$

while the direct demands are given by:

$$q_1^i = \frac{b - 1 - bp_1^i + p_2^i}{b^2 - 1},\ q_2^i = \frac{b - 1 - bp_2^i + p_1^i}{b^2 - 1},$$

where p_1^i and p_2^i denote the prices of the two differentiated products in country i. Country i's aggregate demands for products 1 and 2 are:

$$Q_1^i = N^i \left(\frac{b - 1 - bp_1^i + p_2^i}{b^2 - 1} \right),\ Q_2^i = N^i \left(\frac{b - 1 - bp_2^i + p_1^i}{b^2 - 1} \right).$$

A multinational firm from the rest of the world intends to make an investment in the region in order to service the regional demand. This may be due to that transportation costs associated with exporting the differentiated goods to the region are prohibitively high, so that in order to supply the regional market the multinational firm needs to go for FDI.[14] Denote the multinational firm's FDI location choice by a vector, $\omega = (i, j)$, $i, j \in \{B, S\}$, where the first component means that the multinational firm locates the production of q_1 in country i, while the second component means that it locates the production of q_2 in country j.[15] Therefore, the multinational firm has four possible location choices:

$$\omega \in \Omega \equiv \{(B, B), (B, S), (S, B), (S, S)\}.$$

In order to produce any one of the differentiated products, the multinational firm first needs to establish a production line. After paying the fixed set-up cost, it uses one unit

[14] The reason for making this assumption is as follows. The trade versus FDI choice is well understood from the literature on trade costs and FDI. See Neary (2009) for a recent survey. It is not the focus of our paper.

[15] As noted in the Introduction, two differentiated goods can be reinterpreted as two product lines. We use product line and good/product interchangeably in the following analysis.

of labor to produce one unit of the differentiated product. We also assume that the fixed cost of setting up any product line is $F > 0$ irrespective of its location.[16] Two markets are segmented and as a result when the multinational firm locating the production of good k in one country and selling it in the other country, it needs to pay a transportation cost per unit, $\tau > 0$. Hence, the effective marginal cost for the multinational firm to sell good k in country i is given by $c_k^i(\omega)$. In particular,

$$c_1^i(i,j) = w,\ c_1^{-i}(i,j) = w + \tau;\ c_2^j(i,j) = w,\ c_2^{-j}(i,j) = w + \tau,$$

where $-i/-j = S$, if $i/j = B$; $-i/-j = B$, if $i/j = S$. We suppose that: $w + \tau < 1$. This guarantees that the multinational firm is able to service both countries' demands irrespective of its location choice.

Two countries and the multinational firm play a two-stage game of complete information. In the first stage, two countries simultaneously announce lump-sum subsidies $s^i(\omega)$, $\omega \in \Omega$, to the multinational firm (conditional on it locating part or all of production in their territories).[17] Since the budget of a government must be balanced, the subsidy paid to the multinational firm is financed by a poll tax.[18] In the second stage, the multinational firm makes its location choice and then services the regional demand.

The multinational firm receives its profits plus/minus subsidies/taxes. Two countries receive national welfare, $W^i = N^i u^i$.

Before going further, note that both countries may benefit from FDI and have an economic incentive to attract FDI simply because of import substitution effects in our model. This is true when $b \geq 2$. In order to simplify analysis, we consider the case where $b = 2$.[19] In addition, since the two differentiated products enter into the representative

[16] We make this assumption in line with previous contributions. Allowing for differences in fixed investment costs would have obvious effects on the FDI location choice. All else being equal, the low-cost country becomes a relatively more attractive location.

[17] It is a lump-sum tax if $s^i(\omega)$ is strictly negative.

[18] When a country collects taxes from the multinational firm, it redistributes the revenues among its households as a poll subsidy.

[19] We can show that the results obtained in the paper carry over to the case where $b > 2$.

household's utility function in a symmetric way, and the technologies for producing them are the same, FDI location choices $\omega = (B, S)$ and $\omega = (S, B)$ are equivalent. Hence, we consider three possible location choices: $\omega = (S, S)$, $\omega = (B, S)$ and $\omega = (B, B)$ in the following analysis. Next, we solve the model from backward.

3 Equilibrium Analysis

We first consider the benchmark case where two countries do not engage in FDI competition, i.e., $s^i(\omega) = 0$, $\forall i \in \{B, S\}$, $\forall \omega \in \Omega$. We simply determine what the profit-maximizing FDI location choice is. When the multinational firm makes a particular choice and supplies the regional demand, it receives:

$$\pi(\omega) = \sum\nolimits_{i\in\{B,S\},k\in\{1,2\}} \left[p_k^i(\omega) - c_k^i(\omega)\right] Q_k^i(\omega) - 2F, \tag{2}$$

where $p_k^i(\omega)$ and $Q_k^i(\omega)$ denote good k's price and sales in country i. The equilibrium price, price-cost margin, sales and profits would be:

$$p_k^i(\omega) = \frac{1 + c_k^i(\omega)}{2},$$

$$p_k^i(\omega) - c_k^i(\omega) = \frac{1 - c_k^i(\omega)}{2},$$

$$Q_1^i(\omega) = N^i\left[\frac{1 - 2c_1^i(\omega) + c_2^i(\omega)}{6}\right], Q_2^i(\omega) = N^i\left[\frac{1 - 2c_2^i(\omega) + c_1^i(\omega)}{6}\right],$$

$$\pi^*(\omega) =$$
$$\sum_{i\in\{B,S\}} N^i\left[\frac{(1 - c_1^i(\omega))(1 - 2c_1^i(\omega) + c_2^i(\omega))}{12} + \frac{(1 - c_2^i(\omega))(1 - 2c_2^i(\omega) + c_1^i(\omega))}{12}\right] - 2F.$$

In particular,

$$\pi^*(B,S) = \frac{1}{12}\left(N^B + N^S\right)\left[(1-w)^2 + (1-w-\tau)^2 + \tau^2\right] - 2F, \tag{3a}$$

$$\pi^*(B,B) = \frac{1}{6}\left[N^B(1-w)^2 + N^S(1-w-\tau)^2\right] - 2F, \tag{3b}$$

$$\pi^*(S,S) = \frac{1}{6}\left[N^B(1-w-\tau)^2 + N^S(1-w)^2\right] - 2F. \tag{3c}$$

Since it is straightforward to show that: $\pi^*(B,B) > \pi^*(S,S)$, the multinational firm will not locate the production of both goods in the small country. Hence, we need to compare the profits that it receives when choosing $\omega = (B,B)$ with those that it receives when choosing $\omega = (B,S)$. In other words, the multinational firm's decision problem is that given one good, say good 1, is produced in the big country, whether should the other good, say good 2, be produced in the big country or in the small country? Define:

$$\Delta\pi \equiv \pi^*(B,B) - \pi^*(B,S) = \frac{1}{6}\tau\left[N^B(1-w-\tau) - N^S(1-w)\right]. \tag{4}$$

$\Delta\pi$ is the multinational firm's investment premium when it locating the production of both goods in the big country. Obviously, it will choose $\omega = (B,B)$ to service the regional demand if and only if the investment premium is strictly positive.[20]

Proposition 1 $\Delta\pi > 0$ *if and only if*

$$\frac{N^B}{N^S} > \frac{1-w}{1-w-\tau}. \tag{5}$$

Proof. Condition (4) implies the Proposition immediately. ■

The forces that drive the investment premium are the market size effect and the cannibalization effect. On the one hand, other things being equal, the multinational firm prefers producing both goods in the big country to producing them in the small country since shipping goods from one country to the other country incurs transportation costs.

[20] We henceforth omit the knife-edge cases.

Call this the market size effect. On the other hand, when both goods are produced in the big country, they cannibalize each other sales both in the big country and in the small country. All else being equal, the multinational firm should allocate the production of different goods in different countries in order to alleviate the cannibalization effect.[21] The multinational firm's equilibrium location choice is determined by the interaction between these two effects.

Consider the market size effect and the cannibalization effect of the multinational firm shifting the production of good 2 from the small country to the big country. Before doing that, the multinational firm's profits from good 1 are:

$$\pi_1(B,S) = N^B \frac{(1-w)(1-w+\tau)}{12} + N^S \frac{(1-w-\tau)(1-w-2\tau)}{12}.$$

When the production of good 2 has been shifted to the big country, the multinational firm's profits from good 1 are:

$$\pi_1(B,B) = N^B \frac{(1-w)^2}{12} + N^S \frac{(1-w-\tau)^2}{12}.$$

Obviously, the above profit change is only due to the cannibalization effect. Denote it by CE_1,

$$CE_1 = -N^B \frac{(1-w)\tau}{12} + N^S \frac{(1-w-\tau)\tau}{12} < 0.$$

On the other hand, before moving the production of good 2 to the big country, the profits that the multinational firm receives from good 2 are:

$$\pi_2(B,S) = N^B \frac{(1-w-\tau)(1-w-2\tau)}{12} + N^S \frac{(1-w)(1-w+\tau)}{12}.$$

[21] See Baldwin and Ottaviano (2001).

After doing that, its profits from good 2 are:

$$\pi_2(B,B) = N^B \frac{(1-w)^2}{12} + N^S \frac{(1-w-\tau)^2}{12}.$$

The profit change is driven by both the market size effect and the cannibalization effect. In order to get the market size effect, we first control the cannibalization effect. Note that the magnitude of the cannibalization effect is affected by the effective marginal costs of supplying products 1 and 2. Assume that after moving the production of good 2 to the big country, the low-cost good 2 faces a high-cost good 1 in the big country; while the high-cost good 2 faces a low-cost good 1 in the small country.[22] Now, the profits that the multinational firm receives from good 2 are:

$$\widetilde{\pi}_2(B,B) = N^B \frac{(1-w)(1-w+\tau)}{12} + N^S \frac{(1-w-\tau)(1-w-2\tau)}{12}.$$

With the help of this brain experiment, we get the market size effect:[23]

$$ME_2 = \widetilde{\pi}_2(B,B) - \pi_2(B,S) = \left(N^B - N^S\right) \frac{(2-2w-\tau)\tau}{6} > 0;$$

and in turn the cannibalization effect is given by:

$$CE_2 = \pi_2(B,B) - \widetilde{\pi}_2(B,B) = -N^B \frac{(1-w)\tau}{12} + N^S \frac{(1-w-\tau)\tau}{12} < 0.$$

In summary, the market size effect of the multinational firm shifting the production of good 2 from the small country to the big country, denoted by ME, is given by:

$$ME = ME_2 = \left(N^B - N^S\right) \frac{(2-2w-\tau)\tau}{6} > 0;$$

[22] Before shifting the production of good 2 to the big country, the low-cost good 2 faces the high-cost good 1 in the small country, while the high-cost good 2 faces the low-cost good 1 in the big country. What we have done here keeps the effective marginal costs of the two products in each market still different after moving the production of good 2 to the big country; and in this sense, we control the cannibalization effect.

[23] We may also control the market size effect and get the cannibalization effect at the first place.

while the cannibalization effect is given by:

$$CE_1 + CE_2 = -N^B \frac{(1-w)\tau}{6} + N^S \frac{(1-w-\tau)\tau}{6} < 0.$$

For convenience, we use the absolute vale of $CE_1 + CE_2$, called CE, to denote the cannibalization effect. It turns out when Condition (5) holds, the market size effect dominates the cannibalization effect, and the multinational firm locates the production of both goods in the big country. Otherwise, it locates the production of different goods in different countries.

Next, we turn to discuss the welfare implications of the multinational's FDI location choice and want to know whether its choice achieves allocative efficiency. Allocative efficiency requires that the multinational firm's FDI location choice should maximize the sum of its profits and two competing countries' national welfare. From previous discussion, two countries' national welfare corresponding to each of the multinational firm's location choices is easily calculated, and

$$W^B(B,B) = N^B \frac{(1-w)^2}{12} + N^B w, \tag{6a}$$

$$W^B(B,S) = N^B \frac{\left[(1-w)^2 - (1-w-\tau)\tau\right]}{12} + N^B w, \tag{6b}$$

$$W^B(S,S) = N^B \frac{(1-w-\tau)^2}{12} + N^B w; \tag{6c}$$

$$W^S(S,S) = N^S \frac{(1-w)^2}{12} + N^S w, \tag{6d}$$

$$W^S(B,S) = N^S \frac{\left[(1-w)^2 - (1-w-\tau)\tau\right]}{12} + N^S w, \tag{6e}$$

$$W^S(B,B) = N^S \frac{(1-w-\tau)^2}{12} + N^S w. \tag{6f}$$

It is straightforward to show that:

$$W^B(B,B) > W^B(B,S) > W^B(S,S);$$

and

$$W^S(S,S) > W^S(B,S) > W^S(B,B).$$

We define:

$$\Delta^B \equiv W^B(B,B) - W^B(B,S) = N^B \frac{(1-w-\tau)\tau}{12}, \tag{7a}$$

$$\Delta^S \equiv W^S(B,S) - W^S(B,B) = N^S \frac{(1-w)\tau}{12}. \tag{7b}$$

Δ^B measures the net benefits of the big country by hosting the production of both goods rather than hosting the production of one good while importing the other good from the small country; while Δ^S measures the net benefits of the small country by hosting the production of one good rather than importing both goods from the big country. It is easy to see that both Δ^B and Δ^S are strictly positive, and both countries benefit from FDI due to these kinds of import substitution effects.[24]

Proposition 2 *When countries do not engage in competition for FDI, allocative efficiency is achieved.*

Proof. When $\frac{N^B}{N^S} > \frac{1-w}{1-w-\tau}$, the multinational firm chooses to produce both products in the big country. First of all, it is easy to see that: $\left[W^B(B,B) + W^S(B,B) + \pi^*(B,B)\right] - \left[W^B(B,S) + W^S(B,S) + \pi^*(B,S)\right] = \Delta^B - \Delta^S + \Delta\pi > 0$. It is also straightforward to show that: $\left[W^B(B,B) + W^S(B,B) + \pi^*(B,B)\right] - \left[W^B(S,S) + W^S(S,S) + \pi^*(S,S)\right] > 0$. Hence, allocative efficiency is achieved when the multinational firm chooses to locate the production of both goods in the big country. When $\frac{N^B}{N^S} < \frac{1-w}{1-w-\tau}$, the multinational firm chooses to produce different products in different countries. Using similar arguments,

[24] This implies that both countries have an economic incentive to engage in FDI competition.

we can establish that allocative efficiency is achieved. ■

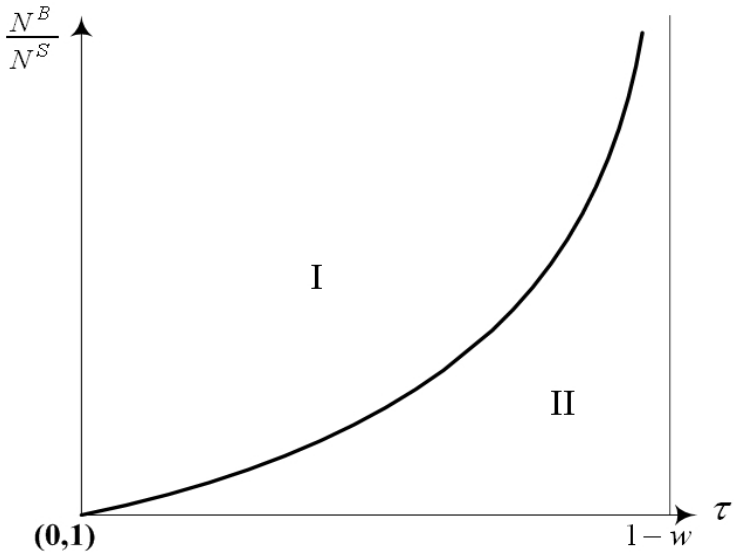

Figure 1: No Competition for FDI

We use Figure 1 to briefly summarize discussion of the above subsection. The horizontal axis measures the unit transportation cost, while the vertical axis measures the relative market size. The upward sloping curve represents the case where $\frac{N^B}{N^S} = \frac{1-w}{1-w-\tau}$, and it divides the plane into two regions. When parameter configurations fall into region I, the multinational firm chooses to produce both products in the big country, while when parameter configurations fall into region II, it locates the production of different goods in different countries. In any case, allocative efficiency is achieved.

Policy competition for FDI

Let us turn to discuss policy competition for FDI. In the last stage of the game, after observing two countries' lump-sum subsidy policies, the multinational firm simply makes its location choice to maximize its profits plus subsidies.[25] In the first stage, two countries play a Nash subsidy game. Instead of deriving two countries' best responses, then characterizing Nash equilibria, we use a simple and intuitive way to approach the game.[26]

[25] Its equilibrium price-quantity decisions are not affected by two countries' lump-sum subsidy policies, and they are the same as those in the benchmark case.

[26] The full characterization of Nash equilibria of the first stage of the game is available upon request.

As the first step, note that the small country is not able to attract the multinational firm to locate the production of both goods in its territory in an equilibrium outcome.

Lemma 3 *When two countries engage in FDI competition, FDI location choice,* $\omega = (S, S)$*, cannot emerge in an equilibrium outcome.*

Proof. See Appendix. ■

The small country's net gains when the multinational firm changing its location choice from $\omega = (B, B)$ to $\omega = (S, S)$ are strictly dominated by those of the big country when the multinational firm changing its location choice from $\omega = (S, S)$ to $\omega = (B, B)$. Compared with the location choice, $\omega = (B, B)$, the multinational firm's investment premium when choosing $\omega = (S, S)$ is strictly negative. Hence, the small country cannot win two product lines in an equilibrium outcome.

According to Lemma 3, the analysis is much simplified. Since the possible FDI location that will emerge in an equilibrium outcome is either $\omega = (B, B)$ or $\omega = (B, S)$, it seems that two countries only compete for one product line. Note that the small country's subsidy payment conditional on the multinational firm choosing $\omega = (B, S)$ should not exceed its net gains,

$$s^S(B, S) \leq \Delta^S.$$

The similar argument applies to the big country and we have:

$$s^B(B, B) - s^B(B, S) \leq \Delta^B.$$

The RHS of the above expression represents the big country's valuation of the additional product line, while the LHS of it represents the extra payment that it should make in order to attract the product line. Based on the above arguments, we have the following result on the equilibrium location of FDI.

Proposition 4 *The big country will attract both product lines if and only if*

$$(ME - CE) + \left(\Delta^B - \Delta^S\right) > 0. \tag{8}$$

Otherwise, two countries attract one product line respectively.

Condition (8) says that the equilibrium location of FDI is determined by the interaction between the market size effect, the cannibalization effect and the import substitution effects. Moreover, it is straightforward to show $(ME - CE) + \left(\Delta^B - \Delta^S\right) > 0$ if and only if Condition (5) holds.[27]

Next, we turn to discuss two countries' equilibrium payments to the multinational firm.

Proposition 5 *(1) In the case where the big country attracts both product lines, its equilibrium payment to the multinational firm is:*

$$s^{B*}(B,B) = \left(3N^S - 2N^B\right)\frac{(2 - 2w - \tau)\,\tau}{12}. \tag{9}$$

(2) In the case where two countries attract one product line respectively, the big country's equilibrium payment is:

$$s^{B*}(B,S) = \frac{1}{4}\left[N^S(1 - w - \tau) - \frac{2}{3}N^B(1 - w)\right]\tau; \tag{10}$$

while that of the small country is:

$$s^{S*}(B,S) = \frac{1}{4}\left[N^B(1 - w - \tau) - \frac{2}{3}N^S(1 - w)\right]\tau. \tag{11}$$

Proof. See Appendix. ■

[27] We consider a monopoly model with linear demand functions and the monopolist firm's effective marginal production costs are constants, so that the monopolist firm's profits from the sales of one product in one country and the country's consumption surplus are proportionate. Considering other forms of demand may make us have more cases to analyze; however, the basic driving forces that we address are still there and our results cannot be changed qualitatively.

Consider the case when the big country attracts both product lines. The big country will choose a payment as low as possible such that the small country is not able to attract one product line or two product lines to its territory. It turns out that the minimal subsidy payment that prevents the small country from attracting both product lines is sufficient for doing this. Note that compared with locating the production of both goods in the small country, the investment premium under producing both goods in the big country is strictly positive. If this premium dominates the small country's valuation of the two product lines, i.e., $\frac{N^B}{N^S} > \frac{3}{2}$, then the big country can collect a lump-sum tax from the multinational firm in an equilibrium outcome; otherwise, it pays a lump-sum subsidy to the multinational firm.

Consider the case when two countries attract one product line respectively. Since the market size effect is dominated by the cannibalization effect, the multinational firm wants to allocate the production of different goods in different countries. However, the small country's valuation of an additional product line is strictly positive. As a result, the big country chooses a payment as low as possible preventing the small country from attracting both product lines. Note that compared with locating the production of both goods in the small country, the investment premium under producing different goods in different countries is strictly positive. If this premium dominates the small country's valuation of an additional product line, i.e., $\frac{N^B}{N^S} > \frac{3}{2}\left(\frac{1-w-\tau}{1-w}\right)$, then the big country can tax the multinational firm in an equilibrium outcome; otherwise, it subsidizes the multinational firm.

We turn to discuss the equilibrium payment of the small country. Again, the multinational firm wants to allocate the production of different goods in different countries. However, the big country's valuation of an additional product line is strictly positive. As a result, the small country chooses a payment as low as possible preventing the big country from attracting both product lines. When $\frac{N^B}{N^S} < \frac{2}{3}\left(\frac{1-w}{1-w-\tau}\right)$, the cannibalization effect is sufficiently great so that dominates the big country's valuation of the additional product line, the small country is able to tax the multinational firm. Otherwise, it needs

to pay a subsidy to the multinational firm.[28]

4 Welfare Analysis

In this section, we consider the welfare implications of FDI competition and want to address the following questions. First, is allocative efficiency achieved? Second, what are the distribution effects of FDI competition? Third, compared with the benchmark case, whether does FDI competition Pareto improve or Pareto deteriorate national welfare of the competing countries? The first question is answered in Proposition 6.

Proposition 6 *When countries engage in FDI competition, allocative efficiency is achieved.*

Proof. Note that the equilibrium subsidy payments made by countries to the multinational firm are lump-sum transfer payments. Hence, similar arguments to those used in the proof of Proposition 2 establish the result stated in the proposition. ■

That FDI competition will achieve allocative efficiency is a well known result obtained in the contributions considering policy competition for a single product firm.[29] We show that this result carries over to the case when countries compete for multiproduct multinational firms. Next, we turn to the distribution effects of FDI competition.

Proposition 7 *Consider the case where* $\frac{N^B}{N^S} > \frac{1-w}{1-w-\tau}$*, i.e., the multinational firm produces both products in the big country. Compared with the benchmark case, (1) the small country's national welfare is unchanged; (2) while the big country benefits from FDI competition if and only if* $\frac{N^B}{N^S} > \frac{3}{2}$*; otherwise, it loses from it.*

Proof. Part (1) is established by the fact that regardless of whether countries engage in FDI competition, the multinational firm chooses to produce both goods in the big country when $\frac{N^B}{N^S} > \frac{1-w}{1-w-\tau}$. Turn to Part (2). In the case considered, the big country wins two

[28] Note that the equilibrium subsidy payments are affected by the absolute measure rather than the relative measure of country size. Also see Footnote 12.

[29] For instance, see Bjorvatn and Eckel (2006).

product lines and when $\frac{N^B}{N^S} > \frac{3}{2}$, it collects a lump-sum tax from the multinational firm, hence, its national welfare is strictly higher than that in the benchmark case. Otherwise, it pays a lump-sum subsidy to the multinational firm, hence, its national welfare is strictly lower than that in the benchmark case. ■

Proposition 8 *Consider the case where $\frac{N^B}{N^S} < \frac{1-w}{1-w-\tau}$, i.e., the multinational firm chooses to produce different goods in different countries. Compared with the benchmark case, (1) national welfare of the small country will be improved by FDI competition if and only if $\frac{N^B}{N^S} < \frac{2}{3}\left(\frac{1-w}{1-w-\tau}\right)$; otherwise, the small country loses from it; (2) while national welfare of the big country will be improved by FDI competition if and only if $\frac{N^B}{N^S} > \frac{3}{2}\left(\frac{1-w-\tau}{1-w}\right)$; otherwise, the big country loses from it.*

Proof. First of all note that regardless of whether countries engage in FDI competition, the multinational firm chooses to produce different goods in different countries. Hence, compared with the benchmark case, a country's national welfare is improved when it collects a lump-sum tax from the multinational firm; while its national welfare is deteriorated when it pays a lump-sum subsidy to the multinational firm. For the small country, its equilibrium payment is strictly negative/strictly positive when $\frac{N^B}{N^S} < / > \frac{2}{3}\left(\frac{1-w}{1-w-\tau}\right)$; while that of the big country is strictly negative/strictly positive when $\frac{N^B}{N^S} > / < \frac{3}{2}\left(\frac{1-w-\tau}{1-w}\right)$. ■

An interesting result implied by Proposition 7 and Proposition 8 is regarding when the two competing countries Pareto strictly gain or lose from FDI competition.

Corollary 9 *When $\frac{N^B}{N^S} < \frac{1-w}{1-w-\tau}$, i.e., the multinational firm chooses to produce different goods in different countries, FDI competition Pareto strictly improves national welfare of the two competing countries, if and only if $\frac{3}{2}\left(\frac{1-w-\tau}{1-w}\right) < \frac{N^B}{N^S} < \frac{2}{3}\left(\frac{1-w}{1-w-\tau}\right)$; it Pareto strictly deteriorates their national welfare if and only if $\frac{2}{3}\left(\frac{1-w}{1-w-\tau}\right) < \frac{N^B}{N^S} < \frac{3}{2}\left(\frac{1-w-\tau}{1-w}\right)$.*

We briefly summarize our discussion on policy competition for FDI with the help of Figure 2. The horizontal axis measures the unit transportation cost, while the vertical

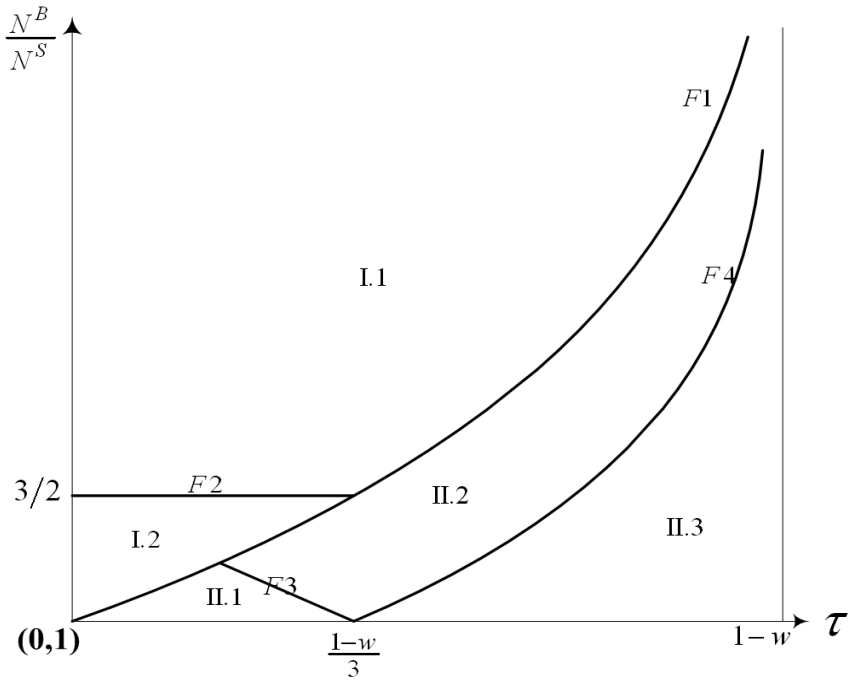

Figure 2: Competition for FDI

axis measures the relative market size. Curve F1 represents the case where $\frac{N^B}{N^S} = \frac{1-w}{1-w-\tau}$. When parameter configurations are on the left side of it, falling into region I, the big country wins both product lines. The horizontal line segment F2 represents the case where $\frac{N^B}{N^S} = \frac{3}{2}$ and it splits region I into two parts. Region I.1 represents the case where the big country taxes the multinational firm, hence FDI competition weakly Pareto improves national welfare of the competing countries. When parameter configurations fall into region I.2, the big country pays a subsidy to the multinational firm and competition for FDI weakly Pareto deteriorates national welfare of the competing countries. Region II represents the case where two countries attract one product line respectively. Here, the downward sloping line segment F3 represents the case when $\frac{N^B}{N^S} = \frac{3}{2}\left(\frac{1-w-\tau}{1-w}\right)$; while curve F4 represents the case where $\frac{N^B}{N^S} = \frac{2}{3}\left(\frac{1-w}{1-w-\tau}\right)$. They together split Region II into three parts. When parameter configurations fall into region II.1, since two countries pay a subsidy to the multinational firm respectively, FDI competition strictly Pareto deteriorates national welfare of the competing countries. In region II.2, the big country taxes while the small country subsidizes the multinational firm. Hence, compared with

the benchmark case, the big country's national welfare is improved; while that of the small country is deteriorated. Region II.3 represents the case where both the small country and the big country are able to tax FDI, hence competition for FDI strictly Pareto improves national welfare of the competing countries.

5 Discussion

As we have seen in the previous analysis, introducing multiproduct multinational firms into the analysis of FDI competition affects the FDI location choice, investment policy and welfare in interesting ways. Our paper both contributes and complements the literature of policy competition for FDI in a number of respects.

When countries do not provide any financial inventive to attract FDI, which country is the attractive location for FDI? Our paper shows that when allocating its production between the competing countries, the multiproduct multinational firm faces a trade-off between the market size effect and the cannibalization effect. If the former dominates the latter, then it chooses to produce both goods in the relatively large country; otherwise, it allocates the production of different goods in different countries. Consider papers studying policy competition for single product multinational firms. In Bjorvatn and Eckel (2006), the attractive location for FDI is determined by the interaction between the market size effect and the competition effect. When the former dominates the latter, the foreign firm will invest in the relatively large country, and *vice versa*. While absent policy competition for FDI, both Haufler and Wooton (1999) and Barros and Cabral (2000) show that the foreign firm will establish a production plant in the relatively large country due to the market size effect. In Fumagalli (2003), the foreign firm will definitely invest in the technically advanced country.

In case when countries engage in FDI competition, we show that the relatively large country has a chance to attract at least one product line, while the relatively small country may attract at most one product line. When considering tax competition for a

single product firm, Barros and Cabral (2000), Bjorvatn and Eckel (2006) and Fumagalli (2003) show that both countries has a chance to win the firm; while in Haufler and Wooton (1999), the relatively small country will never win FDI competition since the two competing countries only differ in market size.[30]

Let us turn to discuss welfare issues. Barros and Cabral (2000), Fumagalli (2003) and Bjorvatn and Eckel (2006) show that allocative efficiency is achieved when countries compete for FDI, i.e., from an aggregate perspective, policy competition leads to an efficient outcome. Though Haufler and Wooton (1999) do not explore the welfare implications of FDI competition, their analysis imply this result as well. We show that this result carries over to the case where countries compete for a multiproduct multinational firm.

Moreover, an interesting result that we obtain is that policy competition for FDI may Pareto strictly improve or Pareto strictly deteriorate national welfare of the competing countries. When considering policy competition for a single product firm, Bjorvatn and Eckel (2006) obtain the result that tax competition for FDI may Pareto weakly improve national welfare of the competing countries.[31] That happens in the case where one of the competing countries does not benefit from the entry of the multinational firm; hence, its valuation of FDI is strictly negative. This increases the bargaining power of the other country and may lead to taxation of FDI rather than subsidies. Our result is derived in the situation where both countries have an economic incentive to attract FDI. Behrens and Picard (2008) show that compared with a world in which multinational firms are disregarded, the presence of multinational firms relaxes the problem of tax competition, hence alleviating the race to the bottom. However, similar results cannot be obtained when countries compete for multiproduct multinational firms since compared with the case where countries compete for a single product firm, the competing countries may

[30] Some papers show that FDI competition increases the attractiveness of the small country (Barros and Cabral (2000) and Bjorvatn and Eckel (2006)), or the less technologically advanced country (Fumagalli (2003)) as the location for the investment since its valuation of FDI is higher than that of the other country. As a result, policy competition may change the FDI location choice in these papers.

[31] Though Haufler and Wooton (1999) do not consider the welfare implications of FDI competition, their analysis implies a similar result to that of Bjorvatn and Eckel (2006), while the driving force is different.

strictly lose from FDI competition.[32]

6 Concluding Remarks

We have studied policy competition for a foreign-owned multiproduct monopolist firm between two countries of different size. We show that the equilibrium outcome of FDI competition is determined by the interaction between the market size effect and the cannibalization effect, and countries' subsidy policies. Welfare effects of competition for FDI are derived; in particular, we show that the competing countries may Pareto strictly gain from or Pareto strictly lose from competition for FDI.

Our model naturally has some limitations. We capture the idea that countries benefit from FDI due to import substitution effects. In addition, the situation that we focus on is relevant for market seeking FDI. We do not consider other possible beneficial effects of FDI, such as job creation and technological spillovers; and do not take inputs or resources seeking FDI into account. However, to the best of our knowledge, our paper is among the first contributions introducing multiproduct multinational firms into policy competition for FDI models. We want to further explore other implications of this interesting idea in our future research.

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[32] Note that Behrens and Picard (2008) do not consider the case where two countries differ in size. Bucovetsky and Haufler (2008) use a traditional public finance model to study capital tax competition when firms can endogenously choose their organizational form, which is different from our approach.

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Appendix

Proof of Lemma 3

We prove Lemma 3 by contradiction. Suppose that the multinational firm chooses to produce both goods in the small country in an equilibrium outcome, and the small country's subsidy payment to the multinational is $s^{S*}(S,S)$. According to Expressions (6c) and (6d), the big country's gross national welfare is:

$$W^B(S,S) = N^B \frac{(1-w-\tau)^2}{12} + N^B w;$$

while the small country's gross national welfare is:

$$W^S(S,S) = N^S \frac{(1-w)^2}{12} + N^S w.$$

According to Expression (3c), the multinational firm's profits are:

$$\pi^*(S,S) = \frac{1}{6}\left[N^B(1-w-\tau)^2 + N^S(1-w)^2\right] - 2F.$$

If the multinational firm produces both goods in the big country, then according to Expressions (6a) and (6f), the big country achieves gross national welfare:

$$W^B(B,B) = N^B \frac{(1-w)^2}{12} + N^B w;$$

while the small country achieves gross national welfare:

$$W^S(B,B) = N^S \frac{(1-w-\tau)^2}{12} + N^S w.$$

According to Expression (3b), the multinational firm's profits are:

$$\pi^{*}(B,B)=\frac{1}{6}\left[N^{B}(1-w)^{2}+N^{S}(1-w-\tau)^{2}\right]-2F.$$

Hence, the subsidy offered by the small country to the multinational firm conditional on it producing both goods in its territory will not be bigger than its net gains from the change of FDI location, i.e., from $\omega=(B,B)$ to $\omega=(S,S)$,

$$s^{S*}(S,S)\leq W^{S}(S,S)-W^{B}(B,B)=N^{S}\frac{(2-2w-\tau)\tau}{12}.$$

However, note that the big country is able to choose a subsidy payment, which satisfies

$$s^{B*}(B,B)\leq W^{B}(B,B)-W^{B}(S,S)=N^{B}\frac{(2-2w-\tau)\tau}{12},$$

such that

$$\pi^{*}(B,B)+s^{B*}(B,B)\geq\pi^{*}(S,S)+s^{S*}(S,S),\tag{A1}$$

and attracts both product lines. In an equilibrium outcome, the equality holds in the above inequality, and the big country's minimal payment can be solved:

$$s^{B*}(B,B)=\left(3N^{S}-2N^{B}\right)\frac{(2-2w-\tau)\tau}{12}.$$

Hence, that the small country attracts both product lines cannot emerge in an equilibrium outcome. ■

Proof of Proposition 5

Part (1). From the proof of Lemma 3, we know that:

$$s^{B*}(B,B)=\left(3N^{S}-2N^{B}\right)\frac{(2-2w-\tau)\tau}{12},$$

is the minimal subsidy offered by the big country, which can successfully prevent the small country from attracting both product lines to its territory. Here, we also need to check whether the small country is able to increase $s^S(B,S)$, with $s^S(B,S) \leq \Delta^S$, such that to attract one product line. The big country may choose a $s^{B*}(B,S)$ to prevent the small country from doing this, which satisfies

$$(ME - CE) + \left(s^{B*}(B,B) - s^{B*}(B,S)\right) \geq \Delta^S,$$

with $s^{B*}(B,B) - s^{B*}(B,S) \leq \Delta^B$. This $s^{B*}(B,S)$ exists since in the case that we consider, the following inequality

$$(ME - CE) + \Delta^B > \Delta^S,$$

always holds.

Part (2). First of all, two countries' subsidy polices must satisfy

$$\pi^*(S,S) + s^{S*}(S,S) \leq \pi^*(B,S) + s^{S*}(B,S) + s^{B*}(B,S),$$

i.e.,

$$\begin{aligned} &s^{S*}(S,S) - s^{S*}(B,S) - s^{B*}(B,S) \\ &\qquad \leq \pi^*(B,S) - \pi^*(S,S) = \frac{1}{6}\left[N^B(1-w) - N^S(1-w-\tau)\right]\tau, \quad \text{(A2)} \end{aligned}$$

in order to prevent the small country from attracting both product lines. Here, the big country's subsidy payment should not exceed its net gains from the change of FDI location, i.e., from $\omega = (B,S)$ to $\omega = (S,S)$,

$$s^{B*}(B,S) \leq W^B(B,S) - W^B(S,S) = N^B\frac{(1-w)\tau}{12}.$$

Similarly, the small country's subsidy payments must satisfy

$$s^{S*}(S,S) - s^{S*}(B,S) \leq W^S(S,S) - W^S(B,S) = N^S \frac{(1-w-\tau)\tau}{12}, \tag{A3}$$

i.e., its net subsidy payment should not exceed its net gains. Conditions (A2) and (A3) together imply that:

$$s^{B*}(B,S) \geq \frac{1}{4}\left[N^S(1-w-\tau) - \frac{2}{3}N^B(1-w)\right]\tau.$$

In an equilibrium outcome, the equality holds in the above inequality, giving the minimal $s^{B*}(B,S)$ preventing the small country from attracting both product lines. This $s^{B*}(B,S)$ exists since it is easy to show that: $\frac{1}{4}\left[N^S(1-w-\tau) - \frac{2}{3}N^B(1-w)\right]\tau < N^B\frac{(1-w)\tau}{12}$.

Next, two countries' subsidy polices must satisfy

$$(ME - CE) + s^{B*}(B,B) \leq s^{B*}(B,S) + s^{S*}(B,S), \tag{A4}$$

in order to prevent the big country from attracting both product lines. Similar to the above arguments, we have:

$$s^{S*}(B,S) \leq \Delta^S,$$

and

$$s^{B*}(B,B) - s^{B*}(B,S) \leq \Delta^B. \tag{A5}$$

Conditions (A4) and (A5) together imply that:

$$s^{S*}(B,S) \geq \frac{1}{4}\left[N^B(1-w-\tau) - \frac{2}{3}N^S(1-w)\right]\tau.$$

In an equilibrium outcome, the equality holds in the above inequality, giving the minimal $s^{S*}(B,S)$ preventing the big country from attracting both product lines. This $s^{S*}(B,S)$

exists since in the case we consider, the following inequality

$$(ME - CE) + \Delta^B < \Delta^S,$$

always holds. ■