Online Appendix for

"Beneficial Fiscal Competition for Foreign Direct Investment: Transport Infrastructure and Economic Integration"

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A Reversals of the orders in the levels of public investments

This appendix explores the effects of fiscal competition on investment levels. Without fiscal competition, we confirm $\widetilde{k}_A^B < \widetilde{k}_B^B$ when $\frac{2a}{5\tau_0 - a} < \gamma$ and $\frac{(\gamma+2)a}{5\gamma} < \tau_0$ hold. This shows that country B invests more in the transport infrastructure when public investment is sufficiently inefficient and the infrastructure-independent transport cost is large. In this case, the marginal impact of investment on the local firm in country A is negative because of the larger gains from the separated locations of the firms, and country A's hesitation to invest in country A is large.

Under fiscal competition, we find that, $\widehat{k}_A^B > \widehat{k}_B^B$. This is easily confirmed by the second term of Eq.(3), which shows that the marginal effect on the local firm's profits in country A is larger than that on the equilibrium subsidy s_B^* in country B.

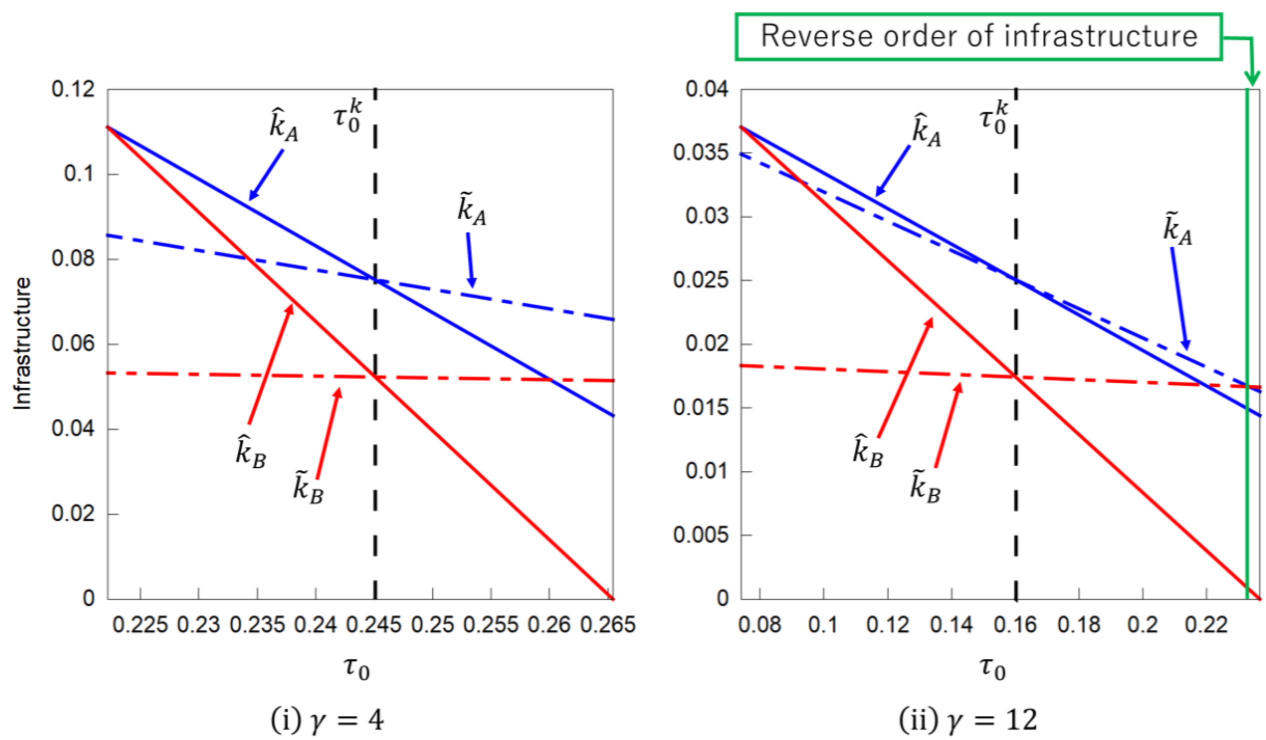

Figure 4: Equilibrium investment levels

Using the same parameter $a = 1$, Figure 4 shows different patterns of public investment in infrastructure over different levels of infrastructure-independent transport costs, τ_0, with two different levels of efficiency of public investment, γ. The dot-dashed curves in the figure illustrate

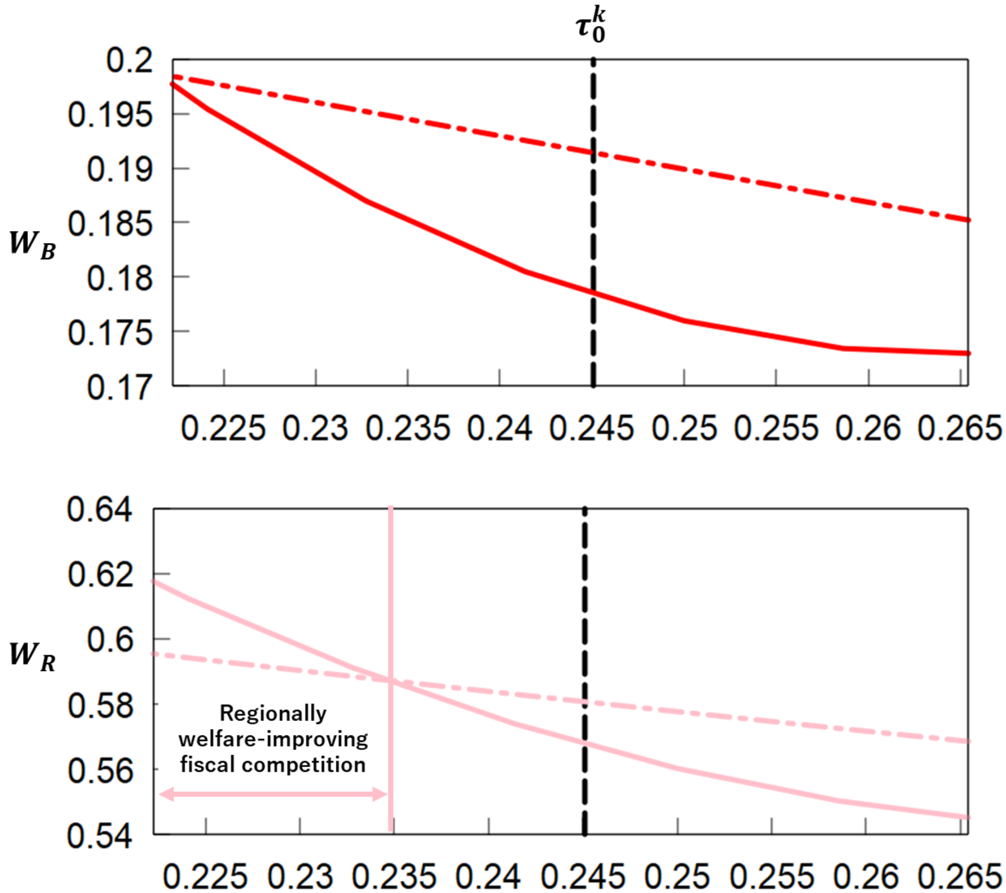

Figure 5: Regional welfare

the equilibrium investment level without fiscal competition, whereas the solid curves represent the equilibrium investment level with fiscal competition. We can observe $\widetilde{k}_A < \widetilde{k}_B$ and $\widehat{k}_A > \widehat{k}_B$ under large τ_0 from the right figure.[35]

B Joint welfare

Figure 5 uses $a = 1$ and $\gamma = 4$ and shows welfare in country B and joint welfare in the upper and lower figures. The solid curves represent welfare under fiscal competition and the dashed curve represents welfare without fiscal competition. Unlike the case with $\gamma = 3.25$, shown in Figure 3, fiscal competition reduces welfare in country B. Despite this negative effect in country B, there exists a unique threshold of τ below which fiscal competition improves regional welfare. For regional welfare, which also includes welfare gains in the non-host country, the region as a whole can benefit from fiscal competition by improving transport infrastructure. Therefore, in such cases,

[35] The second term of $\widehat{k}_i^B$ comprises the direction term $\{2(3\gamma + 13)a - 51\gamma\tau_0\}$ and scaling element. By comparing the scaling terms, we obtain $\frac{11}{9\gamma(3\gamma-4)(9\gamma-29)} \gtreqless \frac{(9\gamma-11)}{9\gamma(3\gamma-4)(9\gamma-29)} \iff 0 \gtreqless 9\gamma - 22$. Assuming $\gamma > \frac{29}{9}$, the scaling effect is larger for country B.

regional Pareto improvement is possible if the competing countries do some kind of transfer between themselves.

C Exports from country T

We modify the model with two possible options for firm M: having a subsidiary in one of the two competing countries or exporting goods from the MNE's domestic country T. For this modification, we introduce the fixed cost of FDI, denoted as F, if the MNE decides to establish a subsidiary inside the competing region.

If the MNE chooses to export its goods from country T without having its subsidiary inside the region, then the FDI costs no longer arise; however, other transport costs, $\tau_i^T = \tau_0^T - k_i$, are needed. Because the main motivation for FDI in our model is (prohibitively) the high transport costs between country T and the competing region, we assume $\tau_0 < \tau_0^T$. In addition, government $i \in \{A, B\}$'s investments in transport infrastructure affect the transport costs between countries i and T and have no impact on the transport costs between $-i$ and T. With this specification, we can conclude that the optimal strategy for firm M is to export if the fixed costs for FDI are large and/or the gap in infrastructure-independent transport costs are small, and to otherwise, have a subsidiary.[36]

Now consider the effect of fiscal competition on firm M's equilibrium supply choices. Let $(\sigma^{nfc}, \sigma^{fc})$ be the set of firm M's equilibrium supply choices with and without fiscal competition, where $\sigma^{nfc}, \sigma^{fc} \in \{Export, FDI\}$. Because this study focuses on the fiscal policy for FDI, and the equilibrium fiscal policy is a subsidy, as shown in the benchmark analysis, the possible patterns are $(Export, Export)$, $(Export, FDI)$, and (FDI, FDI). In the first case, $(Export, Export)$, fiscal competition has no impact on FDI. The last case, (FDI, FDI) corresponds to the benchmark analysis. Therefore, we examine the second case $(Export, FDI)$ in the rest of this appendix.

In the final stage, firms compete in a Cournot competition. Because the equilibrium outputs under fiscal competition are the same as those in the benchmark case, we consider the case without fiscal competition, in which firm M exports from country T. The equilibrium output levels are

$$x_{MA}^T = \frac{a - 2\tau_A^T}{3} \quad \text{and} \quad x_{LA}^T = \frac{a + \tau_A^T}{3}$$
$$x_{MB}^T = \frac{a + \tau - 2\tau_B^T}{3} \quad \text{and} \quad x_{LB}^T = \frac{a + \tau_B^T - 2\tau}{3}.$$

These equilibrium supplies yield the following welfare function of each country, $W_A^T = \frac{\left(x_{MA}^T + x_{LA}^T\right)^2}{2} + \left(x_{LA}^T\right)^2 + \left(x_{LB}^T\right)^2 - \frac{\gamma k_A^2}{2}$ and $W_B^T = \frac{\left(x_{MB}^T + x_{LB}^T\right)^2}{2} - \frac{\gamma k_B^2}{2}$.

[36] The trade-off between avoiding trade costs versus avoiding FDI fixed costs is known as "proximity-concentration trade-off" Brainard (1997).

Subsequently, the followings are the first order conditions for k_i,

$$\frac{\partial W_A^T}{\partial k_A} = \frac{2a - \tau_A^T}{9} + 2\left[-\frac{a + \tau_A^T}{9} + \frac{2(a + \tau_B^T - 2\tau)}{9}\right] - \gamma k_A^T = \frac{4a + 4\tau_B^T - 3\tau_A^T - 8\tau}{9} - \gamma k_A^T = 0$$
$$\frac{\partial W_B^T}{\partial k_B} = \frac{2(2a - \tau - \tau_B^T)}{9} - \gamma k_B^T = 0$$

and provide the following equilibrium investments in the transport infrastructure:

$$\widetilde{k}_A^T = \frac{3\gamma(4a + \tau_0^T - 8\tau_0) - 4(\tau_0^T - 2\tau_0)}{3(3\gamma - 4)(3\gamma - 1)}$$
$$\widetilde{k}_B^T = \frac{2\{3\gamma(2a - \tau_0^T - \tau_0) - (6a - 4\tau_0^T - \tau_0)\}}{3(3\gamma - 4)(3\gamma - 1)}.$$

By comparing the equilibrium investments in the transport infrastructure, we obtain,

$$\widehat{k}_A^B - \widetilde{k}_A^T = \frac{4(63\gamma^2 + 141\gamma - 28)a - 3\gamma(3\gamma - 1)(27\gamma + 100)\tau_0 - 3\gamma(3\gamma - 4)(9\gamma - 29)\tau_0^T}{9\gamma(3\gamma - 1)(3\gamma - 4)(9\gamma - 29)} \gtreqless 0$$
$$\iff \tau_0 \lesseqgtr \frac{4(63\gamma^2 + 141\gamma - 28)a - 3\gamma(3\gamma - 4)(9\gamma - 29)\tau_0^T}{3\gamma(3\gamma - 1)(27\gamma + 100)} \equiv \tau_0^{k_A T}$$
$$\widehat{k}_B^B - \widetilde{k}_B^T = \frac{2\{4(135\gamma^2 - 165\gamma + 14)a - 3\gamma(3\gamma - 1)(72\gamma - 79)\tau_0 + 3\gamma(3\gamma - 4)(9\gamma - 29)\tau_0^T\}}{9\gamma(3\gamma - 1)(3\gamma - 4)(9\gamma - 29)} \gtreqless 0$$
$$\iff \tau_0 \lesseqgtr \frac{4(135\gamma^2 - 165\gamma + 14)a + 3\gamma(3\gamma - 4)(9\gamma - 29)\tau_0^T}{3\gamma(3\gamma - 1)(72\gamma - 79)} \equiv \tau_0^{k_B T}$$

and $\tau_0^{k_A T} - \tau_0^{k_B T} = -\frac{(3\gamma-1)(33\gamma+7)(9\gamma\tau_0-8a)}{3\gamma(3\gamma-1)(9\gamma-29)} < 0$. Therefore, if $\tau_0 < \tau_0^{k_A T}$ holds, fiscal competition increases public investments in transport infrastructure in both countries.

By comparing the terms in the first-order conditions, we obtain

$$\frac{\partial CS_A^T}{\partial k_A} - \frac{\partial CS_A^B}{\partial k_A} = \frac{(\tau_0 - k_A - k_B) - (\tau_0^T - k_A)}{9} = -\frac{(\tau_0^T - \tau_0) + k_B}{9} < 0$$
$$\frac{\partial \pi_L^T}{\partial k_A} - \frac{\partial \pi_L^B}{\partial k_A} = \frac{-2\{(\tau_0^T - k_A) - (\tau_0 - k_A - k_B)\}}{9} + \frac{4\{(\tau_0^T - k_B) - 2(\tau_0 - k_A - k_B) + 2(\tau_0 - k_A - k_B)\}}{9}$$
$$= \frac{2(\tau_0^T + \tau_0 - 3k_B)}{9}$$
$$\frac{\partial CS_B^T}{\partial k_B} - \frac{\partial CS_B^B}{\partial k_B} = \frac{(\tau_0 - k_A - k_B) - 2(\tau_0 - k_A - k_B) - 2(\tau_0^T - k_A)}{9} = -\frac{(\tau_0 - k_A - k_B) + 2(\tau_0^T - k_A)}{9} < 0.$$

The second comparison is likely positive because $\tau_0^T > \tau_0$ and $\tau_0 > k_A + k_B$. Therefore, fiscal competition increases the marginal benefits of k_i through consumer gains. Additionally, government A has a stronger incentive to invest in transport infrastructure without fiscal competition to support firm L in expanding its market share in country B, which means that fiscal competition makes government A less likely to increase public investment.

D Two subsidiaries in the competing region

Next, we consider another possible option for the MNE: having a subsidiary in each country in the region, which is identified with the superscript F. Analogous to the case of exports from country T shown in Appendix C, having a subsidiary in one country incurs a fixed cost F. As in the benchmark model, firm M chooses country B as its production location if it decides to establish a subsidiary with a profit of $\pi_M^{B*} + s_B - F$. Alternatively, if firm M has two subsidiaries, firm M's profit is $\pi_M^F = p_A^F x_{MA}^F + p_B^F x_{MB}^F + s_B + s_A - 2F$. Recall that we focus on the equilibrium at which an MNE has one subsidiary in each country under fiscal competition. Therefore, country B does not design its fiscal policy in equilibrium $s_B = 0$ because firm M is already located there without fiscal competition and firm M's decision is whether or not to enter country A.

In the new case, the equilibrium outputs are,

$$\left(x_{MA}^B = \frac{a-2\tau}{3} <\right) x_{MA}^F = \frac{a}{3} = x_{LA}^F \left(< x_{LA}^B = \frac{a+\tau}{3}\right),$$
$$x_{MB}^F = \frac{a+\tau}{3} = x_{MB}^B \qquad \text{and} \qquad x_{LB}^F = \frac{a-2\tau}{3} = x_{LB}^B.$$

This indicates that the MNE establishes one subsidiary in equilibrium without fiscal competition if

$$\begin{aligned}\pi_M^F - \pi_M^B\big|_{s_A=s_B=0} &= \left\{\left(x_{MA}^F\right)^2 + \left(x_{MB}^F\right)^2 - 2F - \left(x_{MB}^B\right)^2 - \left(x_{MA}^B\right)^2 - F\right\}\\ &= \frac{4\tau(a-\tau)}{9} - F < 0 \iff F > \underline{F}^F \equiv \frac{4\tau(a-\tau)}{9}\end{aligned}$$

holds. This means that the MNE ceases having a second subsidiary if the fixed cost exceeds the gains from having a second subsidiary in country A.

Under fiscal competition, firm M decides to additionally enter country A if and only if,

$$\begin{aligned}\pi_M^F - \pi_M^B\big|_{s_B=0} &= \left\{\left(x_{MA}^F\right)^2 + \left(x_{MB}^F\right)^2 + s_A - 2F\right\} - \left\{\left(x_{MA}^B\right)^2 + \left(x_{MB}^B\right)^2 - F\right\}\\ &= s_A - F + \frac{4\tau(a-\tau)}{9} > 0 \iff s_A > F - \frac{4\tau(a-\tau)}{9} \equiv \underline{s}_A^F > 0,\end{aligned}$$

where the last inequality holds, because $F > \underline{F}^F$. Recall that firm M does not have a second subsidiary because of the high fixed costs; thus, country A needs to provide a subsidy to attract firm M.

Next, we examine country A's incentive to attract firm M. By comparing welfare in country A

with and without attracting firm M, we obtain

$$\begin{aligned} W_A^F - W_A^B &= \left\{ \frac{(x_{MA}^F + x_{LA}^F)^2}{2} + \left(x_{LA}^F\right)^2 + \left(x_{LB}^F\right)^2 - s_A - \frac{\gamma k_A^2}{2} \right\} \\ &\quad - \left\{ \frac{(x_{MA}^B + x_{LA}^B)^2}{2} + \left(x_{LA}^B\right)^2 + \left(x_{LB}^B\right)^2 - \frac{\gamma k_A^2}{2} \right\} \\ &= -\frac{\tau^2}{6} - s_A > 0 \iff s_A < -\frac{\tau^2}{6} \equiv \bar{s}_A^F. \end{aligned}$$

Because country A has a local firm, attracting firm M reduces the local firm's profits, which exceed the gains from consumers. Therefore, government A cannot provide subsidies or impose taxes on the firm M. This clearly contradicts the FDI decision of firm M in country A as firm M needs a subsidy to establish a second subsidiary. Thus, country A has no incentive to design its fiscal policy to attract firm M in the equilibrium.

E Product similarities

We modify the model with the representative utility function as $u_i = a(x_{iL}+x_{iM}) - \frac{x_{iL}^2 + 2\beta x_{iL}x_{iM} + x_{iM}^2}{2}$ which yields the inverse demand function as $p_{iL} = a - x_{iL} - \beta x_{iM}$ and $p_{iM} = a - x_{iM} - \beta x_{iL}$. To simplify the discussion, we focus on the case $\beta = 0$ hereafter.

In the last stage of the game, firms produce the following outputs:

$$\begin{aligned} x_{AM}^A &= \frac{a}{2} > x_{BM}^A = \frac{a-\tau}{2}, &\quad \text{and} \quad && x_{AM}^B &= \frac{a-\tau}{2} > x_{BM}^B = \frac{a}{2}, \\ x_{AL}^A &= \frac{a}{2} > x_{BL}^A = \frac{a-\tau}{2}, &\quad \text{and} \quad && x_{AL}^B &= \frac{a}{2} > x_{BL}^B = \frac{a-\tau}{2}. \end{aligned}$$

In the third stage, firm M decides which country to locate in by comparing its profits,

$$\pi_M^B - \pi_M^A = s_B - s_A, \tag{C-01}$$

which means that firm M prefers to be located in country B because of the weak preference assumption for firm M in country B without fiscal competition, $s_B = s_A = 0$.

First, we consider the case without fiscal competition. Given the location of firm M in country B, the welfare functions of the two countries are,

$$\begin{aligned} W_A^B &= \frac{\left(x_{AL}^B\right)^2}{2} + \frac{\left(x_{AM}^B\right)^2}{2} + \left(x_{AL}^B\right)^2 + \left(x_{BL}^B\right)^2 - \frac{\gamma k_A^2}{2} = \frac{a^2}{2} + \frac{\{a - \tau_0 + k_A + k_B\}^2}{2} - \frac{\gamma k_A^2}{2}, \\ W_B^B &= \frac{\left(x_{BL}^B\right)^2}{2} + \frac{\left(x_{BM}^B\right)^2}{2} - \frac{\gamma k_B^2}{2} = \frac{a^2}{4} + \frac{\{a - \tau_0 + k_A + k_B\}^2}{4} - \frac{\gamma k_B^2}{2}. \end{aligned}$$

Additionally, the first order conditions and the optimal investments in public infrastructure are,

$$\begin{cases} \frac{\partial W_A^B}{\partial k_A} = a - \tau_0 + \widetilde{k}_A + \widetilde{k}_B - \gamma\widetilde{k}_A = 0 \\ \frac{\partial W_B^B}{\partial k_B} = a - \tau_0 + \widetilde{k}_A + \widetilde{k}_B - 2\gamma\widetilde{k}_B = 0 \end{cases} \quad \rightarrow \quad \begin{cases} \widetilde{k}_A = \frac{2(a-\tau_0)}{2\gamma-3} \\ \widetilde{k}_B = \frac{a-\tau_0}{2\gamma-3}. \end{cases}$$

Under fiscal competition, the most generous fiscal policies are,

$$W_A^A - W_A^B = \left(x_{AL}^A\right)^2 - s_A - \left(x_{AL}^B\right)^2 = \frac{\tau(2a-\tau)}{4} - s_A \geq 0 \iff s_A \leq \frac{\tau(2a-\tau)}{4} \equiv \overline{s}_A$$
$$W_B^B - W_B^A = \left(x_{BL}^B\right)^2 - s_B - \left(x_{BL}^A\right)^2 = \frac{\tau(2a-\tau)}{4} - s_B \geq 0 \iff s_B \leq \frac{\tau(2a-\tau)}{4} \equiv \overline{s}_B(= \overline{s}_A).$$

The most generous fiscal policies are the same across countries because no market interactions occur, and the only gains from attracting firm M are via consumer surplus. This implies that fiscal competition does not affect firm M's location.

Similar to the benchmark analysis, the equilibrium fiscal policy of the host country B is derived as,

$$\pi_M^B - \pi_M^A = \underbrace{\Omega}_{=0} + s_B - \overline{s}_A = 0 \iff s_B^* = \overline{s}_A.$$

Under fiscal competition, the first-order conditions and optimal investment levels are

$$\begin{cases} \frac{\partial W_A^B}{\partial k_A} = a - \tau_0 + \widetilde{k}_A + \widetilde{k}_B - \gamma\widetilde{k}_A = 0 \\ \frac{\partial W_B^B}{\partial k_B} = a - \tau_0 + \widetilde{k}_A + \widetilde{k}_B + \underbrace{(a - \tau_0 + \widetilde{k}_A + \widetilde{k}_B)}_{=\frac{\partial s_B^*}{\partial k_B} > 0} - 2\gamma\widetilde{k}_B = 0 \end{cases} \quad \rightarrow \quad \begin{cases} \widehat{k}_A = \frac{a-\tau_0}{\gamma-2} \\ \widehat{k}_B = \frac{a-\tau_0}{\gamma-2}. \end{cases}$$

We find $\widetilde{k}_B < \widetilde{k}_A < \widehat{k}_A = \widehat{k}_B$.

F Three countries in the region

We introduce another country in the competing region, denoted as country C. Supplies to country C are provided by firms L and M which incur trade costs that differ from those between countries A and B, $\tau(= \tau_0 - k_A - k_B)$. If goods are exported from country A, the per-unit trade costs are $\tau_{AC} = \tau_0 - k_A - k_C$, whereas exports from country B entail $\tau_{BC} = \tau_0 - k_B - k_C$. As exports from country $i \in \{A, B\}$ to C use ports in countries i and C but not in $j \neq i$, the new transport costs are a function of public investments in countries i and C but not in country j. For simplicity, we normalized $k_C = 0$.

For simplicity, we assume that there are no firms in country C to make it easy to compare the results with those in the benchmark analysis. Furthermore, the market size and utility of the representative consumers are assumed to be the same as those of countries A and B: $p_C = a(x_{CL} + x_{CM}) - \frac{(x_{CL}+x_{CM})^2}{2}$.

The amounts of supplies to countries A and B are the same as in the benchmark analysis, and those to country C are computed as follows:

$$x_{CL}^A = \frac{a-\tau_{AC}}{3}, \qquad x_{CM}^A = \frac{a-\tau_{AC}}{3} \qquad \text{(Firm } M \text{ in } A\text{)},$$
$$x_{CL}^B = \frac{a-2\tau_{AC}+\tau_{BC}}{3}, \qquad x_{CM}^B = \frac{a+\tau_{AC}-2\tau_{BC}}{3} \qquad \text{(Firm } M \text{ in } B\text{)}.$$

Given the set of outputs, firm M's decision on its location is

$$\pi_M^B - \pi_M^A = \underbrace{\frac{4\tau^2}{9}}_{=\Omega} \underbrace{-\frac{(k_A-k_B)(a-\tau_{BC})}{9}}_{\equiv \Omega_{BC}} + (s_B - s_A),$$

where the first and third terms have the same fundamental location advantages in B and fiscal policies as in the benchmark analysis. The second term is a new term in the presence of a third country in the region. Because the trade costs for country C depend on the investment level in the host country, larger investments in the host country enhance attractiveness of country A. Therefore, if $k_A > k_B$, country A is more attractive and the term capturing the export platform location advantage Ω_{BC} is negative. Alternatively, when $k_B > k_A$, meaning that country B is attractive, $\Omega_{BC} > 0$ holds true.

Note that, as the sign of the second term is ambiguous, firm M's location choice can be either in A or B. To make the analysis compact, we focus on the case where firm M chooses country B to locate for the purpose of comparison.[37] In other words, we assume $\Omega + \Omega_{BC} > 0$ for a while. Given the location of firm M in B, the objective functions of countries A and B are:

$$W_A^B = \frac{1}{2}\left(\frac{2a-\tau}{3}\right)^2 + \left(\frac{a+\tau}{3}\right)^2 + \left(\frac{a-2\tau}{3}\right)^2 + \left(\frac{a-2\tau_{AC}+\tau_{BC}}{3}\right)^2 - \frac{\gamma k_A^2}{2},$$
$$W_B^B = \frac{1}{2}\left(\frac{2a-\tau}{3}\right)^2 - s_B - \frac{\gamma k_B^2}{2}.$$

First, we consider the case without fiscal competition, $s_B = s_A = 0$. The first-order conditions are

$$\frac{\partial W_A^B}{\partial k_A} = \frac{2a-\tau}{9} + \frac{2a-10\tau}{9} + \underbrace{\frac{2(a-2\tau_{AC}+\tau_{BC})}{9}}_{+:\text{Export expansion effect}} - \gamma k_A = 0,$$
$$\frac{\partial W_B^B}{\partial k_B} = \frac{2a-\tau}{9} - \gamma k_B = 0. \tag{4}$$

The sole difference from the first-order conditions in the benchmark analysis is the third term in the first-order condition for country A, which captures the export expansion effect of firm L. As public

[37]We also assume away the possibility that countries A and B deviate from the interior solution. By increasing from the interior solution, both countries may benefit owing to more public investments even with the same location of firm M. However, such deviation may not be allowed by citizens as such deviation would increase their tax burden although they are convinced with the interior solution because it is based on cost-benefits analysis, namely, the first-order conditions.

investments in transport infrastructure in country A reduce the transport costs of firm L to country C and increase profits from the country, the term is positive, and country C has an additional benefit from investments. Therefore, country A's investment increases. Additionally, such an increase in k_A induces country B to invest more because of the complementarity of the public infrastructure. By solving the system of equations, we derive the following public investments:

$$\widetilde{k}_A^C = \frac{6(12\gamma+1)a-(135\gamma-8)\tau_0}{3(27\gamma^2-60\gamma+4)} \qquad \text{and} \qquad \widetilde{k}_B^C = \frac{6(3\gamma-5)a-(9\gamma-4)\tau_0}{3(27\gamma^2-60\gamma+4)}.$$

As we assume $\Omega+\Omega_{BC}>0$ to derive the optimal investments given firm M's location in B, we need to check whether $(\widetilde{k}_A^C, \widetilde{k}_B^C)$ satisfies the inequality. We have,

$$\begin{aligned}
\Omega+\Omega_{BC}|_{\widetilde{k}_A^C,\widetilde{k}_B^C} &= \frac{4(\Xi_{\Omega_1}a^2+\Xi_{\Omega_2}a\tau_0+\Xi_{\Omega_3}\tau_0^2)}{81(27\gamma^2-60\gamma+4)^2} \\
\text{where} \quad \Xi_{\Omega_1} &\equiv -18(243\gamma^3-774\gamma^2-138\gamma-68) \\
\Xi_{\Omega_2} &\equiv -18(927\gamma^2+504\gamma-20)<0 \\
\Xi_{\Omega_3} &\equiv +(6561\gamma^4-16038\gamma^3+23166\gamma^2-1692\gamma+32)>0.
\end{aligned}$$

Furthermore, we have,

$$\begin{aligned}
\frac{\partial^2\, \Omega+\Omega_{BC}|_{\widetilde{k}_A^C,\widetilde{k}_B^C}}{\partial\tau_0^2} &= \frac{8\Xi_{\Omega_3}}{81(27\gamma^2-60\gamma+4)^2}>0 \\
\left.\frac{\partial\, \Omega+\Omega_{BC}|_{\widetilde{k}_A^C,\widetilde{k}_B^C}}{\partial\tau_0}\right|_{\tau_0=\underline{\tau_0}} &= \frac{8a(7290\gamma^3-11907\gamma^2+2124\gamma-64)}{243\gamma(9\gamma-4)(27\gamma^2-60\gamma+4)}>0.
\end{aligned}$$

This implies that $\Omega+\Omega_{BC}|_{\widetilde{k}_A^C,\widetilde{k}_B^C}$ takes the minimum value at $\tau=\underline{\tau}_0$ and the maximum value at $\tau=\overline{\tau}_0$:

$$\begin{aligned}
\Omega+\Omega_{BC}|_{\widetilde{k}_A^C,\widetilde{k}_B^C,\tau_0=\underline{\tau}_0} &= -\frac{8a^2(27\gamma-4)(81\gamma^2-108\gamma+16)}{729\gamma^2(9\gamma-4)^2}<0, \\
\Omega+\Omega_{BC}|_{\widetilde{k}_A^C,\widetilde{k}_B^C,\tau_0=\overline{\tau}_0} &= \frac{a^2(729\gamma^4-486\gamma^3+162\gamma^2-12\gamma+32)}{81\gamma^2(9\gamma-4)^2}>0.
\end{aligned}$$

Therefore, there exists a unique $\tau_0=\tau_0^\Omega$ below which $\Omega+\Omega_{BC}|_{\widetilde{k}_A^C,\widetilde{k}_B^C}<0$ holds. When τ_0 is small, the fundamental location advantage in B, Ω, is small, and the export platform location advantage, Ω_{BC}, is relatively important. As the benchmark analysis shows that investment in A is likely to be larger than that in B, Ω_{BC} is the dominant effect under small τ_0, and firm M prefers a location in A. To avoid these possibilities, our analysis focuses on the range $\tau_0 \in [\tau_0^\Omega, \overline{\tau}_0]$.

Let us now consider the case of fiscal competition. In the second stage, governments determine their fiscal policies as in the benchmark analysis. Note that country B's most generous fiscal policy is the same as in the benchmark case because no local firms exist, and the consumer surplus and costs of public investments are the sole interests that are independent of country C. In country

A, the most generous fiscal policy is associated with country C because local firm L makes profits from the country. This it is computed as:

$$W_A^A - W_A^B \geq 0 \iff s_A \leq \underbrace{\frac{\tau(4a-9\tau)}{18}}_{=\bar{s}_A} + \left(\underbrace{-\frac{(k_A - k_B)(2a - 3\tau_{AC} + \tau_{BC})}{9}}_{\equiv \bar{s}_A^{\Omega} \ (-\text{:Fierce market competition effect})} \right).$$

The second term is new and is negative when $k_A > k_B$. With larger public investments in country A and lower trade costs, firm L has a cost advantage over firm M if the location of firm M is in B. This means that country A has additional hesitation to attract firm M in the presence of a neighboring country.

Given the new most generous fiscal policies, we can determine the condition under which firm M chooses to locate in country B as:

$$\pi_M^B - \pi_M^A = \Omega + \Omega_{BC} + (\bar{s}_B - \bar{s}_A - \bar{s}_A^{\Omega}) = \Omega + \Omega_{BC} + \underbrace{(\bar{s}_B - \bar{s}_A)}_{+} + \underbrace{(-\bar{s}_A^{\Omega})}_{+}$$

This means that country B is more likely to attract firm M because country A is hesitant to attract firm M if public investment does not change significantly.

Similar to the case without fiscal competition, suppose $\Omega + \Omega_{BC} > 0$ for a while and firm M is located in country B. Given this possibility, the equilibrium fiscal policy in B is $s_B^* = -\Omega - \Omega_{BC} + \bar{s}_A$. The first-order condition in country A remains unchanged compared to the case without fiscal competition, but the welfare function in country B is $W_B^B = CS_B^B - s_B - \frac{\gamma k_B^2}{2}$ and the first-order condition in B is

$$\begin{aligned}\frac{\partial W_B^B}{\partial k_B} &= \frac{2a-\tau}{9} + \left(\frac{8\tau}{9} - \frac{2a-9\tau}{9}\right) \\ &\quad - \underbrace{\left(\frac{k_A - k_B}{9} - \frac{a - \tau_{BC}}{9}\right)}_{\frac{\partial \Omega_{BC}}{\partial k_B}} - \underbrace{\left(\frac{k_A - k_B}{9} + \frac{2a - 3\tau_{AC} + \tau_{BC}}{9}\right)}_{\frac{\partial \bar{s}_A^{\Omega}}{\partial k_B}} - \gamma k_B = 0 \\ \Rightarrow &\ \frac{2a-\tau}{9} + \left(\frac{8\tau}{9} - \frac{2a-9\tau}{9}\right) - \underbrace{\frac{a - 2\tau_{AC} + \tau_{BC}}{9}}_{+\ (\because x_{CL}^B > 0)} - \frac{k_A - k_B}{3} - \gamma k_B = 0\end{aligned}$$

This implies that the marginal benefit from an increase in k_B decreases in the presence of fiscal competition if $k_A > k_B$ holds, and both countries' investment levels shrink because of complementarity.[38] This is because larger investments in country B reduce the trade costs of firm M

[38] The new first-order conditions provide the following optimal investment levels,

$$\widehat{k}_A^C = \frac{2(36\gamma - 91)a - 5(27\gamma - 56)\tau_0}{3(3\gamma - 11)(9\gamma - 14)}, \qquad \text{and} \qquad \widehat{k}_B^C = \frac{2(27\gamma - 17)a - 10(18\gamma - 23)\tau_0}{3(3\gamma - 11)(9\gamma - 14)}$$

and we have $k_A^C - k_B^C = \frac{2(9\gamma - 74)a + 5(9\gamma + 10)\tau_0}{3(3\gamma - 11)(9\gamma - 14)}$ which is positive when γ is sufficiently large.

from country B to country C and make the government in country A hesitant to attract firm M. Therefore, country A regards consumer gains as a more important welfare effect and can increase its most generous fiscal policy, forcing country B to increase its equilibrium subsidy.

Therefore, once we consider a third country in the region, it is ambiguous whether fiscal competition increases public investments. If the role of the third country in the competing region is small, owing to a small market or relatively geographically isolated location in the region, the effects in the benchmark analysis are dominant, and our results should hold.

G Export-spurring investments in transport infrastructure

We modify the formulation of the total unit transport cost from country i to country j as follows:.

$$\tau_{ij} = \tau_0 - k_i - (1-\eta)k_j \quad i \neq j = A, B.$$

In the final stage, the Cournot outcomes are

$$x_{MA}^B = \frac{a-2\tau_{BA}}{3}, \quad x_{MB}^B = \frac{a+\tau_{AB}}{3}, \quad x_{LA}^B = \frac{a+\tau_{BA}}{3}, \quad x_{LB}^B = \frac{a-2\tau_{AB}}{3}$$
$$x_{MA}^A = \frac{a}{3} = x_{LA}^A, \quad x_{MB}^A = \frac{a-\tau_{AB}}{3} = x_{LB}^A.$$

Unlike the benchmark analysis, the location choice of firm M depends on the level of public investment and the type of investment η. Under no fiscal competition, this is characterized by

$$\pi_M^{B*} - \pi_M^{A*}|_{s^A=s^B=0} = \frac{4}{9}\Big(\tau_{AB}^2 + a(\tau_{AB}-\tau_{BA})\Big) = \frac{4}{9}\Big(\tau_{AB}^2 + a\eta(k_B-k_A)\Big).$$

This implies that the location of firm M depends on the difference in transportation costs $\tau_{AB}-\tau_{BA}$. From the definition of transportation costs, a higher level of public investment in country B rather than in country A reinforces the incentive to locate in country B. To simplify our comparison with the main findings, we assume that $\alpha = 1$, $\gamma = 4$, and $\tau_0 = \frac{1}{4}$ which leads to firm M's location in B irrespective of fiscal competition.

Under no fiscal competition for any η, we obtain $\pi_M^{B*} - \pi_M^{A*}|_{s^A=s^B=0} > 0$, and firm M enters country B as in the benchmark case. The public investment levels are as follows:

$$\tilde{k}_A^B = \frac{84 - \eta\{13 + (-26+\eta)\eta\}}{4[288 + (-2+\eta)\eta\{-47+(-2+\eta)\eta\}]},$$
$$\tilde{k}_B^B = \frac{(1-\eta)\{60 - \eta(-15+7\eta)\}}{4[288 + (-2+\eta)\eta\{-47+(-2+\eta)\eta\}]}.$$

By contrast, under fiscal competition, firm M chooses to enter country B if and only if $\pi_M^{B*} - \pi_M^{A*}|_{s^A=0,s^B=s_B^*} > 0$ for $0.122185 < \eta < 0.561274$. Therefore, within this range of η, fiscal competition does not influence the location choice of firm M. The public investment levels are

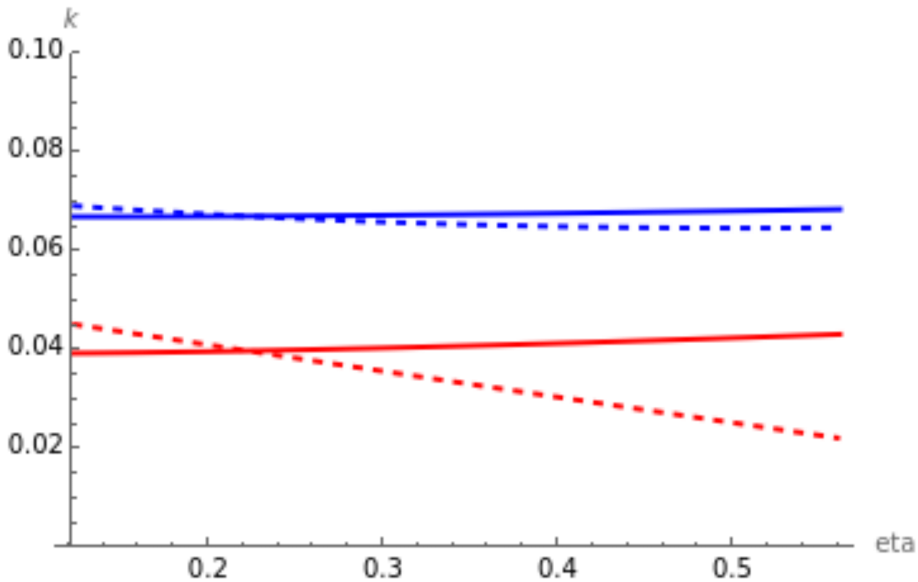

Figure 6: Equilibrium investment level

as follows:

$$\hat{k}_A^B = \frac{68 + \eta\{223 - 7\eta(10 + 3\eta)\}}{28[36 + (2 - \eta)\eta\{61 + 3(2 - \eta)\eta\}]},$$
$$\hat{k}_B^B = \frac{40 + \eta\{127 - 3\eta(2 + 7\eta)\}}{28[36 + (2 - \eta)\eta\{61 + 3(2 - \eta)\eta\}]}.$$

Considering the difference in public investment between the no fiscal competition and fiscal competition cases yields $\tilde{k}_i^B - \hat{k}_i^B > 0$ for $i = A, B$ if $\eta < 0.222433$, and otherwise $\tilde{k}_i^B - \hat{k}_i^B > 0$ for $i = A, B$. Therefore, fiscal competition reduces investments in both countries under a low η, which corresponds to the case with a large τ_0^k in Figure 4; fiscal competition increases investments when public investments are more export-spurring. In Figure 6, the dot-dashed lines indicate the equilibrium public investment level of a no fiscal competition case, whereas the solid lines illustrate that of a fiscal competition case. When $\eta = 0$, the solid lines lie below the dot-dashed lines, consistent with Figure 4 for $\tau_0 = \frac{1}{4}$. If $\eta > 0.222433$, the opposite results are observed and the solid lines lie above the dot-dashed lines.

This finding indicates another policy implication, that export-spurring investments tend to result in fiscal competition that induces more public investments globally. In the benchmark analysis, we find that sufficiently low infrastructure-independent trade costs are important for welfare improvement. However, under a wave of anti-trade liberalization, such as anti-dumping protections, accelerating trade liberalization is difficult to pursue. However, even in such cases, countries can avoid investment-shrinking fiscal competition by designing international rules that allow for fiscal competition only when they compete in export-spurring public investments.

References

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