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Transport Infrastructure Investments and Competition for FDI*

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Abstract

This paper studies how transport infrastructure investments affect a bidding war for a firm between two asymmetric countries within a region in a context of imperfect competition, where transport infrastructure investments play the role of a global public good, leading to a reduction in the unit trade cost between the two countries. A number of interesting results are derived from the model. In particular, transport infrastructure investments can intensify fiscal competition between the two countries. Surprisingly, this conventional wisdom seems to be confirmed by this paper for the first time. Welfare implications of the model are also examined.

Key Words: transport infrastructure investments, fiscal competition, FDI, imperfectly competitive market

JEL Classifications: F21, F23, H40

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1 Introduction

Competition for attracting foreign direct investment (hereafter FDI) has become commonplace in the past thirty years and is on the rise. On the one hand, there are a number of reasons why a multinational enterprise (hereafter MNE) wishes 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. On the other hand, national or regional governments prefer local manufacturing to imports, as this provides cheaper consumer products; creates new jobs and new demands for local services; generates positive production externalities for local industries; and so on. As a result, governments compete fiercely to persuade foreign investors to locate new investments within their territories.[1] Familiar fiscal policy instruments, notably the corporate tax rate, and the location specific subsidy, are at governments' hands in FDI competition. They may also use non-fiscal policy instruments to attract FDI, notably making investments in transport infrastructure.

Transport infrastructure investments play a crucial role in promoting competitiveness, enhancing connectivity both within and between countries. National governments invest heavily in transport infrastructure to avail of these advantages, that is, infrastructure investments in ports, roads, railways and airports.[2] Moreover, transport infrastructure investments are often viewed as a longer-term policy than fiscal policy tools.[3] With such investments increasing mobility between countries, the corporate tax rate can be affected. Many countries, especially within the European Union, are concerned about tax competition and the potential "race to the bottom in taxes".

[1] Overviews of competition for FDI can be found in, for example, UNCTAD (1996), Oman (2000), Charlton (2003), and Barba Navaretti and Venables (2004).

[2] PWC, Assessing the global transport infrastructure market: Outlook to 2025, https://www.pwc.com/gx/en/transportation-logistics/pdf/assessing-global-transport-infrastructure-market.pdf.

[3] Transport infrastructure investment decisions are likely to be irreversible, while fiscal policy tools are more flexible and can be viewed as a policy with less commitment value.

In this paper, we study how transport infrastructure investments affect a bidding war for a firm between two asymmetric countries in a context of imperfect competition. The situation that we consider is as follows. An MNE from the rest of the world wants to establish a production plant, producing and selling a homogeneous good in a region with two countries of different market size. By locating its production activities in one country the MNE needs to export its goods to the other country incurring international trade costs. Both countries have an economic incentive to compete for the location of the MNE's investment due to the import substitution effects, that is, each country prefers locally produced goods to imported goods since the price of the former is cheaper than the latter. The MNE and the two countries play a sequential game of complete information. In the first stage, the larger and the smaller countries simultaneously and non-cooperatively make transport infrastructure investments, which play the role of a global public good, leading to a reduction in the unit trade cost between the two countries.[4] In the second stage, they simultaneously and non-cooperatively announce their lump-sum subsidy/tax to the MNE conditional on it locating within their territories. Then in the last stage, the MNE makes its location choice and serves regional demands.

We derive a number of interesting results from our model. In particular, though transport infrastructure investments do not affect the equilibrium outcome of fiscal competition, that is, the larger country always wins FDI, they do affect the larger country's subsidy/tax offered to the MNE. When the difference between the two countries' market size is relatively small, transport infrastructure investments lower the larger country's subsidy paid to the MNE. In this sense, such investments mitigate fiscal competition between the two countries. When the difference between the two countries' market size is sufficiently large, transport infrastructure investments reduce the larger country's tax collected from the MNE. In this sense, such investments intensify fiscal competition be-

[4]Obviously, trade costs are different from tariffs and quotas which have been substantially lowered by successive rounds of multilateral trade negotiations, that is, GATT and WTO; and various regional trade agreements. As a result, infrastructure related trade cost reductions have become relatively more significant as a way of further reducing the exporting costs of transporting products across international borders.

tween the two countries. Surprisingly, this conventional wisdom seems to be confirmed by this paper for the first time.[5]

There is just one asymmetry in our model, the larger country enjoys a market size advantage over the smaller country, that is, all else equal, given the existence of trade costs between the two countries, the MNE will earn more profits by locating in the larger country than in the smaller country.[6] However, since transport infrastructure investments lower such trade costs, they reduce the market size advantage the larger country has. Moreover, each country wants to be the host to the MNE's investment simply because the price of locally produced goods is cheaper than that of the imported goods, as a result, a country's consumption surplus is higher when being the host to the investment than not. It is natural that the larger country gains more than the smaller country under FDI. However, each country's net benefit under FDI, that is, its valuation of FDI decreases with transport infrastructure investments. The lower the trade costs are, the smaller the price difference between the locally produced and the imported goods is, and hence, the smaller the net benefit under FDI is. Now, since the larger country has its market size advantage, and the larger country's valuation of FDI is higher than that of the smaller country, the larger country wins FDI for sure irrespective of the two countries' transport infrastructure investments; and it offers a payment to the MNE being equal to the smaller country's valuation of FDI net of the MNE's profit premium by locating in the larger country.

Note that transport infrastructure investments do affect these two terms. When the difference between the two countries' market size is relatively small, their fiscal competition is fierce and consequently, the larger country pays a subsidy to the MNE. However, the larger country would take the opportunity of making transport infrastructure investments to lower the smaller country's valuation of FDI; at the same time, the smaller country itself also makes such investments in order to reduce the price of imported goods

[5]Note that empirical studies on international taxation presuppose the idea that decreasing mobility costs would intensify tax competition. See, for example, Hines (1999) and Devereux (2007).

[6]See Haufler and Wooton (1999).

achieving higher consumption surplus. As a result, the larger country pays less to the MNE than in the case without transport infrastructure investments. Hence, such investments mitigate fiscal competition between the two countries. When the difference between the two countries' market size is sufficiently big, the larger country faces less competition from the smaller country, and it is able to tax the MNE. Since the larger country's transport infrastructure investments make the MNE's profit premium by locating in the larger country shrink and hence reduce its tax revenue, it will not make such investments. However, the smaller country will again invest in transport infrastructure in order to increase its consumption surplus, making the MNE's profit premium by locating in the larger country become smaller. As a result, the MNE pays less tax to the larger country than in the case without transport infrastructure investments. In this sense, such investments intensify fiscal competition between the two countries.

Based on the above discussions, the welfare implications of our model are straightforward. The smaller country always benefits from the opportunity of making transport infrastructure investments. The larger country benefits from making such investments when its market size is slightly bigger than that of the smaller country. When the larger country's market size is sufficiently greater than that of the smaller country, the larger country loses from the opportunity of making transport infrastructure investments.

Our analysis has interesting and important policy implications. Recently, the EU has claimed that transport infrastructure policies are beneficial, but may intensify tax competition. Our results suggest that countries would benefit from their own transport infrastructure investments when they have similar market sizes. Moreover, in this case, there is no need to worry about fiercer tax competition. However, when countries differ significantly in their market size, transport infrastructure investments would have the potential to intensify tax competition, with the larger country losing from the opportunity of making such investments. This case may lead to a call for cooperation in infrastructure policy to help ease tax competition.

Literature

To the best of our knowledge, our paper is among the first papers to introduce (transport) infrastructure investments into fiscal competition models in the context of imperfect competition, and is related to several strands of literature. Studies of fiscal competition under an imperfectly competitive environment are pioneered by Haufler and Wooton (1999). In particular, as an extension of their basic model, in a two-country regional setting, they consider a situation where two countries use both a lump-sum subsidy/tax and a tariff/consumption tax to compete for FDI, and show that the existence of a second tax instrument raises the likelihood that the larger country is able to charge positive profit taxes in equilibrium. Our set-up is different from theirs in important ways. In our model, prior to their fiscal competition and the MNE's location and production and sales decisions, two countries engage in a transport infrastructure investment competition in the first stage; while in their model a tariff/consumption tax is only chosen by the importing country after two countries' fiscal competition and the MNE's location choice. By comparing our results with Haufler and Wooton (1999), it is evident that when both countries are able to use both transport infrastructure investments and a lump-sum subsidy/tax to compete for FDI, the larger country's ability to tax the MNE is softened while in their paper that ability is reinforced.

Becker and Fuest (2010) consider a three-country regional model of competition for FDI through both tax and transport infrastructure policies, with two countries forming a union and being able to coordinate their transport infrastructure policies rather than their tax policies. Similar to their paper, we also model the role of transport infrastructure investments as reducing transport costs of goods across countries. However, there are two differences between our paper and theirs. First, in their model, countries simultaneously choose tax and transport infrastructure policies; whereas in our model, countries engage in transport infrastructure investment competition before their fiscal competition. Moreover, they show that transport infrastructure investments may mitigate tax compe-

tition, whereas besides a similar result, we also find a situation where such investments will intensify tax competition.

There have been interesting contributions to examine the interplay between the corporate tax rate and infrastructure investments when countries can use both policies to compete for mobile capital. Notable examples of theoretical studies are Zissimos and Wooders (2008), Hindriks, Peralta and Weber (2008), Pieretti and Zanaj (2011), Han, Pieretti and Zou (2017), and Dewit, Hynes and Leahy (2017).[7] Our paper is different from those papers in two important aspects. First, the above mentioned papers interpret investment in public infrastructure widely as any government investment that leads to a reduction in the marginal cost of doing business within the host country; and hence model infrastructure investments as a local public good; whereas we model transport infrastructure investments as a global public good, lowering the cost of transporting goods from one country to another irrespective of the location of FDI. Second, competition for mobile capital models are appropriate to deal with competition for portfolio investments rather than for competition for a profit-maximizing firm, for example, see Fumagalli (2003).

The structure of the paper is as follows. In section 2, we set out the model. Equilibrium analysis and welfare implications of the model are contained in sections 3 and 4. The final section concludes.

2 Model

There are two countries in a region, the smaller country A, with an inverse demand for a good, $p_A = 1 - Q_A$, and the larger country B, with an inverse demand for the same good, $p_B = 1 - \frac{1}{N}Q_B$; $N > 1$ measures the market size of country B relative to that of country A. An MNE from the rest of the world wants to establish a production plant in either country A or country B to service the regional demands.[8] Trade between the two

[7] Note that Zissimos and Wooders (2008), and Hindriks, Peralta and Weber (2008) obtain the result that infrastructure investments may mitigate tax competition between countries as well.

[8] As in Haufler and Wooton (1999), and many other interesting contributions, for example, Barros and Cabral (2000), Bjorvatn and Eckel (2006), and Ma (2013), direct export is not an option for the

countries incurs transportation costs. We assume that the MNE only faces transportation costs; other costs, such as variable and fixed production costs are assumed off.[9]

The two countries and the MNE play a three-stage game of complete information. In the first stage, two countries simultaneously and non-cooperatively make transport infrastructure investments, k_A and k_B, which reduce the unit trade cost from τ to $\frac{\tau}{1+k_A+k_B}$.[10] After observing those investments, two countries engage in fiscal competition for the location of the MNE's plant, simultaneously and non-cooperatively announcing their lump-sum subsidies, s_A and s_B, to the MNE conditional on it locating its investment within their territories.[11] After observing the two countries' transport infrastructure investments and their offers for FDI, the MNE makes its location choice, and then services the regional demands.[12]

Country i receives its consumption surplus net of its payments to the MNE and its costs of transport infrastructure investments, $\frac{1}{2}k_i^2$, $i \in \{A, B\}$. The MNE receives its profits plus the subsidy received. As usual, we solve the model by backward induction.

3 Equilibrium Analysis

In this section, we conduct the equilibrium analysis of our model. First, in subsection 3.1, we study the MNE's location, and production and sales decisions, given that the two countries' transport infrastructure investments and their offers to the MNE are fixed. Then, in subsection 3.2, we go back to a stage, and taking the MNE's equilibrium decisions into account, we examine fiscal competition between the two countries, given that their transport infrastructure investments are fixed. Then, we are back to the first stage,

MNE here.

[9] Our results do not depend on this assumption provided that variable and fixed production costs are the same across the two countries, and hence, they only differ in market size.

[10] As discussed in the Introduction, in this paper, we focus on the situation where infrastructure investments may serve as a global public good.

[11] When $s_i < 0$, country i offers a lump-sum tax; while when $s_i = 0$, it adopts a non-intervention policy, $i \in \{A, B\}$.

[12] Note that the existing literature, such as Zissimos and Wooders (2008), Hindriks, Peralta and Weber (2008), Pieretti and Zanaj (2011), Han, Pieretti and Zou (2017), and Dewit, Hynes and Leahy (2017), models the timing of the games in the same way.

and taking the MNE's equilibrium decisions and the equilibrium outcome of fiscal competition into account, we determine the two countries' equilibrium transport infrastructure investments in subsection 3.3.

3.1 The MNE's decisions

Given k_A and k_B; and s_A and s_B, when the MNE locates in country A, it receives operating profits:

$$\pi^A = \left(1 - Q_A^A\right) Q_A^A + \left(1 - \frac{1}{N} Q_B^A - \frac{\tau}{1 + k_A + k_B}\right) Q_B^A,$$

where Q_A^A and Q_B^A are its sales in countries A and B respectively. The superscript denotes the location of FDI, while subscripts denote countries/markets. It is straightforward to show that:

$$\begin{aligned}
&p_A^A = \tfrac{1}{2},\ p_B^A = \tfrac{1}{2} + \tfrac{\tau}{2(1+k_A+k_B)} \\
&Q_A^A = \tfrac{1}{2},\ Q_B^A = \tfrac{N}{2}\left(1 - \tfrac{\tau}{1+k_A+k_B}\right) \\
&\pi^A = \tfrac{1}{4}\left[1 + N\left(1 - \tfrac{\tau}{1+k_A+k_B}\right)^2\right] \\
&cs_A^A = \tfrac{1}{8} \\
&cs_B^A = \tfrac{N}{8}\left(1 - \tfrac{\tau}{1+k_A+k_B}\right)^2
\end{aligned} \quad , \tag{1}$$

where cs_A^A denotes country A's consumer surplus, and cs_B^A denotes that of country B in the case.

When the MNE chooses to locate in country B, its operating profits are:

$$\pi^B = \left(1 - Q_A^B - \frac{\tau}{1 + k_A + k_B}\right) Q_A^B + \left(1 - \frac{1}{N} Q_B^B\right) Q_B^B,$$

where Q_A^B and Q_B^B are its sales in countries A and B respectively. It is easy to show that:

$$\begin{aligned}
&p_A^B = \tfrac{1}{2} + \tfrac{\tau}{2(1+k_A+k_B)},\ p_B^B = \tfrac{1}{2} \\
&Q_A^B = \tfrac{1}{2}\left(1 - \tfrac{\tau}{1+k_A+k_B}\right),\ Q_B^B = \tfrac{N}{2} \\
&\pi^B = \tfrac{1}{4}\left[N + \left(1 - \tfrac{\tau}{1+k_A+k_B}\right)^2\right] \\
&cs_A^B = \tfrac{1}{8}\left(1 - \tfrac{\tau}{1+k_A+k_B}\right)^2 \\
&cs_B^B = \tfrac{N}{8}
\end{aligned} \quad , \tag{2}$$

where cs_A^B denotes country A's consumer surplus, and cs_B^B denotes that of country B in the case.

Note that:

$$\pi^B - \pi^A = \frac{1}{4}(N-1)\left[1 - \left(1 - \frac{\tau}{1+k_A+k_B}\right)^2\right] > 0,$$

which means that the larger country B enjoys a market size advantage over the smaller country A; and this drives the MNE to locate in the larger country when the two countries do not engage in fiscal competition for FDI. In addition, we have the following result.

Proposition 1 *The larger country's market size advantage is eroded by transport infrastructure investments.*

Proof. It is straightforward to show that: $\frac{\partial\left(\pi^B - \pi^A\right)}{\partial k_i} < 0,\ i \in \{A, B\}$. ■

Transport infrastructure investments reduce the unit trade cost between the two countries; and in turn, the lower this cost is, the less attractive the larger country becomes.[13]

When facing the two countries' offers, the MNE locates in country B if and only if:

$$\pi^B + s_B > \pi^A + s_A, \tag{3}$$

[13]People may immediately infer from this result that the larger country will not have an incentive to make transport infrastructure investments. However, as we will see, though transport infrastructure investments erode the larger country's market size advantage, it may still have an incentive to make such investments in order to reduce its subsidy paid to the MNE when necessary.

otherwise, the MNE establishes its production plant in country A.[14]

3.2 Fiscal competition

Given k_A and k_B; and taking the MNE's subsequent equilibrium decisions into account, the two countries engage in fiscal competition to attract FDI. It turns out that this competition is similar to a first-price sealed-bid auction of complete information. Based on the previous discussions, country A's net benefit under FDI, and hence, its valuation of FDI is:

$$\begin{aligned} v_A &\equiv cs_A^A - cs_A^B \\ &= \frac{1}{8}\left[1 - \left(1 - \frac{\tau}{1 + k_A + k_B}\right)^2\right]; \end{aligned}$$

while country B's net benefit under FDI, and hence, its valuation of FDI is:

$$\begin{aligned} v_B &\equiv cs_B^B - cs_B^A \\ &= \frac{N}{8}\left[1 - \left(1 - \frac{\tau}{1 + k_A + k_B}\right)^2\right]. \end{aligned}$$

Note that in the model, each country prefers locally produced goods to imported goods since the price of the former is cheaper than the latter, that is, import substitution effects provide each country with an economic incentive to compete for FDI. We have the following result.

Proposition 2 *Irrespective of which country makes transport infrastructure investments, they lower each country's valuation of FDI.*

Proof. It is immediate to show that: $\frac{\partial v_i}{\partial k_j} < 0$, $i, j \in \{A, B\}$. ■

Transport infrastructure investments reduce the unit trade cost between the two countries; and in turn, they lower the price of imported goods. Hence, a country's net benefit under FDI will be reduced by such investments.

[14] The knife-edge case is omitted in the analysis.

It is easy to see that the larger country's valuation of FDI is higher than that of the smaller country,

$$v_B > v_A. \tag{4}$$

Now, since the larger country has a market size advantage over and its valuation is higher than the smaller country, we have:

$$\pi^B + v_B > \pi^A + v_A, \tag{5}$$

which means that the larger country B will win FDI competition for sure. Note that in this model, transport infrastructure investments do not affect the MNE's location choice.

However, they do affect the larger country B's payment to the MNE.[15] In equilibrium, the larger country B pays the MNE:

$$\begin{aligned} s_B &= v_A - \left(\pi^B - \pi^A\right) \\ &= \frac{1}{8}\left[1 - 2\left(N - 1\right)\right]\left[1 - \left(1 - \frac{\tau}{1 + k_A + k_B}\right)^2\right]. \end{aligned} \tag{6}$$

When $N < \frac{3}{2}$, $s_B > 0$, it is a subsidy; while when $N > \frac{3}{2}$, $s_B < 0$, it is a tax, provided that the two countries' transport infrastructure investment levels are finite.[16] The following Proposition states how country B's equilibrium subsidy/tax changes with transport infrastructure investments.

Proposition 3 *When $N < \frac{3}{2}$, transport infrastructure investments reduce the larger country's subsidy paid to the MNE; while when $N > \frac{3}{2}$, they reduce the larger country's tax revenues paid by the MNE.*

[15] In equilibrium, the smaller country's bid is equal to its valuation of FDI, which is on the out-of-equilibrium path, and will never be implemented.

[16] When $N = \frac{3}{2}$, country B adopts a non-intervention policy.

Proof. See expression (6). It is straightforward to show that:

$$\frac{\partial s_B}{\partial k_i} = -\left[1 - 2\left(N - 1\right)\right]\left(1 - \frac{\tau}{1 + k_A + k_B}\right)\left[\frac{\tau}{4\left(1 + k_A + k_B\right)^2}\right];$$

and when $N < \frac{3}{2}$, $\frac{\partial s_B}{\partial k_i} < 0$; while when $N > \frac{3}{2}$, $\frac{\partial s_B}{\partial k_i} > 0$. ■

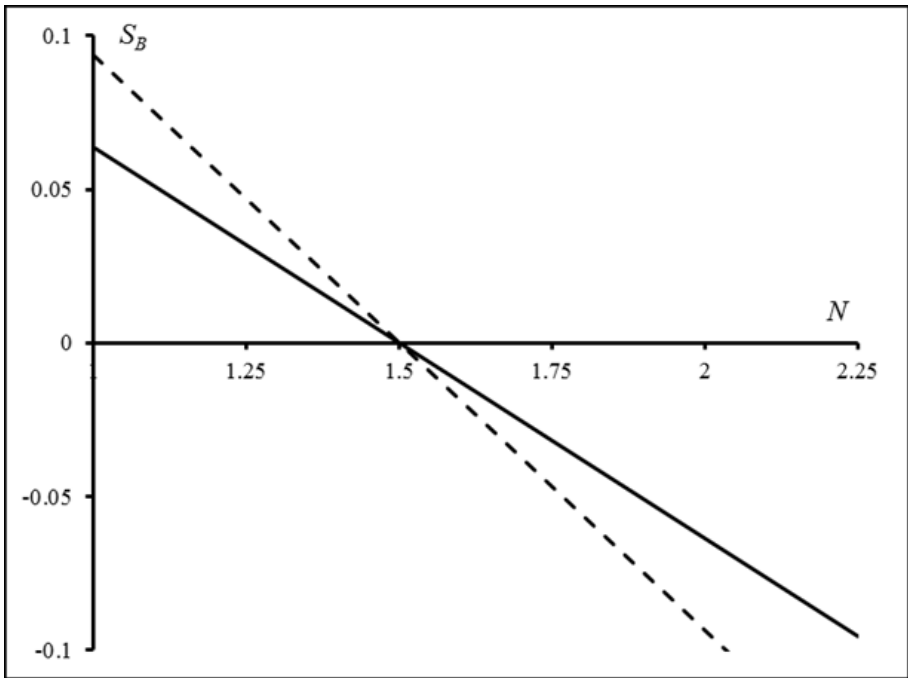

Figure 1: Equilibrium subsidy/tax

See Figure 1. The horizontal axis measures country B's market size relative to that of country A, while the vertical axis measures country B's subsidy/tax offered to the MNE. The dashed downward sloping line represents the equilibrium subsidy/tax given that the two countries do not make transport infrastructure investments. Obviously, it is a subsidy as $N < \frac{3}{2}$; while it is a tax when $N > \frac{3}{2}$. When either country A or country B or both countries make such investments and as a result, decreasing the unit trade cost, the equilibrium subsidy/tax is shown by the solid downward sloping line. Clearly, when the relative market size between the two countries is small, $(N < \frac{3}{2})$, the solid downward sloping line is below that of the dashed one, which means that transport infrastructure investments would lower country B's subsidy paid to the MNE. When the relative market

size between the two countries is big enough, ($N > \frac{3}{2}$), the solid downward sloping line is above that of the dashed one, which means that transport infrastructure investments would lead to country B reducing the tax it imposes on the MNE.

The results stated in Proposition 3 immediately imply that the larger country B will have an incentive to make transport infrastructure investments only if its market size is not much bigger than that of the smaller country A in the sense $N < \frac{3}{2}$ in the first stage of the game to which we now turn.

3.3 Transport infrastructure investment competition

Taking the MNE's equilibrium decisions, and the equilibrium outcome of fiscal competition into account, the two countries engage in transport infrastructure investment competition in the first stage. Since the MNE will choose to locate in the larger country B, national welfare of the smaller country A is equal to its consumption surplus achieved in this case net of its investment costs of transport infrastructure:

$$\begin{aligned} W_A &= cs_A^B - \frac{1}{2}k_A^2 \\ &= \frac{1}{8}\left(1 - \frac{\tau}{1 + k_A + k_B}\right)^2 - \frac{1}{2}k_A^2; \end{aligned} \tag{7}$$

while national welfare of the larger country B is equal to its consumption surplus under FDI net of its payments to the MNE and its investment costs of transport infrastructure:

$$\begin{aligned} W_B &= cs_B^B - s_B - \frac{1}{2}k_B^2 \\ &= \frac{N}{8} - \frac{1}{8}\left[1 - 2\left(N - 1\right)\right]\left[1 - \left(1 - \frac{\tau}{1 + k_A + k_B}\right)^2\right] - \frac{1}{2}k_B^2. \end{aligned} \tag{8}$$

First-order condition for national welfare maximization of country A with respect to

its transport infrastructure investment, k_A, is:

$$\left(1-\frac{\tau}{1+k_A+k_B}\right)\left[\frac{\tau}{4\left(1+k_A+k_B\right)^2}\right]=k_A. \tag{9}$$

First-order derivative of national welfare of country B with respect to its transport infrastructure investment, k_B, is:

$$\frac{\partial W_B}{\partial k_B}=\left[1-2\left(N-1\right)\right]\left(1-\frac{\tau}{1+k_A+k_B}\right)\left[\frac{\tau}{4\left(1+k_A+k_B\right)^2}\right]-k_B.$$

When $N<\frac{3}{2}$, setting $\frac{\partial W_B}{\partial k_B}=0$, we have:

$$\left[1-2\left(N-1\right)\right]\left(1-\frac{\tau}{1+k_A+k_B}\right)\left[\frac{\tau}{4\left(1+k_A+k_B\right)^2}\right]=k_B. \tag{10}$$

When $N>\frac{3}{2}$, $\frac{\partial W_B}{\partial k_B}<0$, and in turn, $k_B=0$.

Hence, in the first stage transport infrastructure investment competition, depending on the range of relative market size between the two countries, we will have two types of equilibrium stated in the following Proposition.

Proposition 4 *(1) When* $N<\frac{3}{2}$,

$$k_A^*>0,\ k_B^*>0,$$

where they simultaneously satisfy conditions (9) and (10). (2) When $N>\frac{3}{2}$,

$$k_A^*>0,\ k_B^*=0,$$

where k_A^* *solves:*

$$\left(1-\frac{\tau}{1+k_A}\right)\left[\frac{\tau}{4\left(1+k_A\right)^2}\right]=k_A.$$

For the first part of the Proposition, the larger country B's subsidy payments decrease with its own transport infrastructure investments, which explains that it makes

such investments in equilibrium. The smaller country A makes transport infrastructure investments in order to consume cheaper imported goods and increase its consumption surplus. As to the second part, the larger country B's tax revenues decrease with its own infrastructure investments, which explains that it does not make such investments in equilibrium. For the same reason as above, the smaller country A will again invest in transport infrastructure.[17]

Propositions 3 and 4 together imply the main result of the paper, which states the effects of transport infrastructure investments on fiscal competition between the larger and the smaller countries in equilibrium.

Proposition 5 *Compared with the situation when both countries do not make transport infrastructure investments, when the larger country's market size is slightly bigger than that of the smaller country (in the sense $N < \frac{3}{2}$), fiscal competition between the two countries is mitigated by such investments; while when the larger country's market size is sufficiently greater than that of the smaller country (in the sense $N > \frac{3}{2}$), transport infrastructure investments intensify fiscal competition between the two countries.*

Proof. First note when $N < \frac{3}{2}$, the larger country's subsidy paid to the MNE decreases with transport infrastructure investments by Proposition 3. According to Proposition 4, in this case, both countries invest in transport infrastructure in equilibrium. Hence, compared with the situation when the two countries do not make such investments, now, the larger country pays less to the MNE. Similarly, when $N > \frac{3}{2}$, the larger country's tax collected from the MNE decreases with transport infrastructure investments by Proposition 3. According to Proposition 4, in this case, the smaller country rather than the larger country invests in transport infrastructure in equilibrium. Therefore, compared with the situation when the two countries do not make such investments, now, the MNE pays less to the larger country. ■

[17] That the smaller country makes bigger infrastructure investments than the larger country is related to Pieretti and Zanaj (2011). They find a situation where smaller countries can attract international capital by supplying higher levels of public goods than larger countries.

The payment made between the larger country and the MNE (expression (6)) is driven by the smaller country's valuation of FDI and the MNE's profit premium by locating in the larger country. When the difference between the two countries' market size is relatively small, their fiscal competition is fierce and as a result, the larger country pays a subsidy to the MNE. However, the larger country would take the opportunity of making transport infrastructure investments to lower the smaller country's valuation of FDI; at the same time, the smaller country itself also makes such investments in order to reduce the price of imported goods achieving higher consumption surplus. Consequently, the larger country pays less to the MNE than in the case without transport infrastructure investments. In this sense, transport infrastructure investments mitigate fiscal competition between the two countries.[18]

When the difference between the two countries' market size is sufficiently great, the larger country faces less competition from the smaller country, and it is able to tax the MNE. Since the larger country's transport infrastructure investments make the MNE's profit premium by locating in the larger country shrink and hence reduce its tax revenue, it will not make such investments. However, the smaller country will again invest in transport infrastructure in order to increase its consumption surplus, making the MNE's profit premium by locating in the larger country become smaller. Consequently, the MNE pays less tax to the larger country than in the case without transport infrastructure investments. Hence, such investments intensify fiscal competition between the two countries. It is a result that seems to be proved first in our paper.[19]

4 Welfare Implications

In this section, we briefly discuss the welfare implications of our model, which are directly implied by the above analysis. Compared with the situation when the two countries do

[18] As previously discussed, it is a result shared with Zissimos and Wooders (2008), Hindriks, Peralta and Weber (2008), and Becker and Fuest (2010).

[19] Note that the basic model of Haufler and Wooton (1999) can be interpreted as the case where the two countries do not make infrastructure investments.

not make infrastructure investments, the smaller country A benefits from the opportunity of making transport infrastructure investments as the investments enable the MNE to export more goods to country A at a lower price thus increasing its consumption surplus. The larger country B benefits while the MNE loses from two countries' making such investments when $N < \frac{3}{2}$. The larger country B loses while the MNE gains from the smaller country's making transport infrastructure investments when $N > \frac{3}{2}$. We summarize our welfare discussions in the following Proposition.

Proposition 6 *Compared with the situation when both countries do not make transport infrastructure investments, the smaller country always benefits from making such investments. As to the larger country, it benefits from making such investments when its market size is slightly bigger than that of the smaller country. When its market size is sufficiently greater than that of the smaller country, the larger country loses from the opportunity of making transport infrastructure investments.*

Hence, though both countries may benefit from investments in transport infrastructure when they have similar market sizes, such investments would not lead to a strict Pareto improvement when they differ significantly in their market size.

5 Concluding Remarks

We have studied how transport infrastructure investments affect a bidding war for a firm between two asymmetric countries within a region in a context of imperfect competition, where transport infrastructure investments play the role of a global public good, leading to a reduction in the unit trade cost between the two countries. A number of interesting results have been derived from the model. In particular, transport infrastructure investments can intensify fiscal competition between the two countries when the difference between their market size is sufficiently large. Welfare implications of the model have been also examined.

Our model naturally has some limitations. We capture the idea that competing countries benefit from FDI due to import substitution effects. In addition, the situation that we focus on is relevant for market seeking FDI. However, we do not consider other possible beneficial effects of FDI, such as job creation and technological spillovers. It is also well known that MNEs engage in inputs or resources seeking FDI as well. It will be very interesting to investigate the impacts of infrastructure investments on fiscal competition of which the outcome is determined by the interactions of the above effects. We hope to report new results on that in our future work.

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