Appendices to
Regional Integration, Subsidy Competition and the Relocation Choice of MNCs.

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Appendix $A1$: Proof of Proposition 1

Consider the following set of conditions.

1. $s_A^{opt}C \geq s'_A$
2. $W_A(s_A^{opt}U, s_B^{opt}U, U) \geq W_A(s_A^{opt}C, C)$
3. $W_A(s_A^{opt}U, s_B^{opt}U, U) \geq W_A(s'_A, C)$
4. $\Pi(s_A^{opt}U, s_B^{opt}U, U) > \Pi(s_A^{opt}U, s_B^{opt}U, C)$
5. $s_A^{opt}U \leq s'_A$
6. $W_A(s'_A, \widetilde{s_B}(s'_A), U) \geq W_A(s'_A + \epsilon, C)$

We will show that these conditions are logically sufficient to characterise the equilibrium of the subsidy game, using the diagram in Figure $A1$:

The above mentioned seven conditions fully characterize best-reply functions and their intersections in $\{s_A,\ s_B\}$ space. The tree diagram follows from careful inspection of all possible intersections.

We pause now to give some intuition on Proposition 1 and the determination of equilibria in the subsidy game.

The most important condition is Condition 1, that determines whether Concentration/relocation with optimal subsidies for country A is acceptable to country B. In this model, governments will generally compete for investment, since the social benefit to the MNC's presence is higher consumer surplus plus a share of profits. However, Concentration/relocation may be a good option for the 'losing' country if it implies large efficiency gains that are passed through to the consumers, and

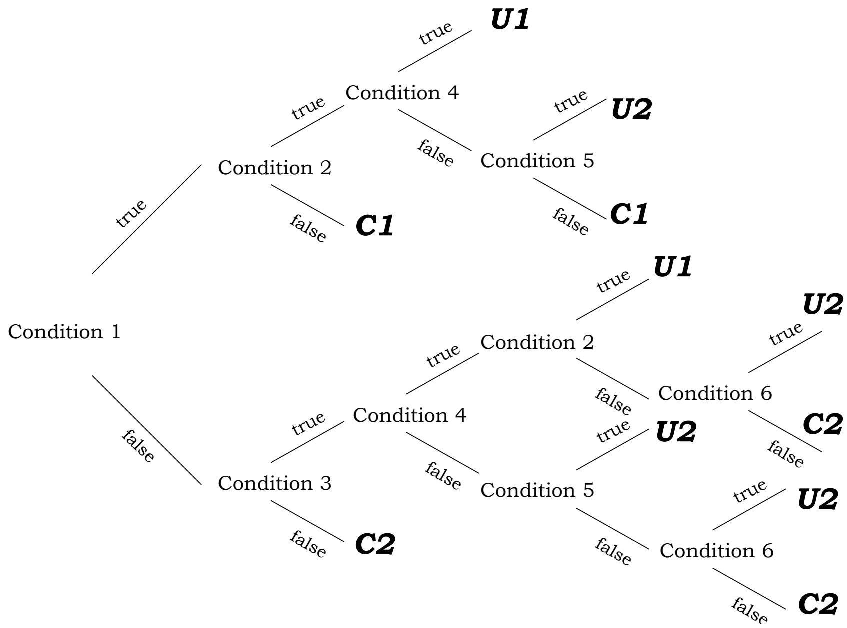

Figure A1: Conditions 1-6 and the existence of equilibrium

ultimately depends on the amount of subsidy spent by the 'winning' government. Hence the role of s'_A. In graphical terms, this means that government B's best-reply schedule will always have a vertical component. To summarize, Condition 1 tells us where governments' best-reply curves intersect in the subspace where Concentration obtains.

When Condition 1 holds, then either government A may not increase welfare under Concentration (Condition 2 does not hold and we have the simple C1 equilibrium), or government A may reach a higher welfare level under Ubiquity, despite higher subsidies from the rival government (U2 equilibrium). When Condition 1 does not hold, then a C1 equilibrium is not possible, but all other types of equilibria exist, depending on government A's comparison between welfare under Concentration with suboptimal subsidization, and welfare under Ubiquity. Table $A1$ displays Conditions $1-6$ expressed in parameter values.

In this proof, we will go through some steps to characterize necessary conditions for the existence of qualitatively different types of equilibria.

U1 equilibrium $(s_A^{opt}U, s_B^{opt}U, U)$

- **MNC**

Table A1: Conditions for existence of different equilibria in the Subsidy Game expressed in parameter values

No.	Condition
1	$t \geq \frac{\frac{(D-\alpha_B)(7-4\phi)}{\sqrt{3-2\phi}} - 2(D-\alpha_A)}{1-\phi}$
2	$t \geq \frac{2\sqrt{\frac{(D-\alpha_A)^2(1-2\phi)^2(7-4\phi)}{12-8\phi}} - 3(D-\alpha_A)}{2\phi^2-3\phi-2}$
3	$\frac{1}{2}\frac{(D-\alpha_A)^2}{3-2\phi} \geq (\frac{1}{2}+\phi)(\Omega(t)-\frac{t}{2})^2 - (\Omega(t)-\frac{t}{2})(2\Omega(t)-(D-\alpha_A)-t)$ where $\Omega(t) = \sqrt{\frac{(D-\alpha_B)^2}{3-2\phi} + t^2}$
4	$t \geq \frac{2}{3-2\phi}(\alpha_B - \alpha_A)$
5	$D - \alpha_A \leq \sqrt{3-2\phi}(D-\alpha_B)$
6	$t \geq \frac{2(D-\alpha_A)(3-2\phi) - \sqrt{4-(D-\alpha_A)^2(3-2\phi)^2 - 16(D-\alpha_a)^2(3-s\phi)^2(1-\phi)\phi}}{2(3-2\phi)^2\phi}$
	$t \leq \frac{2(D-\alpha_A)(3-2\phi) + \sqrt{4-(D-\alpha_A)^2(3-2\phi)^2 - 16(D-\alpha_a)^2(3-s\phi)^2(1-\phi)\phi}}{2(3-2\phi)^2\phi}$

By backward induction, it must be optimal for the MNC to choose U in the second stage, i.e. given these subsidies, Ubiquity profits must be higher than Concentration profits. Hence Condition 4 :

$$\Pi(s_A^{opt}U, s_B^{opt}U, U) > \Pi(s_A^{opt}U, s_B^{opt}U, C) \qquad \text{(Condition 4)}$$

Under this condition, choosing Ubiquity indeed maximises the MNC's second-stage payoff. But when does our candidate equilibrium belong to governments' best replies ?

- **Government A**

Let us start with government A, facing $s_B^{opt}U$. By construction, no subsidy conducive to Ubiquity could dominate this candidate equilibrium subsidy. Recall now that s'_A is the exact subsidy from A that makes government B indifferent between Concentration and $U1$ Ubiquity. In order to induce Concentration, Government A could thus offer a subsidy equal to $\max\{s'_A, s_A^{opt}C\}$, knowing that it will be unmatched by the rival government. We should now check whether this strategy pays off more for A than the candidate equilibrium strategy. If not, then against $s_B^{opt}U$ no other subsidy may dominate the candidate equilibrium subsidy. To achieve this, we first need to examine Condition 1:

$$s_A^{opt}C \geq s'_A \qquad \text{(Condition 1)}$$

If Condition 1 is met, then for $U1$ to be an equilibrium it is necessary that the following condition, Condition 2, hold :

$$W_A(s_A^{opt}U, s_B^{opt}U, U) \geq W_A(s_A^{opt}C, C) \qquad \text{(Condition 2)}$$

If, to the contrary, Condition 1 is not met, then for $U1$ to be an equilibrium it is still necessary that Condition 2 be met, and also that the following condition, Condition 3, hold

$$W_A(s_A^{opt}U, s_B^{opt}U, U) \geq W_A(s'_A, C) \qquad \text{(Condition 3)}$$

Conditions 2 and 3 ensure that against $s_B^{opt}U$, no subsidy conducive to Concentration (even outside the equilibrium set) may be preferred by government A. Hence under these conditions the candidate equilibrium subsidy is government A's best-reply to $s_B^{opt}U$.

- **Government B**

To complete the proof of existence of equilibrium $U1$, we need to examine government B's best-reply to $s_A^{opt}U$. Again, by construction, $s_B^{opt}U$ dominates any other subsidy conducive to Ubiquity. It must therefore be checked that setting an s_B conducive to Concentration, against $s_A^{opt}U$, does not yield a higher payoff.

This simply amounts to Condition 5 (recall that it is implied by Condition 4):

$$s_A^{opt}U \leq s'_A \qquad \text{(Condition 5)}$$

Hence, if either Conditions 4, 2 and 1 are met, or Conditions 4, 2 and 3 are met and 1 is not met, then a $U1$ equilibrium also exists.

$C1$ equilibrium $(s_A^{opt}C, \emptyset, C)$

- **MNC**

The MNC will choose Concentration with subsidy $s_A^{opt}C$ if country B's subsidy is below the profit indifference level. This obviously depends on government B deciding to post a subsidy consistent with this location choice.

- **Government B**

Since the sub-game between governments is simultaneous, a $C1$ equilibrium only obtains whenever government B is better off with Concentration at government A's equilibrium subsidy level, i.e. $s_A^{opt}C$ is sufficient for government B to prefer Concentration. Hence the necessity of Condition 1:

$$s_A^{opt}C \geq s'_A \qquad \text{(Condition 1)}$$

- **Government A**

For $C1$ to be an equilibrium it is sufficient that Condition 2 does not hold, since then the candidate equilibrium subsidy payoff-dominates all other subsidies conducive to either Concentration (by construction) or Ubiquity (by the Condition). However, this condition is not necessary. Whenever Condition 2 holds, it is sufficient that Condition 5 fails to hold for a $C1$ equilibrium to occur. Indeed, the invalidity of Condition 5 implies that against $s_A^{opt}U$ government B will always choose s_B so as to induce Concentration. Given that Concentration with $s_A^{opt}C$ is feasible, it must be government A's best reply.

$C2$ equilibrium[1] $(s'_A, \emptyset, C)$

A $C2$ equilibrium obtains when a subsidy higher than $s_A^{opt}C$ is necessary to make government B accept Concentration. Obviously, A would prefer it to be the smallest amount required by B not to 'compete', hence we may talk about a limit-subsidy equilibrium. Given our assumption that Ubiquity should be the status quo location in case of equal profits, it is sufficient for government A to offer an infinitesimal quantity over the limit subsidy to secure location of the MNC.[2]

For the MNC, as in the previous subsection, s_B must be sufficiently low for the MNC to choose Concentration. Rather straightforwardly, for government B, Condition 1 must be invalid for a $C2$ equilibrium to exist else the $C1$ subsidy would be available for and preferred by A. Examining government A's best-reply strategy, we find that the invalidity of Condition 3 rules out any subsidy leading to Ubiquity, as the candidate subsidy must payoff-dominate it. Alternatively, when Condition 3 is met, the invalidity of Condition 6 guarantees that the limit-subsidy strategy be payoff-dominant. Hence, a $C2$ (limit-subsidy) equilibrium exists whenever Conditions 1 and 3 are not

[1] To save space, we will refer to Conditions $1-6$ as presented in Table $A1$.

[2] In the next section, we will consider that this infinitesimal amount tends to zero in our calculations.

met, or whenever Conditions 1 and 6 are not met but Condition 3 is met, excluding the above-mentioned $U1$ equilibrium.

$U2$ equilibrium $(s_A^{opt}U, \widetilde{s_B}(s_A^{opt}U), U)$

Loosely speaking, a $U2$ equilibrium obtains when government A reaches a high level of welfare with Ubiquity and government B is able to 'compete' for high enough amounts of subsidies. This results in government B offering the exact amount of subsidy that leads to the status quo (Ubiquity, by assumption).

Formally, a $U2$ equilibrium occurs whenever it is in both governments' interest to offer subsidy levels that exactly induce the MNC to keep the status quo, i.e. on the profit indifference line. First consider the case where Condition 1 is met. Condition 5 being true implies a ranking of the three reference subsidy levels. If Condition 4 is false, then the $U1$ equilibrium is not feasible, but if Condition 2 holds, then by continuity government A's best-reply curve should intersect with government B's on the profit indifference line. This result derives from the shape of government B's best-reply function, as explained in the main text. Now consider the case when Condition 1 is not met. As explained before, Condition 3 rules out one instance of the $C2$ equilibrium. Suppose first that Condition 4 does not hold, implying that neither $U1$ nor $C1$ is feasible. Then by a continuity argument again, government A's best-reply must have a 'knife-edge' shape, lying on the profit indifference curve or away by an infinitesimal amount (inducing Concentration). Condition 6 then ensures that a $U2$ equilibrium is reached.

Lastly, suppose that Condition 4 holds, namely that a $U1$ equilibrium would be feasible for the firm but does not exist. Notice that Condition 4 implies Condition 5 (the reciprocal is not true). If Condition 2 fails to hold, government A will not be satisfied with $U1$, hence playing again along the profit indifference line, therefore Condition 6 will again determine which equilibrium will occur.

To summarize, a $U2$ equilibrium occurs when Conditions 1, 2 and 5, but not 4, are met ; or, when Conditions 1 and 2 are not met, but 4, 3 and 6 are met ; or when Conditions 1, 4 and 5 are not met, but 3 and 6 are met ; or else when Conditions 1 and 4 are not met, but 3 and 5 are met. All these cases exhibit rivalry between the two governments, as government B is not willing to settle for Concentration, and government A has to offer more than it would without competition.

Appendix $A2$: MNC Location under Perfect Integration

In this appendix, we establish the MNC location choice for the 3 types of regional integration.

From Table 1, we know the MNC regional profits. The location decision of the MNC amounts to choosing R such that $\Pi = Max(\Pi_U, \Pi_C)$

Harmonization

Let's begin by considering the case of harmonization ($s_A = s_B = 0$). We need to show is that regional integration involves a new location by the MNC so as to run a single subsidiary (regime C). To see this, define, for simplicity, $a = D - \alpha_A$ and $b = D - \alpha_B$. $\Pi_U = \frac{1-\phi}{4}[a^2 + b^2]$, and $\Pi_C = \frac{1-\phi}{4}[a^2 + (a-t)^2]$. Let us call χ the profit differential ($\Pi_U - \Pi_C$). Then $\chi = b^2 - (a-t)^2$. Observe that χ increases with t so that, for sufficiently high values of t, χ is positive (U is preferred by the MNC). When t decreases, the chances for a MNC to choose Concentration increase. Consider now the extreme case of full integration. In such a case, $\chi = b^2 - a^2$. Note that $a > b$ and therefore $\chi < 0$ which implies that the preferred location regime will be Concentration.

Regional Subsidies

Let's proceed now with the limit case of governments coordinating on subsidy levels that maximize regional welfare, replicating the decision of a fictitious regional social planner. Consistent with our framework, the timing of the game is now the following:

- first, the fictitious regional planner sets s_A and s_B
- second, the MNC chooses a location

Notice that the social planner may always set $s_B^{reg}(C)$ so as to induce the MNC to choose Concentration with the desired $s_A^{reg}(C)$. Hence any candidate equilibrium subsidy pair should be compared to the one leading to a welfare maximum under Concentration. For a start, let us determine 'regionally optimal subsidies', i.e. subsidies that maximize the *sum* of both national welfare functions conditional on the MNC choosing a given location. We obtain

$$
\begin{aligned}
s_A^{reg}(U) &= \frac{2\phi - 1}{3 - 2\phi}(D - \alpha_A) \\
s_B^{reg}(U) &= \frac{2\phi - 1}{3 - 2\phi}(D - \alpha_B) \\
s_A^{reg}(U) &= \frac{2\phi - 1}{3 - 2\phi}(D - \alpha_A) + \frac{t}{2}
\end{aligned}
$$

with obvious notations. It is easy to check that such subsidies bring prices down to marginal cost, totally removing the market power inefficiency. For $\{s_A^{reg}(C), 0, C\}$ to be the equilibrium triplet, it must hold that it welfare-dominates $\{s_A^{reg}(U), s_B^{reg}(U), U\}$, let alone any other subsidy pair under Ubiquity. This is true whenever

$$
\widetilde{t} < \frac{2\sqrt{2}\sqrt{(\alpha_A^2 - \alpha_B^2) + D(\alpha_B - \alpha_A)}}{3 - 2\phi}
$$

It is easy to see that for any $t \leq \widetilde{t}$ Concentration will be the prevailing equilibrium. To check that Ubiquity is indeed an equilibrium we need to verify that the MNC will choose Ubiquity when receiving $s_A^{reg}(U), s_B^{reg}(U)$. Put another way, we need to show that $\Pi_U(s_A^{reg}(U), s_B^{reg}(U)) - \Pi_C(s_A^{reg}(U), t) \geq 0$ for $t > \widetilde{t}$ which is clear after simple inspection. Summarizing, in the absence of trade within the region, the prevailing equilibrium is $U1$. Under perfect integration, $C1$ prevails.

Subsidy Competition

To establish location regime in the case of subsidy competition in an integrated region, we need to evaluate Conditions $1 - 6$ for $t = 0$. We normalize for commodity $\phi = 0$ when repatriation is high, $\phi = 1$ when repatriation is low. At this point, it is also technically convenient and innocuous to assume $\alpha_A = 0$. Recall that $\alpha_B > 0$.

Using Tables 1 and 2, and Figure $A1$, straightforward calculations show that:

- When repatriation is high, Condition 1 is satisfied for $\alpha_B > \frac{D}{2}$. In this particular case, as Condition 2 is never satisfied independently of repatriation, the prevailing equilibrium is $C1$.

- In all other cases, Condition 1 is never satisfied. Note that, for all values of ϕ, Condition 3 holds and Condition 4 is never satisfied. When repatriation is high, Condition 5 holds. When repatriation is low, Condition 5 is not satisfied while Condition 6 is satisfied. Both situations correspond to U2 as the prevailing equilibrium.

Appendix $A3$: Harmonization as a Policy Option

We start by the case where the prevailing equilibrium under full integration is $U2$. In this case, country A offers $s_A^{opt}(U)$ and country B offers $\widetilde{s_B}(s_A^{opt}(U))$. Conversely, the equilibrium associated with harmonization is $C1$. Define $\Delta = W^{reg}(C,0,t) - W^{reg}(U, s_A^{opt}(U), \widetilde{s_B}(s_A^{opt}(U)))$ as the difference in regional welfare with harmonization and subsidy competition. Recalling that $\alpha_A = 0$ and $\alpha_B > 0$, we obtain

$$\Delta = \frac{D(4\alpha_B - D(1-2\phi)^2)}{12 - 8\phi}$$

Observe that Δ is positive for $\alpha_B > \frac{1}{4}D(1-2\phi)^2$. This means that for sufficiently high levels of regional asymmetry, harmonization dominates subsidy competition. How high ϕ must be, depends on the level of repatriation. For intermediate levels of ϕ (i.e. $\phi = \frac{1}{2}$) this result holds even for tiny differences between the countries. For extreme values of ϕ, harmonization dominates subsidy competition for intermediate levels of regional asymmetry. Note that for low repatriation $U2$ is always obtained and therefore this condition always holds. For the case of high repatriation we need the additional condition that guarantees $U2$ be an equilibrium ($\alpha_B < \frac{D}{2}$). This implies that when repatriation is high, subsidy competition reduces regional welfare for $\alpha_B \in [\frac{1}{4}D(1-2\phi)^2, \frac{D}{2}]$.

In the case where subsidy competition does not prevent relocation, subsidy competition dominates harmonization for, by construction, subsidies are optimal.

Appendix $A4$: Net Gains from Trade

We know so far that the reduction of regional tariffs may lead to an excess of subsidization.

In the case under which subsidy competition prevents the region from enjoying gains from trade, the effect of integration consists in a switch from a $U1$ to a $U2$ equilibrium. Simple investigation of regional welfare under both equilibria shows that reducing trade barriers within the region reduces welfare ($W^{reg}(U, s_A^{opt}(U), s_B^{opt}(U)) - W^{reg}(U, s_A^{opt}(U), \widetilde{s_B}(s_A^{opt}(U))) = \frac{\alpha_B^2}{6-4\phi}$, which is always positive).

Appendix $A5$: Gains from Trade and Coordination

We prove here the first part of Proposition 3. First, a brief inspection of nationally and regionally optimal subsidies (Appendix $A2$) shows that they coincide only at a $U1$ equilibrium. Second, regionally optimal subsidies must induce the MNC to choose Ubiquity for U1 to be a subgame-perfect equilibrium. This implies that an analog of Condition 4 with regional subsidies must be met. This analog condition is given by:

$$\Pi(s_A^{reg}U, s_B^{reg}U, U) \geq \Pi(s_A^{reg}U, s_B^{reg}U, C)$$

Define t_1 as the threshold tariff such that the inequality in Condition 4 just holds, and similarly t_2 for the analog condition. Then $t \geq \min\{t_1, t_2\}$ is a sufficient condition to obtain different equilibria under subsidy competition and coordination. Note that it is straightforward to compute these threshold tariffs using Table $A1$ and show that they exceed prohibitively high tariffs. Since regional coordination achieves a regional welfare maximum by assumption, a gain from coordination always occurs for a low enough tariff.

Appendix $A6$: Gains from Coordination and Trade Integration

We prove here the second part of Proposition 3. Recall that at a full-integration subgame-perfect equilibrium, the MNC chooses Ubiquity with $U2$ subsidies. On the contrary, a social planner would prefer Concentration with $C1$ subsidies. The welfare differential between coordination and competition is given by:

$$W^{reg}(s_A^{reg}C, t, C) - W^{reg}(s_A^{opt}U, \widetilde{s_B}(s_A^{opt}(U), U) = \frac{(D-\alpha_A)^2}{3-2\phi} - \frac{3-2\phi}{16}t^2 - \frac{(D-\alpha_A)^2 + (D-\alpha_B)^2}{2(3-2\phi)}$$

Taking the derivatives of these welfare differentials with respect to t yields:

$$\frac{\partial \left[W^{reg}(s_A^{reg}C, t, C) - W^{reg}(s_A^{opt}U, \widetilde{s_B}(s_A^{opt}(U), U)\right]}{\partial t} = -\frac{3-2\phi}{8}t^2 - \frac{\alpha_B - \alpha_A}{2}$$

It is straightforward to see, that evaluated in the neighborhood of a zero tariff, these derivatives are always negative, proving the second part of the Proposition.

Appendix $A7$: Regional MNC

MNC profits are given by:

$$\Pi_U(s_A, s_B) = \frac{1}{4}[(D - \alpha_A + s_A)^2 + (1-\phi)(D - \alpha_B + s_B)^2]$$
$$\Pi_C(s_A, s_B) = \frac{1}{4}[(D - \alpha_A + s_A)^2 + (D - \alpha_A + s_A - t)^2]$$

so that:

$$\widetilde{s_A}(s_B) = \left(\sqrt{1-\phi}\right) s_B - (D - \alpha_A) + (\sqrt{1-\phi})\,(D - \alpha_B) + t$$

Table A2 displays welfare functions.

Table A2: Welfare functions in the case of a regional MNC.

Country	Loc.	Welfare		
		CS	PS	GS
A	U	$\frac{1}{2}(\frac{D-\alpha_A+s_A}{2})^2$	$(\frac{D-\alpha_A+s_A}{2})^2 + [1-\phi](\frac{D-\alpha_B+s_B}{2})^2$	$-s_A(\frac{D-\alpha_A+s_A}{2})$
A	C	$\frac{1}{2}(\frac{D-\alpha_A+s_A}{2})^2$	$(\frac{D-\alpha_A+s_A}{2})^2 + (\frac{D-\alpha_A+s_A-t}{2})^2$	$-s_A(\frac{2A-2\alpha_A+2s_A-t}{2})$
B	U	$\frac{1}{2}(\frac{D-\alpha_B+s_B}{2})^2$	$\phi(\frac{D-\alpha_B+s_B}{2})^2$	$-s_B(\frac{D-\alpha_B+s_B}{2})$
B	C	$\frac{1}{2}(\frac{D-\alpha_A+s_A-t}{2})^2$	0	$t(\frac{D-\alpha_A+s_A-t}{2})$

Table A3 expresses Conditions (1)-(6) at $t = 0$ in the regional MNC case. Only Conditions 1 and 6 are satisfied when repatriation is high ($\phi = 0$), implying the equilibrium is $C1$. When repatriation is low ($\phi = 1$), the validity of Condition 1 depends on regional asymmetry. If $\alpha_B < \frac{D}{3}$ Condition 1 is not satisfied and therefore the equilibrium is $C2$. The prevailing equilibrium is $C1$ otherwise.

Table A3: Conditions for existence of different equilibria in the Subsidy Game expressed in parameter values.

No.	Condition
1	$\frac{2}{3}(D-\alpha_A) \leq \frac{D-\alpha_B}{\sqrt{3-2\phi}}$
2	$t \leq D-\alpha_A - \sqrt{\frac{1}{3}(D-\alpha_A)^2 + 4\frac{(D-\alpha_B)^2(1-\phi)}{(3-2\phi)^2}}$
3	$\frac{1}{2}(D-\alpha_A)^2 + (1-\phi)(\frac{D-\alpha_B}{3-2\phi})^2 \geq \frac{3}{2}(\Omega(t)-\frac{t}{2})^2 - (\Omega(t)-\frac{t}{2})(2\Omega(t)-(D-\alpha_A)-t)$
	where $\Omega(t) = \sqrt{\frac{(D-\alpha_B)^2}{3-2\phi} + t^2}$
4	$t \geq 2(D-\alpha_A) - \frac{2\sqrt{1-\phi}}{3-2\phi}(D-\alpha_B)$
5	$D-\alpha_A \leq \frac{D-\alpha_B}{\sqrt{3-2\phi}}$
6	$t \leq \frac{(2D-\alpha_A-\sqrt{1-\phi}(\alpha_B-1))^2}{2D-\alpha_A-2\sqrt{1-\phi}(\alpha_B-1)}$

We can identify the value of ϕ that is sufficient to make the region switch to a $C2$ equilibrium. As Conditions 3 and 2 are never satisfied, we simply have to find the value of ϕ that makes Condition 1 be satisfied.[3] Simple inspection of Condition 1 at $t=0$ shows that this condition is satisfied whenever $\phi < \frac{3(D^2+6D\alpha_B-3\alpha_B^2)}{8A^2}$. For instance in a region made up of similar countries, Condition 1 would be satisfied for $\phi > \frac{3}{8}$. With greater regional asymmetry, the existence of a $C2$ equilibrium, and therefore of excessive subsidization, depends on lower levels of repatriation.

Let us now evaluate the gains from regional trade integration. Given location outcomes, they amount to:

$$W^{reg}(C, s_A^{opt}(C), 0) \geq W^{reg}(U, s_A^{opt}(U), s_B^{opt}(U)) \text{for high repatriation} \quad (1)$$

$$W^{reg}(C, s'_A, 0) \geq W^{reg}(U, s_A^{opt}(U), s_B^{opt}(U)) \text{for low repatriation} \quad (2)$$

In other words, we must sign the following expressions:

- $\Delta_4 = W^{reg}(U, s_A^{opt}(U), s_B^{opt}(U))$-$W^{reg}(C, s'_A, 0)$ for low repatriation and $\alpha_B \leq \frac{D}{3}$
- $\Delta_5 = W^{reg}(U, s_A^{opt}(U), s_B^{opt}(U))$-$W^{reg}(C, s_A^{opt}(C), 0)$ otherwise

Note that s'_A is evaluated at a zero tariff. Simple calculations yield:

- $\Delta_4 = \frac{1}{2}(4D^2 - 4A\sqrt{(D-\alpha_B)^2} - 6D\alpha_B + 3\alpha_B^2)$

[3] Remember from our previous discussion (see Figure A1) that should this happen, the prevailing equilibrium would be $C1$.

- $\Delta_{5a} = \frac{5\alpha_B^2 - 10\alpha_B D - 2D^2}{18}$ for a high repatriation rate and
- $\Delta_{5b} = \frac{D^2}{9} - D\alpha_B + \frac{\alpha_B^2}{2}$ for the special case of low repatriation and $\alpha_B > \frac{D}{3}$

which are always negative.

Finally, we evaluate the derivative of the gain from coordination with respect to t in the neighborhood of zero.

When $C1$ is an equilibrium, the gain from coordination is given by

$$\frac{\partial \left[W^{reg}(s_A^{reg}C, t, C) - W^{reg}(s_A^{opt}C, t, C) \right]}{\partial t} = \frac{D - \alpha_D}{6} + \frac{t}{4}$$

which is positive at any relevant value of t, and in particular at $t = 0$.

When $C2$ is an equilibrium, the gain from coordination is given by a similar though substantially more cumbersome calculation. We display here the value of this derivative at the neighbourhood of a zero tariff.

$$\frac{\partial \left[W^{reg}(s_A^{reg}C, t, C) - W^{reg}(s_A^{opt}C, t, C) \right]}{\partial t} = \frac{3\left((D - \alpha_A)\sqrt{3 - 2\phi} - (D - \alpha_B) \right)}{2\sqrt{3 - 2\phi}}$$

which is strictly positive.

Hence potential tariff increases from full integration may cause higher gains from coordination, suggesting that the maximum gain occurs at a positive tariff level.