Subsidy competition and the Mode of FDI: Acquisition vs Greenfield*

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Abstract

We model subsidy competition for a foreign MNC's investment in a two-country PTA. Taking into account acquisitions as an alternative investment mode weakens the case for subsidising greenfield investment, even for a single government. Competition between member states should result in welfare losses, even more so if spillovers from the MNC's presence exist. While our predictions are sensitive to the acquisition price, in many cases a ban on subsidies may increase welfare. In addition, we show how trade integration and increased competition for targets raise the prospects for social waste.

JEL-Classification: F15, F21, F23

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1 Introduction

This paper attempts to fill a gap in the literature dealing with subsidy competition for FDI. Our objective is to give a formal treatment of FDI that has firms considering cross-border acquisitions as an alternative to greenfield investment. In this unified framework, we assess the welfare consequences of incentive-based competition between governments.

Using a conventional subsidy competition model, we show that the alternative of acquisitions may reverse the expected welfare consequences of subsidy competition. As is well-known,

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subsidy competition will reduce welfare by transferring surplus to foreign multinationals, unless it corrects for some misalignment between social and private returns to FDI (see surveys by Wilson, 1999 and Blomström and Kokko, 2003, for example). In our model, subsidies indeed allow the allocation of FDI to the efficient location, but they also distort the investment type towards greenfield FDI, with the large subsidies required often sufficient to reduce regional welfare. Therefore taking cross-border acquisitions into account can dramatically affect the welfare implications of subsidy competition for FDI.

The widespread use of investment incentives to influence MNC location, leading to 'subsidy wars', is now well documented (UNCTAD, 1996; Oman, 2000; Charlton, 2003). These studies report many subsidy wars in emerging and rich countries alike, particularly within regional blocs. Some of the most notable and fierce bidding contests have arisen in the European automobile and semi-conductor industries, while AFTA and Mercosur have been accompanied by increased competition for investment in South East Asia and South America respectively.[1] At the same time, there has also been intense subsidy competition taking place within some large countries, most notably in Brazil, the US, Canada, India and China (see Oman, 2000 for examples).

As well as seeing an increase in total FDI, recent years have also seen cross-border mergers and acquisitions increasing in importance relative to greenfield investment. Calderón *et al.* (2002) report that merger and acquisition activity almost doubled as a percentage of GDP (and increased as a share of total investment) in industrialised countries between the late 1980s and the late 1990s. Meanwhile, in developing countries, mergers and acquisitions were more than nine times as high as a share of GDP compared to 1987-89, whereas the increase in total FDI inflows into these countries was approximately threefold.

Despite this rise in mergers and acquisitions, subsidies have gone exclusively to greenfield investment projects.[2] While this might be partly due to employment effects and other spillovers

[1] European examples include competition leading to heavily subsidised car plants for BMW in Leipzig, Germany in 2001 and Nissan in Sunderland, UK in 2000, while in 2004, AMD was offered $550 million to locate a microchip production facility in Dresden, Germany. In ASEAN, Thailand outbid the Philippines in 1996 to land a $500 million investment from General Motors. More details on these and other examples are provided in the working paper version of this paper, while Oman (2000) and Charlton (2003) offer far more comprehensive discussion.

[2] All the above-cited studies commissioned by the UNCTAD and OECD report subsidy offers to 'landmark'

associated with greenfield investment that are less likely to accrue with acquisitions, it also reflects a certain hostility shown by governments towards foreign firms bidding for domestic rivals. Policy makers often view acquisitions of domestic firms by foreign predators as undesirable, fearing anti-competitive effects of increasingly concentrated ownership by large MNCs while ignoring the possible transfer of improved technology into a country, with potentially beneficial effects for consumers in the region.[3] One possible reason for this is that policy makers do not recognise that acquisitions involve payments to the original owners of the firm, which should compensate them for any lost future profits.

For the sake of our argument it is important to understand that the MNCs may consider greenfield and mergers and acquisitions as substitutable alternative methods of investment. Indeed, there is no reason to think that an MNC would not choose the optimal mode of investment. It is a surprising feature of most of the literature on FDI that it exclusively considers either greenfield or M&A as if the two were independent activities. In this sense, our paper complements a growing literature that investigates the investment choice in equilibrium (Mattoo *et al.*, 2004, Bjorvatn, 2004, Bertrand, 2005, Ferrett, 2005). In our model, the endogenous choice of the investment mode relies upon the existence of domestic firms and their characteristics (i.e. acquisition price and production costs) and the fixed cost associated with greenfield investment.

We attempt to complement existing work on the positive and normative consequences of competition for FDI, by taking into account acquisitions as an alternative to subsidised greenfield investment. To begin with, the tax competition literature, as reviewed by Wilson (1999), predicts that intergovernmental competition for mobile capital should lead to a fiscal 'race to the bottom'. This results in sub-optimally low tax rates and the under-provision of public goods. Applied to subsidy competition for FDI, this reasoning implies that competition can only decrease regional welfare, as surplus is transferred to extra-regional MNCs.

investment projects, i.e. projects of significant size. None of these projects involved mergers or acquisitions. To the best of our knowledge, no investment incentives have been granted to investment projects involving mergers or acquisitions.

[3]Kendall and Ryan (2006) consider the welfare and competition policy implications of international acquisitions. Acquisitions that involve the transfer of technology from a more efficient foreign predator to a domestic target are shown to be welfare-improving for the domestic country.

Importantly, the existence of socially positive externalities to FDI has been put forward as a rationale for offering subsidies. Indeed, subsidies can make investors internalise the wedge between social and private returns to FDI, and direct it to the location where its social return is higher, potentially reversing the location outcome without subsidies, and increasing efficiency. This argument applies to the cases of employment effects (Barros and Cabral, 2000), technological spillovers (Fumagalli 2003), or more generally to any country-specific positive externality associated with MNC operations (Blomström and Kokko, 2003). In a sense, subsidies play the role of a price signal for investors.

The New Economic Geography literature has enriched both the 'race to the bottom' and the 'signal' arguments. First, it has shown that non-cooperative tax levels should depend on geographical advantages such as proximity to a large market or to a pool of suppliers or workers (Haaland and Wooton, 1999, Haufler and Wooton, 1999). Second, it has shown that government subsidies could lead to full agglomeration even in an initially symmetric configuration (Kind, Midelfart-Knarvik and Schjelderup, 2000, Ludema and Wooton, 2000). Agglomeration rents could therefore be 'signalled' by subsidy offers.

Most of the above-cited papers conclude in favour of subsidy competition. Going beyond the pure-transfer paradigm, they emphasise the potential of subsidies to allocate investment more efficiently than in the absence of intervention. This comes either from some socially positive externalities differing across countries, or because subsidies allow a country that enjoys a geographical or technological advantage to capture some of the rents generated by FDI. In the first case, competition can restore allocative efficiency; in the second, competition preserves the efficient location while raising regional welfare.

While our paper shares many theoretical features with the above cited literature, we identify cases where subsidy competition for greenfield investment reduces regional welfare when the alternative of acquisition is available. We show that subsidy competition will be harmful in a number of plausible cases, depending on the fixed costs associated with the investment project. More specifically, for low fixed cost projects, competition reduces regional welfare. For interme-

diate levels of fixed costs, competition is harmful when acquisition costs are above a certain level and beneficial otherwise. For high fixed costs, competition is always beneficial. These results persist even in the presence of positive spillovers from MNC operations: we find that subsidy competition will tend to be harmful for an even greater range of fixed costs.

As in the previous literature, in our model subsidies efficiently allocate FDI in the regional union. However, with the alternative of mergers and acquisitions present, subsidies also distort the investment type towards greenfield FDI. This may increase welfare in some cases, but may also harm member countries when a large subsidy is required to overturn the firm's preferred investment type.

We perform comparative statics of the model to the effects of regional trade integration and of changes in the acquisition price. Indeed, increased subsidy competition has coincided with waves of FDI flows following the creation of trade blocs[4], motivating the first exercise. We therefore try to understand the effects of regional integration on incentive-based competition in our model[5]. We show that regional integration causes a general increase in subsidy expenditure, which tends to lead to increased welfare losses for low fixed cost projects, but this effect is offset when fixed costs are high as beneficial subsidy competition becomes likelier. In a second exercise, we capture fiercer competition between potential buyers as an increase in the acquisition price, towards the pre-entry duopoly profits. This upward pressure on acquisition prices is found to increase the welfare-decreasing potential of subsidy competition.

The rest of this paper is set out as follows. Section 2 sets up the model and considers the case of intervention by a single government. Section 3 characterises equilibria of the subsidy game between the two governments in the region. This allows us to first analyse welfare effects arising purely from changes to market structure and then allow for additional spillover effects of FDI. Section 4 undertakes comparative statics analysis to determine the effects of trade integration

[4]Ethier (1998) argues that attraction of FDI, rather than traditional gains from trade, has been a key motivation for membership in regional unions, consistent with the modest actual extent of trade concessions agreed upon.

[5]Norman and Motta (1993), Motta and Norman (1996) and Neary (2002 and 2004) analyse the impact of regional integration on FDI. Raff (2004) shows that regional PTA formation with profit tax competition can lead to lower external tariffs and a reduction in tax rates. All these papers assume that FDI is greenfield.

and increased competition for targets. Section 5 concludes.

2 The model

The world is assumed to consist of three countries, 1, 2 and 3. Countries 1 and 2 are potential partners in a preferential trade agreement (PTA) while 3 is a foreign country from outside the region. Each country contains a firm, indexed by country: firms 1 and 2 already sell in their own and each others' markets, while firm 3 can choose between greenfield investment and mergers and acquisitions to supply the markets in the two potential PTA partners[6]. The foreign firm is assumed to have a lower marginal cost than the other two firms and can transfer this cost advantage to any plant it buys or establishes in another country.[7]

We consider a three-stage game. In the first stage the two partner governments set policy levels, which are assumed to be lump-sum location taxes/subsidies on the foreign firm, should it choose to invest in either partner country.

In the second stage, the foreign firm chooses how to supply the partner countries. It faces two choices (assuming at least one to be profitable): greenfield FDI, setting up a new plant in either country 1 or 2; or acquiring the existing firm in either country 1 or 2. If it chooses greenfield FDI, it will face a fixed set-up cost and a trade cost for units shipped between countries 1 and 2. If it chooses acquisition, it will also pay this trade cost, plus an acquisition price that depends on the profits of the acquired firm in a way explained below.

In the third stage, all firms remaining in the market sell a homogeneous product under Cournot competition. Markets are segmented, meaning that we can ignore the market in country 3 when analysing the effects of regional integration on countries 1 and 2. We note that, because of their lump-sum nature, subsidies and fixed costs do not affect third-stage production decisions,

[6] In order to concentrate on the choice of investment mode, we rule out the possibility of exports from country 3. To reduce the number of cases that must be considered we also rule out the possibility of buying out both firms.

[7] Unlike Mattoo *et al.* (2004), we do not allow firms to choose the degree of technology transfer, instead we assume the full technological advantage is always transferred.

but only the second-stage investment decisions.[8]

Country i's demand curve is given by

$$p_i = a_i - \sum_j q_{ij} \tag{1}$$

where p_i is the price in country i ($i = 1, 2$) and q_{ij} is firm j ($j = 1, 2, 3$)'s sales in country i. The a_i parameters can be interpreted in various ways. The most literal interpretation is in terms of country sizes, with country 1 larger (smaller) than country 2 for $a_1 > (<) a_2$. However these parameters could also be thought of as representing other factors, such as tastes, which result in differences in demand between countries.

Firm j selling in country i has a marginal cost of c_{ij}, which might consist of two components: a constant marginal cost of $c_j > 1$ for $j = 1, 2$ or 1 for $j = 3$ and a trade cost, due to one or all of transport costs, tariffs or non-tariff barriers, of τ if production takes place outside country i.

The foreign firm (firm 3) has to pay a fixed cost of F if it sets up a new plant in country 1 or 2, but may receive a location subsidy of S_i from government i to locate there.[9]

Firm 3 (the predator) can alternatively acquire either firm 1 or 2 (the targets) and produce in that firm's country, transferring its cost advantage and thus producing with a marginal cost of 1. The cost of acquiring a firm depends on its profitability, but we allow for a range of alternative prices. We follow the literature in considering the reservation price. The highest acquisition price we allow for equals the profits the target firm would make in absence of any investment. However, this does not take into account the fact that their expected profits will fall after greenfield investment. This gives a certain bargaining power to the predator that can be exploited to set a more favorable acquisition price. We consider that the lowest possible acquisition price equals the profits the target will make in the case of greenfield investment. How close the price is to the lowest bound, which is captured below by the parameter α, depends on

[8] This implicitly assumes that firm 3 will continue to supply its own market from its original plant in country 3 rather than shutting that plant down and importing from a plant in country 1 or 2.

[9] This subsidy is constrained to be non-negative, so a lump-sum tax is not possible in this model. We make this assumption as our focus is on competing for investment.

target and predator bargaining strengths, which are assumed to depend on institutional features and the existence of potential buyers, such as an exogenous wave of M&As implying a bidding contest.[10] We formally define the acquisition price below.

In the final output stage, Stage 3, firm j faces the following profit maximisation problem:

$$\max_{q_{ij}} \Pi_j = \sum_i \pi_{ij} = \sum_i (p_i - c_{ij}) q_{ij} \tag{2}$$

This is solved to find Cournot outputs and prices under four different modes of entry by firm 3. These are greenfield FDI and acquisitions in country 1 (denoted $G1$ and $A1$ respectively) or country 2 ($G2$ and $A2$). These outputs and prices are included in Appendix 1.

For each firm selling in each market, profits, net of any fixed costs, lump-sum subsidies or acquisition payments, are equal to $\pi_{ij}^k = (q_{ij}^k)^2$, for $k = \{G1, A1, G2, A2\}$. The acquisition price for the firm in country 1 is given by

$$AqPrice_1 = \alpha \left[\pi_{11}^D + \pi_{21}^D\right] + (1 - \alpha) \left[\pi_{11}^{G1} + \pi_{21}^{G1}\right] \tag{3}$$

where $\pi_{11}^D = \left(\frac{a_1 - 2c_1 + c_2 + \tau}{3}\right)^2$ and $\pi_{21}^D = \left(\frac{a_2 - 2c_1 + c_2 - 2\tau}{3}\right)^2$ are firm 1's duopoly profits in countries 1 and 2 before entry by firm 3. A similar expression exists for the acquisition price of firm 2.

In the absence of government intervention, we derive the following condition for firm 1's profits from greenfield FDI to be greater than those from acquiring the domestic firm:

$$\pi_{11}^{G1} + \pi_{21}^{G1} - F > \pi_{11}^{A1} + \pi_{21}^{A1} - AqPrice_1 \tag{4}$$

From this condition, we derive a positive level of fixed costs $\tilde{F}$ below which the firm will always choose greenfield investment.[11]

[10] While we implicitly consider the value of α to be the result of a bargaining process, this is not the main focus of our paper. Hence, to avoid adding unnecessary complexity, we do not explicitly model the bargaining process.

[11] $\tilde{F}$ is the value of F for which the two sides of condition 4 are equal and is shown always to be positive in the working paper version of this paper. This is equivalent to saying that, for any level of fixed costs, full reimbursement of these costs by an active government would lead to the foreign firm choosing greenfield investment.

We now introduce an active government in country 1.[12] We assume that the government does not set an output tax/subsidy, but only a lump-sum subsidy. Additionally, this subsidy is only ever given for greenfield investment; no acquisition will ever be subsidised, even if this would increase the country's welfare.

In order to consider the incentive the government might have to provide a subsidy, we first need to define the welfare function that the government aims to maximise.[13] The components of welfare differ according to the type of investment by the foreign firm but take the general form

$$W_1^k = CS_1^k + \pi_{11}^k + \pi_{21}^k - S_1^k + AqPrice_1^k \tag{5}$$

for $k = \{G1, A1, G2, A2\}$, where $CS_1^k = (Q_1^k)^2/2$ gives consumer surplus with investment of type k. For all types of investment, CS_1^k is strictly positive, but each of the other terms equals zero in at least one case. Unlike all other cases, $A1$ involves firm 1 being acquired by firm 3, hence $\pi_{11}^{A1} = \pi_{21}^{A1} = 0$, while $AqPrice_1^k = 0$ for $k = \{G1, G2, A2\}$. Only $G1$ might involve a subsidy given by government 1, so $S_1^k = 0$ for $k = \{A1, G2, A2\}$.

2.1 One Active Government

We now consider the case where only the government in country 1 is active. Further, we assume that any investment made by the foreign firm will be in this country. Hence we consider the incentive for government 1 to use a subsidy to change the form of investment and identify cases where the government will offer a sufficiently high subsidy for firm 3 to change its mode of entry from $A1$ to $G1$.

Proposition 1 *In the case where only one government is active and when the foreign firm would otherwise enter by acquisition, the government will be willing to subsidise greenfield investment*

[12] To avoid repetition, we do not define a welfare function for country 2 here, simply noting that it takes the obvious form.

[13] We amend this welfare function to allow for positive spillovers in subsection 3.3.

for sufficiently low acquisition prices. The subsidy required to change the form of investment is equal to $F - \widetilde{F}$.

Proof. See Appendix 2. ■

Comparing welfare in the two cases, country 1 will have higher consumer surplus under $G1$, because of an extra firm in the market, and firm 1 will continue to make profits. Hence only the acquisition price can explain a preference for $A1$. It follows that the government will subsidise greenfield investment when the acquisition price is low, but raising α, and hence the acquisition price, reduces the incentive to offer a subsidy.

At this stage of the analysis, we may already have a preliminary idea of the desirability of subsidies, on welfare grounds. To do this, we compare decisions on the mode and location of FDI, according to the type of intervention, namely: laissez-faire, 'myopic' intervention, in the sense that the possibility of M&A's is neglected, and welfare-maximising. Table 1 displays a comparison of these three situations.

Table 1: Choice of FDI mode and location, according to the type of intervention.

Fixed costs	Intervention		
	Laissez-faire	Myopic	Welfare-maximising
$0 \leq F \leq \tilde{F}$	G1	G1	G1
$\tilde{F} < F \leq W_1^{G1} - W_1^{A1} - \tilde{F}$	A1	G1	G1
$W_1^{G1} - W_1^{A1} - \tilde{F} < F \leq W_1^{G1}$	A1	G1	A1
$F \geq W_1^{G1}$	A1	A1	A1

To summarise, there are ways in which subsidies to FDI may realign private and general interest. First, a $G1$ investment translates into increased total welfare for the host government, relative to $A1$, because of greater competition. That effect is typically not considered by the MNC, therefore it may be considered to be a positive externality and provide a rationale for subsidisation. Refraining from subsidising such investment leads to an excess of acquisition FDI compared to the social optimum (comparing the first and third columns of Table 1). Second,

a 'myopic' government, unaware of the M&A alternative to greenfield FDI, will over-subsidise investment. This will lead to an excess of greenfield FDI (comparing the second and third columns of Table 1). These two misalignments will be important in our welfare analysis of subsidisation, when we tackle subsidy competition in the next section.

3 Subsidy competition

We now introduce two active governments, and solve for the equilibrium of the three-stage game described in the previous section.

3.1 The lump-sum subsidy game

To keep things simple, we focus on a single-plant investment project with rival governments offering lump-sum subsidies. As already explained, we assume away acquisition subsidies. The MNC may now choose between two modes of investment and two locations, maximising profits inclusive of subsidies.

Before we turn to first-stage subsidisation decisions and solve the game by backward induction, we introduce some useful notation. S_1 and S_2 denote the subsidies simultaneously committed to by governments 1 and 2, respectively.[14] θ denotes the investment type (location and mode) belonging to $\{G1, G2, A1, A2\}$, as defined in Section 2.

We denote by $\Delta_{ii'}^{kk'}$ the difference between gross profits (*excluding subsidies*), in location i using mode k and profits in location i' using mode k', with $i, i' \in \{1, 2\}$ and $k, k' \in \{A, G\}$. This allows us to compare the payoffs associated with each investment type more easily. As an illustration, condition (4) may be rewritten as $\Delta_{11}^{GA} > 0$.

In an analogous way, denote by $\chi_{i'i''}^{kk'}(i)$ the difference between gross welfare (*excluding subsidies*) in country i with location i' and mode k, and welfare in country i with location i'' and

[14] We assume credible commitments. In real economic situations, concerns for reputation towards future investors may arguably be enough to discipline governments. However, they remain beyond the scope of our single-investment model.

mode k'. As an illustration, government 1 prefers acquisition at home to greenfield investment in country 2 if $\chi_{12}^{AG}(1) > 0$.

The solution to the three-stage game will be denoted by a *triple* (S_1, S_2, θ). There will be many different solutions to that game, depending on the particular form of welfare and profit functions. We therefore turn to a systematic exploration of all possible subgame-perfect equilibria.

The determination of the equilibrium of the subsidy game will depend on the location choice of the MNC in the absence of subsidisation. This, as in Haufler and Wooton (1999), will depend on the geographical advantage (home market size) enjoyed by one of the two countries. By convention, we suppose that country 1 hosts the MNC when subsidies are zero.[15]

We now state a Proposition determining which equilibrium prevails for general payoff functions. The proof, given in Appendix 3, uses backward induction. In the next subsection, we shall apply this framework to our specific profit and welfare functions.

Proposition 2 (Existence and unicity of the subgame-perfect equilibrium) *There exists a unique equilibrium of the three-stage game. According to social and private preferences over investment types, the equilibrium may belong to one of the following categories:*

1. *Equilibrium 1:* $(\chi_{21}^{GG}(2) - \Delta_{12}^{GG}, 0, G1)$
2. *Equilibrium 2:* $(\Delta_{11}^{AG}, 0, G1)$
3. *Equilibrium 3:* $(0, 0, G1)$
4. *Equilibrium 4:* $(0, 0, A1)$

Proof. See Appendix 3. ■

The first two equilibria involve intervention. In both cases, country 1 is able to outbid the rival country because it enjoys a geographical advantage. However, the amount of subsidy

[15] This simplifies the exposition, allowing us to avoid 'ties' in case of profit indifference. This amounts to labelling country 1 the country where the investment is most profitable. We later assume $a_1 > a_2$, which implies this.

expenditure varies according to the threat posed by the rival country. In Equilibrium 1, country 1 offers a subsidy equal to government 2's willingness to subsidise. By analogy to auctions, government 1 wins the bid by paying the second price. In contrast, in Equilibrium 2, government 1 pays the smallest necessary subsidy to induce greenfield investment by the MNC. In other words, government 2 does not value the investment enough to affect the price paid by government 1. Hence it must only compensate the MNC for the difference in profits across modes.

The last two equilibria involve no intervention. This comes from the fact that no government values greenfield investment at home enough to incur any subsidy expenditure. Which equilibrium occurs depends on the size of the investment project, as measured by fixed costs. Equilibrium 3 will occur for smaller projects, while Equilibrium 4 will for larger ones.

To be able to characterise the prevailing equilibrium for given social and private preferences over investment types, we must specify the amount of fixed costs incurred by a greenfield investor. We introduce the following useful notation:

$$\begin{aligned}
\widetilde{F} &= \Delta_{11}^{GA} + F \\
\widehat{F} &= \chi_{11}^{GA}(1) + \Delta_{11}^{GA} + F \\
F^{*} &= \chi_{12}^{GG}(1) + \Delta_{11}^{GA} + F \\
F^{**} &= \chi_{21}^{GA}(2) + \Delta_{21}^{GA} + F \\
F^{***} &= \chi_{21}^{GG}(2) + \Delta_{21}^{GA} + F
\end{aligned} \tag{6}$$

We also define $\overline{F}$ as an upper bound above which no government intervention occurs.

Using these thresholds, we may now discuss the desirability of subsidy competition between governments for any potential investment project.

3.2 Welfare effects of subsidy competition

Recall from Proposition 2 that not all outcomes of the subsidy game may qualify as 'subsidy competition'. For instance if Equilibrium 3 or Equilibrium 4 prevails, then no intervention should take place. As a first step towards our welfare discussion, we give a characterisation of the prevailing equilibrium. We will then be able to discuss the welfare effects of subsidy competition, when it takes place at the equilibrium of the subsidy game.

Lemma 1 *For a particular investment project, the outcome of the subsidy game will depend on the value of the fixed cost incurred by a greenfield investor.*

- *Low fixed costs ($F < \widetilde{F}$). Equilibrium 1 with subsidy competition obtains, unless country sizes (tastes) are too different, in the sense of Equation (14) (Equilibrium 3 otherwise).*
- *High fixed costs ($F \geq \overline{F}$). For a low acquisition price, Equilibrium 1 obtains for $F \in [\widetilde{F}, F^{***}]$, Equilibrium 2 obtains for $F \in [F^{***}, \overline{F}]$ and equilibrium 4 obtains for $F > \overline{F}$. For an intermediate acquisition price, Equilibrium 1 obtains for $F \in [\widetilde{F}, \overline{F}]$, and Equilibrium 4 obtains for $F > \overline{F}$. For a high acquisition price, only Equilibrium 4 occurs for $F > \widetilde{F}$.*

Proof. See Appendix 4. ■

As an example, we may illustrate the prediction in this Lemma in the case of a low acquisition price by Figure **??**:

FIGURE 1 ABOUT HERE

We may now use this prediction to assess the welfare effects of subsidy competition. Whenever subsidy competition takes place in equilibrium, we measure regional welfare against the benchmark case of no intervention.

Proposition 3 (Effects of subsidy competition on regional welfare) *For low values of the fixed cost ($F < \widetilde{F}$), subsidy competition reduces social welfare, compared to no intervention.*

For high values of the fixed cost ($F \geq \widetilde{F}$), subsidy competition is always harmful, except when the acquisition price is below a certain threshold, and $F^{***} \leq F < \overline{F}$).

Proof. See Appendix 4. ■

This proposition states that in many cases, putting an end to subsidy competition should enhance welfare in the region as a whole.

In particular, this is always true when fixed costs are low, in the sense that greenfield investment is relatively more profitable without any subsidies. In that case, the actions of both governments should affect neither the location nor the mode of investment ($G1$). Indeed, save for the knife-edge cases of symmetric countries or perfect trade integration, country 1 hosts the MNC, but it will need to pay government 2's willingness to subsidise. Subsidy expenditure is clearly a pure transfer of social surplus from the region to the multinational.

Higher fixed costs imply that the most profitable investment mode is acquisition. This should put a check on governments' ability to subsidise the MNC, as they must now compensate for the profit differential between investment modes.

For intermediate values of the fixed costs, however, both governments are willing to subsidise the MNC. As in the low fixed costs case, government 1 should win the contest, save for two special cases, but how desirable this outcome is will depend on the opportunity cost of greenfield investment. This opportunity cost depends strongly on the foregone acquisition price, and therefore on the parameter α. Hence for a high α, subsidy competition is harmful because the distortion on the MNC's preferred investment type goes in a socially unwanted direction.

By contrast, for higher values of the fixed cost, but still lower than predicted in Lemma 3 ($F > F^{***}$), government 2 will refrain from bidding. Government 1 will therefore be able to replicate a single government's intervention. This leads to a welfare gain relative to no intervention.[16] In this case, greenfield investment is less profitable but socially more desirable, justifying

[16]It should be noted that the subsidy (and hence welfare) is the same here as in the case with one active government.

government 1's intervention.

We implicitly assumed the absence of acquisition subsidies. This may be problematic if subsidy competition results in welfare-dominated greenfield investment: in that case a ban on subsidies would not automatically be justified. Indeed, acquisition subsidies would presumably be a cheaper means, relative to a multilateral ban, to distort the mode towards acquisitions.

However, careful analysis of welfare functions shows that equilibria with greenfield investment and a regional preference for acquisition never obtain. Using Equation (6), we may show that the regional welfare differential between $A1$ and $G1$ is always negative. This amounts to:

$$\chi_{11}^{GA}(1) + \chi_{11}^{GA}(2) \geq 0 \Leftrightarrow \widehat{F} - F^{***} + F^{**} - \widetilde{F} \leq 0$$

which is always verified (see the calculations used in the proof of Lemma 1 in Appendix 4). Hence the assumption of no acquisition subsidies is innocuous for our theoretical analysis of subsidy competition.

3.3 The effect of spillovers

One important justification for granting subsidies to foreign direct investors has been the existence of positive spillovers to the host country[17]. MNC activities may generate both horizontal (within-sector) or vertical (inter-sector) externalities. Vertical spillovers might arise for a number of reasons, most notably due to employment effects or improved technological learning in a vertically linked sector. Horizontal spillovers are also plausible through imitation and increased competition.

In this section we bring the possibility of FDI spillovers into the analysis. Empirical research on the field finds evidence of vertical FDI spillovers but it is less conclusive on the relevance of

[17]See, for instance, Blömstrom and Kokko (2003).

horizontal spillovers[18]. For this reason, we focus on the former.[19]

Vertical spillovers are assumed to be proportional to the output of the foreign firm producing in 1 or 2, and hence equal $\phi(q_{13} + q_{23})$. They will not depend on the investment mode chosen by the MNC. While governments are assumed to recognise these unconditional spillovers, we maintain the assumption of subsidies being conditional on greenfield investment. The welfare function when firm 3 invests in country 1 now becomes:

$$W_1^k = CS_1^k + \pi_{11}^k + \pi_{21}^k - S_1^k + AqPrice_1^k + \phi(q_{13}^k + q_{23}^k) \tag{7}$$

for $k = \{G1, A1\}$, with $\pi_{11}^{A1} = \pi_{21}^{A1} = S_1^{A1} = AqPrice_1^{G1} = 0$. Using this augmented welfare function, we can predict the outcome of the subsidy game.[20]

Lemma 2 *There exists a threshold $\overline{\phi}$ such that when the spillover parameter exceeds that threshold, the prevailing equilibrium is predicted to be as follows:*

- *if $F < F^{**}$, then Equilibrium 1 prevails;*
- *if $F \geq F^{**}$, then Equilibrium 4 obtains.*

Proof. See Appendix 4. ■

We may summarise the prediction of this Lemma with Figure **??**:

FIGURE 2 ABOUT HERE

Let us now comment on the difference to our previous characterisation. When spillovers through backward or forward linkages are significantly high, government 2 has a stronger incentive to enter subsidy competition when acquisitions are more likely. Hosting the MNC now

[18] Aitken and Harrison (1999) find no evidence of horizontal spillovers in Venezuelan manufacturing. Blyde *et al.* (2004) replicate the same results for horizontal spillovers but find significant positive vertical spillovers. Kugler (2005) and Smarzynska Javorcik (2004) provide evidence of vertical spillovers taking place through contacts with local upstream suppliers

[19] For an analysis of the effects of subsidy competition for greenfield investment in the presence of horizontal spillovers, see Fumagalli (2004).

[20] We rule out the possibility of countries being asymmetric in the sense of Equation (15). The occurrence of the corresponding equilibrium, 3, should now be well understood.

becomes socially more valuable compared to the alternative of acquisition abroad, which previously proved beneficial to local firms.

Raising 2's willingness to subsidise results in equilibria with higher subsidy levels. We may now describe the welfare effects of subsidy competition in that setting.

Proposition 4 (Welfare evaluation with vertical spillovers) *Consider the existence of significantly high vertical spillovers in the sense of Lemma 2.*

If fixed costs are low, then subsidy competition reduces social welfare compared to no intervention.

If fixed costs are high, subsidy competition reduces social welfare compared to no intervention, except for a low acquisition price. The threshold price decreases with the extent of spillovers.

Proof. See Appendix 4. ■

Paradoxically, it is when FDI is most beneficial that competition is most likely to be harmful. This may be understood if one considers that the likely winner of that competition would also host the MNC without such competition. When spillovers are negligible, as in the previous analysis, government 2's intervention is less likely. From a welfare point of view, it may accommodate acquisition in the other country due to the beneficial effect on its producer surplus. However, when there are significant vertical spillovers, government 2 always joins the bidding contest, which results in Bertrand-like outcomes.

It should be noted that higher MNC output under greenfield investment implies a larger social value of spillovers, as this value rises in proportion to MNC output. Greenfield investment should therefore be relatively more valuable to the host government, compared to in the previous case. In other words, the competition motive and the spillover motive for attracting FDI reinforce each other.

Whether subsidy competition raises welfare ultimately depends on the acquisition price. Indeed, that price equals a transfer from the MNC to the region. If it is high, then distorting the

choice of the investment mode towards greenfield investment will prove detrimental. Otherwise, it will have positive welfare consequences.

Finally, an extension of this section with asymmetric valuations of spillovers (Φ's) would be straightforward. An interesting result is that a high enough valuation of spillovers for country 2 could overturn the location outcome, offsetting the effect of country 1's geographical advantage. Obviously, the stronger the advantage, the larger the required difference in social valuations. Hence the claim that subsidies act as a signal of externalities rests on very particular conditions.

4 Comparative statics

We may now see how our predictions are affected by exogenous changes in parameter values. These comparative statics shed some light on the effects of trade integration and increased competition for targets.

4.1 Effects of trade integration

The effects of reductions in trade costs may be categorised as follows: a change in the scope of fixed costs under which a particular equilibrium prevails; a change in the prevailing equilibrium, for a given fixed cost; or an increase in the amount of subsidies, for a given fixed cost.

The desirability of subsidy competition will depend on the amount of subsidy expenditure, but also on changes in the prevailing equilibrium that may be translated into welfare changes. We know from the previous analysis that equilibrium conditions are sensitive to changes in τ. We also know that Equilibrium 1 (for high values of the acquisition price) implies that subsidy competition generates social waste compared to no intervention. On the other hand, under Equilibria 1 and 2 (for a sufficiently low α) welfare is greater than in the case of harmonisation. In order to investigate how regional integration affects the impact of subsidy competition, we can simply ask how reductions in τ affect the likelihood of these harmful or beneficial equilibria.

We begin with the case of low fixed costs ($F < \widetilde{F}$). We state the following result:

Proposition 5 *Trade integration leads to increased socially inefficient competition for low-fixed-cost projects. In particular, it causes subsidy expenditure to rise.*

Proof. See Appendix 5. ■

We now turn to the case of high fixed costs. We are interested in Equilibria 1 and 2 since Equilibrium 4 involves no intervention. Welfare gains from subsidy competition may only arise when either Equilibrium 1 or 2 with a low acquisition price obtain. How likely this is depends on the extent of regional integration. We state the following result.

Proposition 6 *Trade integration has mixed effects on subsidy competition for high-fixed-cost investment projects. It makes the existence of beneficial subsidy competition likelier, but it increases the amount of subsidy expenditure, which reduces the welfare gain from subsidy competition.*

Proof. See Appendix 5. ■

To understand Propositions 5 and 6 we need to consider the effects of trade integration on welfare under the alternative forms of investment. Both $G1$ and $A1$ become more attractive to country 1 (and $G2$ and $A2$ to country 2) as the gains from having the firm located in a country are higher with lower τ. Indeed, total output, and hence national welfare, increases more with tariff reductions when the investment is made at home rather than abroad. This in itself explains why equilibria with subsidies and subsidy competition are more likely with lower τ when fixed costs are low, as acquisition never occurs in such cases and the incentive for each government to try to attract investment increases. However, with higher fixed costs, we need to explain why higher subsidies are given for greenfield investment when acquisition is a feasible alternative. In this case, we need to compare the (positive) effects of reducing τ on welfare under the two types of investment. We find that the welfare gain with greenfield investment is higher, again because of a higher marginal effect of a tariff decrease on total surplus. Hence again the incentive for both countries to offer subsidies increases.

That subsidy competition may have beneficial welfare effects in our framework should by now be clear. Subsidy competition may be justified on welfare grounds whenever social preferences

over investment modes are at odds with the MNC's preferences. Trade integration raises the scale of intervention, shifting up expenditure for a typical project, as well as its scope, making ever costlier projects eligible. Welfare gains from intervention should be lower both at the intensive and extensive margins.

4.2 Increased competition for targets

In our model, a structural increase in competition for corporate targets should lead to a rise in the acquisition price, captured by a rise in α. We have already shown how sensitive to changes in the acquisition price the possibility of wasteful subsidy competition may be. We formally tackle this issue here by performing comparative statics of our model with respect to α.

Proposition 7 (Welfare effects of increased competition for targets) *Under subsidy competition, a rise in the acquisition price increases the range of possibilities for social waste.*

Proof. See Appendix 5. ■

The intuition behind this result comes directly from considering the effects of raising the acquisition price on the type of equilibrium. From the firm's point of view, a higher α automatically makes acquisition more costly and biases the firm towards greenfield investment. Hence we would expect financial integration to lead to more equilibria with the latter type of entry. Additionally, for cases where the firm would still choose acquisition without intervention, the subsidy required to induce investment will fall, leading to more cases where either one or both governments are willing to pay the subsidy needed to induce greenfield investment.

5 Conclusions

We have developed a model of subsidy competition for MNCs' location in PTAs, that brings into the analysis the possibility of acquisitions as an alternative to greenfield investment.

With a single government, introducing acquisitions creates a particular motive for subsidisation: to align the firm's preferences with social preferences over investment modes. This will

be relevant when acquisition is more desirable to the MNC than to host country residents. In particular, this occurs when the acquisition price is not high enough to offset the pro-competitive effect of greenfield FDI on the host country.

When governments compete over FDI, however, this motive for subsidisation is partially lost. In most cases, governments are able and willing to offer more than what is necessary to distort the investment mode chosen by the MNC. Under these situations, a simple ban on subsidies (subsidy harmonisation) should improve regional welfare.

Subsidisation will remain justifiable for an interval of moderately large fixed costs (resulting in our Equilibrium 2 with the smallest necessary subsidy). Interestingly, our analysis rejects the intuitive view that the largest investment projects are the most socially valuable, and hence more eligible for subsidisation. Indeed, we always find a fixed-cost threshold above which governments should not impede acquisition. In practice, however, determining whether a project's expected fixed costs actually fall short of our threshold may be difficult. Hence subsidy competition, even in the most favourable cases, should in our view be considered with caution.

These results complement those previously found in the literature which, focusing exclusively on greenfield investment, generally make a positive assessment of subsidy competition.

Adding positive vertical spillovers to the picture may alter the prediction on the outcome of the subsidy game. Without any spillovers, efficiency gains may sometimes make the non-host country prefer acquisition abroad to greenfield investment at home. When significant spillovers arise from FDI, this phenomenon does not occur, raising this country's willingness to pay. We predict fiercer competition than in the absence of spillovers. We then find it even more doubtful that subsidy competition might increase welfare relative to subsidy harmonisation.

The model also predicts that falling trade costs, or upward pressure on acquisition prices, widen the scope for harmful subsidy competition, or reduce its gains when it is beneficial.

We believe that our model provides rich insights on the effects of subsidy competition between trading partners. With the issue of subsidy competition becoming more relevant, and problematic, reflection on potential institutional solutions is surely needed. Hence we conclude

with a word on policy co-ordination. We have seen that a bilateral ban of subsidies to greenfield FDI may actually benefit member countries of a PTA. However, could a superior policy not be implemented by way of a co-ordination agreement?

To answer this question, we need once again to take into account the value of fixed costs. For low fixed costs ($F < \widetilde{F}$) the first-best policy is to allow for greenfield investment in country 1 without intervention. This may be achieved by an outright ban of subsidies, as explained above. For very high fixed costs ($F \geq \overline{F}$), subsidy competition never occurs and the first-best outcome is achieved (Lemma 3). For intermediate values of the fixed cost, we have seen that the most desirable outcome would be greenfield investment in country 1 with the minimum necessary subsidy. This would replicate a single government's intervention. However, this outcome is only reached for relatively high-fixed-cost projects.

There is therefore some scope for policy co-ordination. Targeting the likely winner of the auction and enforcing a subsidy cap could increase total welfare. Implementing such co-ordination seems more realistic at the sub-national level, as a central government could monitor targeting programmes and subsidy caps.

In practice however, only one such agreement has ever been implemented. Through the 1995 'Internal Trade Agreement', Canadian provinces have committed to 'avoid engaging into bidding wars'. While no formal subsidy cap has been implemented, our model, most of the analysis of which is equally applicable at the sub-national level, suggests that this is a step in the right direction. But the provision, allowing provinces to raise expenditure when potential foreign (U.S.) rival locations exist, underlines the need for co-ordination at a higher level of jurisdiction. This suggests that emerging solutions to intra-national subsidy wars could serve as an inspiration in an international setting. Still, the political economy aspects of implementing such co-ordination are left for future research.

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Appendices.

Appendix 1: Final stage outputs and prices

For greenfield FDI in country 1 the outputs are:

$$\begin{array}{ll} q_{11}^{G1} = \frac{a_1-3c_1+c_2+1+\tau}{4} & q_{21}^{G1} = \frac{a_2-3c_1+c_2+1-2\tau}{4} \\ q_{12}^{G1} = \frac{a_1+c_1-3c_2+1-3\tau}{4} & q_{22}^{G1} = \frac{a_2+c_1-3c_2+1+2\tau}{4} \\ q_{13}^{G1} = \frac{a_1+c_1+c_2-3+\tau}{4} & q_{23}^{G1} = \frac{a_2+c_1+c_2-3-2\tau}{4} \end{array} \tag{8}$$

while for acquisition in 1 they are:

$$\begin{array}{ll} q_{11}^{A1} = 0 & q_{21}^{A1} = 0 \\ q_{12}^{A1} = \frac{a_1-2c_2+1-2\tau}{3} & q_{22}^{A1} = \frac{a_2-2c_2+1+\tau}{3} \\ q_{13}^{A1} = \frac{a_1+c_2-2+\tau}{3} & q_{23}^{A1} = \frac{a_2+c_2-2-2\tau}{3} \end{array} \tag{9}$$

Outputs under both modes in country 2 can be seen simply by relabelling firms 1 and 2 above. Total outputs and prices in country 1 in the five cases are given by:

$$\begin{array}{ll} Q_1^{G1} = \frac{3a_1-c_1-c_2-1-\tau}{4} & P_1^{G1} = \frac{a_1+c_1+c_2+1+\tau}{4} \\ Q_1^{A1} = \frac{2a_1-c_2-1-\tau}{3} & P_1^{A1} = \frac{a_1+c_2+1+\tau}{3} \\ Q_1^{G2} = \frac{3a_1-c_1-c_2-1-2\tau}{4} & P_1^{G2} = \frac{a_1+c_1+c_2+1+2\tau}{4} \\ Q_1^{A2} = \frac{2a_1-c_1-1-\tau}{3} & P_1^{A2} = \frac{a_1+c_1+1+\tau}{3} \end{array}$$

with similar expressions for country 2.

Appendix 2: One active government (Proof of Proposition 1)

First, we note that we only need consider cases where the firm would prefer acquisition in the absence of intervention, that is where fixed costs F exceed $\widetilde{F}$ as defined above. The necessary subsidy to induce the firm to change the nature of its investment is $\widetilde{S} = F - \widetilde{F}$. To identify when government 1 will be prepared to offer this subsidy we need to compare W_1^{G1} when $S_1 = 0$ and W_1^{A1}. The maximum subsidy the government will be willing to give is $\chi = W_1^{G1} - W_1^{A1}$. This subsidy is positive when

$$\left(CS_1^{G1} - CS_1^{A1}\right) + \left(\pi_{11}^{G1} - \pi_{21}^{G1}\right) - AqPrice_1 > 0 \tag{10}$$

The first term is positive as consumer surplus is higher for greenfield investment because of the presence of an additional firm, while the second term is also positive. The acquisition price is positive, hence the third term is negative.

When $\chi > 0$, the government is prepared to offer a subsidy. The subsidy required to change the form of investment is equal to $\widetilde{S}$, hence when $\chi > \widetilde{S}$ the government will offer a subsidy of $\widetilde{S}$, the minimum which will be accepted by the firm.

From (10), a rise in α and the acquisition price will reduce the incentive to offer a subsidy.

Appendix 3: Existence and unicity of equilibrium (Proof of Proposition 2)

We solve for subgame-perfect equilibria of the three-stage game using backward induction. It is assumed throughout that no acquisition subsidies are available and that greenfield subsidies are constrained to be non-negative. To avoid 'ties' in the subsidy game, we have assumed country 1 to be larger than country 2, in the sense that $a_1 > a_2$. This geographical advantage translates straightforwardly into a more profitable location alternative than locating in country 2.

Third stage As mentioned in the main text, third stage outputs are not affected by government intervention, because subsidies are lump-sum. Outputs are given by equations (8) and (9)in Appendix 1, and profits equal the sum over countries of squared outputs.

Second stage The MNC will choose an investment type $\theta \in \{G1, G2, A1, A2\}$ so as to maximise profits inclusive of subsidies. Note that due to our assumption on home market sizes, $A2$ is always payoff-dominated for the MNC. It is straightforward to write the optimal decision rule:

$$\theta(S_1, S_2) = \begin{cases} A1 & \text{if } 0 \leq S_1 \leq \Delta_{11}^{AG} \text{ and } 0 \leq S_2 < \Delta_{12}^{AG} \\ G1 & \text{if } S_1 > \Delta_{11}^{AG} \text{ and } S_1 > S_2 - \Delta_{12}^{GG} \\ G2 & \text{if } S_2 \geq \Delta_{12}^{AG} \text{ and } S_1 \leq S_2 - \Delta_{12}^{GG} \end{cases} \tag{11}$$

We should now distinguish between two cases: when the MNC would prefer greenfield investment without intervention ($F < \widetilde{F}$), or when it would prefer acquisition ($F \geq \widetilde{F}$).

First stage ($F < \widetilde{F}$) Governments maximise national welfare minus subsidy expenditure. Because the presence of a greenfield investor raises consumer surplus, both governments prefer investment at home to abroad, and will pay no subsidies if the MNC is predicted to invest abroad[21]. The MNC prefers greenfield investment to acquisition in the absence of subsidies. Hence we must have three types of candidate equilibria: $(0, 0, G1), (S_1, 0, G1), (0, S_2, G2)$.

Consider the candidate equilibrium $(0, 0, G1)$. Governments' willingness to subsidise will equal the welfare gain due to investment at home over investment abroad, i.e. $\chi_{12}^{GG}(1)$ and $\chi_{21}^{GG}(2)$ for governments 1 and 2 respectively. Obviously government 1 will not intervene against a zero subsidy by its rival. Then using Equation (11), Equilibrium $(0, 0, G1)$ obtains if government 2's best-reply to a zero subsidy is a zero subsidy, or:

$$0 > \chi_{21}^{GG}(2) - \Delta_{12}^{GG}$$

If this inequality holds, then Equilibrium 3 exists and is the unique subgame-perfect equilibrium.

When this inequality does not hold, subsidy competition occurs. Recall that investment at home is preferred to abroad, but that subsidies enter welfare functions additively and negatively.

[21] In addition, we assume that in case of a tie, governments offer a subsidy anyway. The widespread popularity of greenfield investment among policy-makers suggests this assumption is realistic.

Therefore, governments' best-reply subsidies must equal:

$$S_1^*(S_2) = \min\{S_2 - \Delta_{12}^{GG} - \epsilon, \chi_{12}^{GG}(1)\}$$
$$S_2^*(S_1) = \min\{S_1 + \Delta_{12}^{GG} - \epsilon, \chi_{21}^{GG}(2)\}$$

where ϵ may be arbitrarily small. The exact intersection depends on a comparison of governments'willingness to subsidise. Government 1 receives the investment if the following inequality holds:

$$\chi_{12}^{GG}(1) > \chi_{21}^{GG}(2) - \Delta_{12}^{GG}$$

Since we assumed a larger home market for country 1, the latter condition always holds. This proves the existence and unicity of Equilibrium 1[22].

First stage ($F \geq \widetilde{F}$) The MNC prefers acquisition in the absence of intervention. Since incentives only apply to greenfield investment, an equilibrium with acquisition exists if and only if governments' willingness to subsidise falls short of profit differentials. Note that by Equation (11), $\forall S_1 \in [0, \Delta_{11}^{AG}], \forall S_2 \in [0, \Delta_{12}^{AG}], \theta(S_1, S_2) = A1$. Hence against a subsidy conducive to $A1$, the maximum willingness to subsidise is given by welfare differentials between $A1$ and greenfield investment at home. This may be written as :

$$\chi_{11}^{GA}(1) \leq \Delta_{11}^{AG} \tag{12}$$
$$\chi_{21}^{GA}(2) \leq \Delta_{12}^{AG} \tag{13}$$

This is true in particular if the left-hand-side terms are negative, meaning that $A1$ is strictly preferred by both governments to all other investment types. More generally, if these inequalities hold, then governments will remain inactive rather than offer subsidies likely to overturn the MNC's location decision. From Equation (11) the Equilibrium is: $(0, 0, A1)$. This proves the existence and unicity of Equilibrium 4.

When Equations (12) and (13) do not hold jointly, we are left with three alternatives. From Equation (11) we know that all remaining alternatives will involve greenfield investment, as at least one government will successfully intervene. Indeed, in each case at least one government will prefer greenfield investment at home by a large enough welfare differential.

Consider first the case where Equation (12) holds and Equation (13) does not hold. Government 2 will consider intervention. We must distinguish between two sub-cases, according to government 1's best-reply to an S_2 large enough to influence the MNC. In the first sub-case, if $\chi_{12}^{GG}(1) \leq \Delta_{11}^{AG}$, then government 1 never finds it in its interest to intervene against a subsidy conducive to $G2$. But we already had that government 1 would not intervene against a subsidy conducive to $A1$. Hence government 1's best-reply strategy is to refrain from intervention (a horizontal flat best-reply schedule at zero). Thus when the above condition holds, the equilibrium must be $(0, \Delta_{12}^{AG}, G2)$, independent of 2's behaviour. This proves the existence and unicity of Equilibrium 5. In the second sub-case, if $\chi_{12}^{GG}(1) > \Delta_{11}^{AG}$, then intervention from 1 is possible. Again, the game resembles a Bertrand pricing game, but it is made more complicated

[22]Note that the prevailing equilibrium resembles an asymmetric Bertrand equilibrium, or a second-price auction with complete information and asymmetric valuations.

due to the possibility of acquisition in country 1. Indeed, government 1's best-reply against a subsidy conducive to $A1$ is not to intervene; however, its best-reply against a subsidy conducive to $G2$ is to make a slightly better bid. Hence the discontinuity in government 1's best-reply. Government 2's best-reply against a subsidy conducive to $A1$ is to compensate for the profit differential. Against a larger subsidy it must make a slightly better bid. Thus governments' best-reply subsidies must equal:

$$S_1^*(S_2) = \begin{cases} 0 & \text{if } S_2 < \Delta_{12}^{AG} \\ \min\{S_2 - \Delta_{12}^{GG} - \epsilon, \chi_{12}^{GG}(1)\} & \text{if } S_2 \geq \Delta_{12}^{AG} \end{cases}$$

$$S_2^*(S_1) = \begin{cases} \Delta_{12}^{AG} & \text{if } S_1 < \Delta_{11}^{AG} \\ \min\{S_1 + \Delta_{12}^{GG} - \epsilon, \chi_{21}^{GG}(2)\} & \text{if } S_1 \geq \Delta_{11}^{AG} \end{cases}$$

where ϵ may be arbitrarily small. Again, the outcome of the game hinges on the comparison between governments' willingness to subsidise. Since the inequality in Equation (5) always holds, Country 1 hosts FDI. Again, the unique subgame-perfect equilibrium is Equilibrium 1.

Consider now the second of our three cases, where Equation (12) does not hold and Equation (13) holds. This means that government 1 prefers greenfield investment at home to $A1$ by some margin, unlike government 2. Government 1 will consider intervention. We must distinguish between two sub-cases, according to government 2's best-reply against a subsidy conducive to $G1$. In the first sub-case, if $\chi_{21}^{GG}(2) \leq \Delta_{12}^{AG}$, then government 2 never finds it in its interest to intervene against a subsidy conducive to $G1$. But we already had that government 2 would not intervene against a subsidy conducive to $A1$. Hence government 2's best-reply strategy is to refrain from intervention (a flat vertical best-reply schedule). Thus when the above condition holds, the equilibrium must be $(\Delta_{11}^{AG}, 0, G1)$, independent of 2's behaviour. This proves the existence and unicity of Equilibrium 2. In the second sub-case, if $\chi_{21}^{GG}(2) > \Delta_{12}^{AG}$, then intervention from 2 is possible. Again, the game resembles a Bertrand pricing game, but it is made more complicated due to the possibility of acquisition in country 1. Indeed, in this sub-case, government 2's best-reply against a subsidy conducive to $A1$ is not to intervene, whereas its best-reply against a subsidy conducive to $G2$ is to make a slightly better bid. Hence the discontinuity in government 2's best-reply schedule. Government 1's best-reply against a subsidy conducive to $A1$ is to simply compensate for the profit differential. Against a larger subsidy it need make a slightly better bid. Thus governments' best-reply subsidies must equal:

$$S_1^*(S_2) = \begin{cases} \Delta_{11}^{AG} & \text{if } S_2 < \Delta_{12}^{AG} \\ \min\{S_2 - \Delta_{12}^{GG} - \epsilon, \chi_{12}^{GG}(1)\} & \text{if } S_2 \geq \Delta_{12}^{AG} \end{cases}$$

$$S_2^*(S_1) = \begin{cases} 0 & \text{if } S_1 \leq \Delta_{11}^{AG} \\ \min\{S_1 + \Delta_{12}^{GG} - \epsilon, \chi_{12}^{GG}(2)\} & \text{if } S_1 > \Delta_{11}^{AG} \end{cases}$$

where ϵ may be arbitrarily small. The outcome of the subsidy game will be Equilibrium 1.

In the third and last case, Equations (12) and (13) both hold, implying that governments prefer greenfield investment at home rather than $A1$ and will intervene. It should now be clear

that governments' best-reply subsidies will be given by:

$$S_1^*(S_2) = \begin{cases} \Delta_{11}^{AG} & \text{if } S_2 < \Delta_{12}^{AG} \\ \min\{S_2 - \Delta_{12}^{GG} - \epsilon, \chi_{12}^{GG}(1)\} & \text{if } S_2 \geq \Delta_{12}^{AG} \end{cases}$$

$$S_2^*(S_1) = \begin{cases} \Delta_{11}^{AG} & \text{if } S_1 \leq \Delta_{11}^{AG} \\ \min\{S_1 + \Delta_{12}^{GG} - \epsilon, \chi_{21}^{GG}(2)\} & \text{if } S_1 > \Delta_{11}^{AG} \end{cases}$$

Once again, Equation (5) holds and Equilibrium 1 prevails.

To summarise, the exhaustive set of conditions below determines which equilibrium prevails:

1. $F < \widetilde{F}$
   (a) If $\chi_{21}^{GG}(2) < \Delta_{12}^{GG}$ Equilibrium : $(0, 0, G1)$
   (b) If $\chi_{21}^{GG}(2) \geq \Delta_{12}^{GG}$
      i. If $\chi_{12}^{GG}(1) + \Delta_{12}^{GG} > \chi_{21}^{GG}(2)$ Equilibrium: $(\chi_{21}^{GG}(2) - \Delta_{12}^{GG}, 0, G1)$
      ii. If $\chi_{12}^{GG}(1) + \Delta_{12}^{GG} \leq \chi_{21}^{GG}(2)$ Equilibrium: $(0, \chi_{12}^{GG}(1) + \Delta_{12}^{GG}, G2)$
2. $F \geq \widetilde{F}$
   (a) If $\chi_{11}^{GA}(1) \leq \Delta_{11}^{AG}$ and $\chi_{21}^{GA}(2) \leq \Delta_{12}^{AG}$ Equilibrium: $(0, 0, A1)$
   (b) If $\chi_{11}^{GA}(1) \leq \Delta_{11}^{AG}$ and $\chi_{21}^{GA}(2) > \Delta_{12}^{AG}$
      i. If $\chi_{12}^{GG}(1) \leq \Delta_{11}^{AG}$ Equilibrium : $(0, \Delta_{12}^{AG}, G2)$
      ii. If $\chi_{12}^{GG}(1) > \Delta_{11}^{AG}$
         A. If $\chi_{12}^{GG}(1) + \Delta_{12}^{GG} > \chi_{21}^{GG}(2)$ Equilibrium: $(\chi_{21}^{GG}(2) - \Delta_{12}^{GG}, 0, G1)$
         B. If $\chi_{12}^{GG}(1) + \Delta_{12}^{GG} \leq \chi_{21}^{GG}(2)$ Equilibrium: $(0, \chi_{12}^{GG}(1) + \Delta_{12}^{GG}, G2)$
   (c) If $\chi_{11}^{GA}(1) > \Delta_{11}^{AG}$ and $\chi_{21}^{GA}(2) \leq \Delta_{12}^{AG}$
      i. If $\chi_{21}^{GG}(2) < \Delta_{12}^{AG}$ Equilibrium: $(\Delta_{11}^{AG}, 0, G1)$
      ii. If $\chi_{21}^{GG}(2) \geq \Delta_{12}^{AG}$
         A. If $\chi_{12}^{GG}(1) + \Delta_{12}^{GG} > \chi_{21}^{GG}(2)$ Equilibrium: $(\chi_{21}^{GG}(2) - \Delta_{12}^{GG}, 0, G1)$
         B. If $\chi_{12}^{GG}(1) + \Delta_{12}^{GG} \leq \chi_{21}^{GG}(2)$ Equilibrium: $(0, \chi_{12}^{GG}(1) + \Delta_{12}^{GG}, G2)$
   (d) If $\chi_{11}^{GA}(1) > \Delta_{11}^{AG}$ and $\chi_{21}^{GA}(2) > \Delta_{12}^{AG}$
      i. If $\chi_{12}^{GG}(1) + \Delta_{12}^{GG} > \chi_{21}^{GG}(2)$ Equilibrium: $(\chi_{21}^{GG}(2) - \Delta_{12}^{GG}, 0, G1)$
      ii. If $\chi_{12}^{GG}(1) + \Delta_{12}^{GG} \leq \chi_{21}^{GG}(2)$ Equilibrium: $(0, \chi_{12}^{GG}(1) + \Delta_{12}^{GG}, G2)$

It is easy to see that the second, sixth, ninth, eleventh conditions are identical and lead to Equilibrium 1. The eighth condition leads to Equilibrium 2. The first conditions leads to Equilibrium 3. The fourth conditions leads to Equilibrium 4. Because of the assumed market size difference, the third, fifth, seventh, tenth and twelfth conditions are never met. This completes the proof of the Proposition.

Appendix 4: Subsidy Competition and social welfare

We proceed in two steps. First, we show which equilibrium prevails for a given fixed cost. Then we consider the desirability of this particular equilibrium.

Characterisation of the equilibrium (Proof of Lemma 1)

We first address the case of equilibria involving no intervention (Equilibria 3 and 4). According to Proposition 2, Equilibrium 3 occurs whenever:

$$\chi_{21}^{GG}(2) - \Delta_{12}^{GG} < 0 \iff \tau\frac{1}{32}\left(14a_2 - 8a1 - 2c_2 - 2 - 2c_1 - 19\tau\right) < 0 \tag{14}$$

Hence when the willingness to pay for the good is not too different between the two countries, subsidy competition always takes place. This may be seen as a restriction on consumer preferences. Therefore Equilibrium 3 may be ruled out of the subsequent analysis provided the condition in Equation (14) is met.[23] By Proposition 2, Equilibrium 4 is likelier for high-fixed-cost investment projects, taking social preferences as given. More precisely, it must be too costly to compensate the MNC for the distortion on the investment mode. Hence the following Lemma.

Lemma 3 *There exists an upper bound on fixed costs $\overline{F}$ such that for any $F > \overline{F}$, no government intervention occurs.*

Proof. The proof follows from inspection of the conditions established in Proposition 2.

We know from Proposition 2 that for values of the fixed cost greater than $\widetilde{F}$, Equilibria 1, 2 and 4 may occur. Equilibrium 4 is the only one without intervention of any of the governments. For the other potential equilibria we now prove that if $F > \overline{F}$, then none of the conditions leading to these equilibria may be verified.

By Proposition 2, if $F \geq \widetilde{F}$ then a necessary and sufficient condition for equilibrium 4 is that Equations (12) and (13) from Appendix 1 jointly hold. Since Δ_{11}^{AG} and Δ_{12}^{AG} are both increasing in F, by definition, there always exists an $\overline{F}$ such that the conditions for existence of Equilibrium 4 always hold for $F > \overline{F}$. This upper bound equals the maximum between the levels of fixed cost that make Δ_{11}^{AG} and Δ_{12}^{AG} negative. In particular, $\overline{F} = \max\{\ \widehat{F}, F^{**}\}$. ■

We now turn to equilibria leading to subsidy competition.

Low fixed costs We begin with the case of low fixed costs ($F < \widetilde{F}$). We know from Equation (14) that unless market sizes (or national tastes) are extremely different, Equilibrium 1 always prevails. In other words, when both governments are able to bid for greenfield investment, government 1 always wins the auction.

High fixed costs Consider now the case of high fixed costs ($F \geq \widetilde{F}$). For very high fixed costs ($F > \max\{\widehat{F}, F^{**}\}$), we know by Lemma 3 that no intervention occurs. There is then no scope for socially wasteful subsidy competition.

Let us now determine the outcome of the subsidy game in the intermediate case of $\widetilde{F} \leq F < \max\{\widehat{F}, F^{**}\}$. Straightforward calculations yield :

[23] If this condition was met, then no subsidy competition could take place. In theory, the difference in sizes (or tastes) would even allow country 1 to levy a tax on FDI. We choose to rule out this degenerate case.

$$F^{**} - \widetilde{F} = \frac{1}{288}[-14(a_1)^2 + 3(a_2)^2 + 36a_1c_1 + 20a_1c_2 + 18a_2c_1 - 30a_2c_2 + 45(c_1)^2 + 61(c_2)^2$$
$$- 198c_1c_2 - 28a_1 + 18a_2 + 90c_1 + 26c_2 - \tau(42a_1 + 90a_2 + 18c_1 + 34c_2 - 14 + 77\tau)]$$

$$\widehat{F} - \widetilde{F} = \begin{cases} \frac{1}{288}[17(a_1)^2 - 54a_1c_1 + 9(c_1)^2 + (1 + c_2 + \tau)(10a_1 + 18c_1 - 7c_2 - 7 - 7\tau)] \\ \text{if } \alpha = 0 \\ \frac{1}{288}[3(a_1)^2 - 14(a_2)^2 - 2a_1(17c_1 + 9c_2 - 23 + 9\tau) + 2a_2(10c_1 - 14c_2 + 18 + 28\tau) \\ +77(c_1)^2 - 35(c_2)^2 - 198c_1 + 58c_1c_2 + 58c_2 + 29 + \tau(2c_1 + 14c_2 - 50 - 77\tau)] \\ \text{if } \alpha = 1 \end{cases}$$

$$\widehat{F} - F^{***} = \begin{cases} \frac{1}{288}[17(a_1)^2 - 54a_1c_1 + 9(c_1)^2 - 7(c_2)^2 \\ +(10a_1 + 18c_1 + 4\tau)(1 + c_2 + \tau) - 14c_2 + 160\tau^2 + 62a_1\tau - 126a_2\tau - 7] \\ \text{if } \alpha = 0 \\ \frac{1}{288}[3(a_1)^2 - 14(a_2)^2 - 2a_1(17c_1 + 9c_2 - 23 - 27\tau) + 2a_2(10c_1 - 14c_2 + 18 - 35\tau) \\ +77(c_1)^2 - 35(c_2)^2 - 198c_1 + 58c_1c_2 + 58c_2 + 29 + \tau(16c_1 + 32c_2 - 32 + 94\tau)] \\ \text{if } \alpha = 1 \end{cases}$$

$$F^{***} - \widetilde{F} = -\frac{\tau}{32}(8a_1 - 14a_2 + 2c_1 + 2c_2 + 19\tau)$$

We now discuss the values of the above equations and rank these fixed costs thresholds.

The right-hand-side in the first equation is negative for a symmetric region for parameter values that lead to positive outputs. In addition, it is increasing in differences in a's and decreasing in $c_2 - c_1$. This term is still negative when taking limit values for c_2. We conclude that for all high-fixed-cost investment projects, government 2 will prefer the prospect of an acquisition in country 1 rather than costly intervention.

The right-hand-side of the second equation is equal to the welfare differential between $G1$ and $A1$ for country 1, hence must depend on the acquisition price received by the host country. This term will be positive for low values of α and negative for high values of α. The right-hand-side of the third equation depends on α in the same manner. Interestingly, the derivatives of these terms with respect to α are identical and constant. Hence these two right-hand-side expressions must equal zero for unique values of α. Lastly, the fourth equation tells us that when country sizes (tastes) are not too different for subsidy competition to occur, then $F^{***} - \widetilde{F} > 0$.

We may therefore rank predicted equilibria according to α. Using the fourth equation and continuity, the root of the third equation must be lower than the root of the second equation. Denote these values by $\{\alpha^\star, \alpha^{\star\star}\}$. Hence for a low acquisition price, $F^{**} < \widetilde{F} < F^{***} < \widehat{F}$ and Equilibria 1 or 2 may occur. In that case, the median fixed cost interval is divided into two segments, with Equilibrium 1 for the lower part of the interval. For an intermediate acquisition price ($\alpha \in [\alpha^\star, \alpha^{\star\star}]$), only Equilibrium 1 obtains. Lastly, for a high acquisition price, Equilibrium 4 obtains and no subsidy competition occurs.

Welfare analysis (Proof of Proposition 3)

Using the definition of $\tilde{F}$ and Lemmata 1 and 3, we measure the effect of subsidy competition on welfare for an arbitrary investment project, within the relevant intervals of fixed costs.

Again, we begin with the low fixed costs case. Note that in the absence of intervention, the outcome would be Equilibrium 3. Thus subsidy competition does not alter the type of investment. Because of the transfer to the MNC, it must therefore lead to a social welfare loss compared to no intervention. This also applies to a comparison between subsidy competition and a single government's intervention.

In the intermediate fixed costs case, subsidy competition arises with Equilibria 1 and 2. Subsidy competition at Equilibrium 2 is socially harmful if regional welfare with $A1$ and no subsidies is larger than welfare with $G1$ and a subsidy equal to Δ_{11}^{GA}, or:

$$\begin{aligned} \chi_{11}^{GA}(1) - \Delta_{11}^{AG} + \chi_{11}^{GA}(2) &< 0 \\ \widehat{F} - F^{***} + F^{**} &< 0 \end{aligned}$$

Calculations show that this condition is never met.

Subsidy competition at Equilibrium 1 is socially harmful if regional welfare with $A1$ and no subsidies is larger than welfare with $G1$ and a subsidy equal to $\chi_{21}^{GG}(2) - \Delta_{21}^{GG}$, or formally:

$$\chi_{11}^{GA}(1) - \left(\chi_{21}^{GG}(2) - \Delta_{21}^{GG}\right) + \chi_{11}^{GA}(2) < 0 \iff \widehat{F} - F^{***} + F^{**} - F^{***} < 0$$

Again, we prove the existence of harmful subsidy competition by continuity. Denote the last left-hand-side expression by $K(\alpha)$. Since $F^{**} - F^{***}$ does not depend on the acquisition price, $K(\alpha)$ must have the same derivative with respect to α as $\widehat{F} - F^{***}$. In addition, we know from the last subsection that $F^{**} - F^{***} < 0 < \widehat{F} - F^{***} < \widehat{F} - \widetilde{F}$. By continuity, $\widehat{F} + F^{**} - 2F^{***}$ must equal zero for an α lower than $\alpha^{\star}$. Denote this last threshold $\alpha^{\star\star\star}$. Straightforward calculations show that $K(0) > 0$. We conclude that a welfare loss should occur at Equilibrium 1 whenever $\alpha > \alpha^{\star\star\star}$. This is the threshold value referred to in the Proposition.

Summarising:

- Low fixed costs ($F < \widetilde{F}$). When subsidy competition occurs, it reduces social surplus compared to no intervention.
- Intermediate fixed costs ($\widetilde{F} \leq F < \overline{F}$). For a low acquisition price, Equilibrium 1 obtains for the lower part of the fixed-cost interval, and Equilibrium 2 obtains for the higher part. Competition is beneficial, except at Equilibrium 1 with $\alpha > \alpha^{\star\star\star}$. For an intermediate acquisition price, only Equilibrium 1 obtains and subsidy competition reduces welfare. For a high acquisition price subsidy competition does not occur.
- High fixed costs ($F \geq \overline{F}$). No subsidy competition takes place.

This completes the proof.

Proof of Lemma 2

Notice that this ranking may depend on the acquisition price, as the interval $[\widetilde{F}, \widehat{F}]$ may not exist for values of α close to one. First, it may be seen that F^{*} is always greater than F^{**}, from:

$$F^* - F^{**} = \frac{1}{288}[14(a_1)^2 - 3(a_2)^2 - 90c_1 - 45(c_1)^2 - 26c_2 - 61(c_2)^2 + 198c_1c_2 + 16c_2\tau$$
$$- a_1(36c_1 + 20c_2 - 28 - 70\tau) + a_2(18 + 18c_1 - 30c_2 - 54\tau) + 35 - 32\tau - 94\tau^2]$$

Second, recall that absent spillovers, $\widehat{F} > F^{**}$ always holds. However:

$$\frac{\partial \widetilde{F}}{\partial \phi} = 0$$
$$\frac{\partial F^{**}}{\partial \phi} = \frac{1}{288}\left(96(a_1 + a_2) + 192c_2 - 384 - 96\tau\right)$$
$$\frac{\partial \widehat{F}}{\partial \phi} = -\frac{1}{288}\left(24(a_1 + a_2) - 144c_1 + 48c_2 + 48 - 24\tau\right)$$

$\widetilde{F}$, a profit differential, is independent of spillovers. However, F^{**} increases in ϕ, while $\widehat{F}$ decreases, and the former derivative is greater than the latter. Straightforward calculations also show that, absent spillovers, $\widetilde{F} - F^{**} > \widehat{F} - \widetilde{F}$. By continuity, for a high enough $\phi > \overline{\phi}$, we must have: $\widetilde{F} < F^{**} < \widehat{F} < F^*$. Proposition 2 then determines which equilibrium prevails.

Lastly, recall that $\widehat{F}$ (measuring government 1's preference for greenfield investment) decreases with α, while $\widetilde{F}$ (measuring the MNC's preference for greenfield investment) increases. There must be some critical value of the acquisition price for which the former becomes lower than the latter. By Proposition 2, above that critical value no Equilibrium 1 may exist.

Proof of Proposition 4

By Lemma 2, Equilibrium 1 obtains when $F < \widetilde{F}$. Then, as proved earlier, subsidisation does not affect the mode, while subsidy expenditure reduces welfare. Spillovers are enjoyed by the host country independent of subsidy competition. Hence a ban on subsidies may increase welfare.

When $\widetilde{F} \leq F < \overline{F}$, then a Bertrand-like equilibrium obtains, in which government 1 wins the bidding contest. While subsidies are greater than necessary, they still distort the MNC's choice towards greenfield investment. The overall welfare effect will therefore depend on α. Define the welfare differential between subsidy competition (Eq. 1) and no intervention as:

$$K(\alpha, \phi) = \chi_{11}^{GA}(1) + \chi_{11}^{GA}(2) - \left(\chi_{21}^{GG}(2) - \Delta_{12}^{GG}\right)$$

By the proof of Proposition 3, we already know that the function $K(\alpha, 0)$ has a unique root denoted by $\alpha^{\star\star\star}$. Notice that $K(\alpha, \phi)$ is decreasing in ϕ, and that the cross-derivative is equal to zero. It follows that for a strictly positive ϕ, the root of $K(\alpha)$ must be smaller than $\alpha^{\star\star\star}$. Tedious calculations show that the sign of $K(\alpha, \overline{\phi})$ will depend on production and trade costs. Still, overlooking vertical spillovers understates the detrimental effects of subsidy competition.

Lastly, $\chi_{21}^{GG}(2) - \Delta_{12}^{GG}$ increases in ϕ, implying even greater subsidisation than absent spillovers.

Appendix 5: Comparative statics results

Proof of Proposition 5

This result may be decomposed and proved in three parts, following our categorisation of the effects of trade integration. First, a reduction in τ increases $\widetilde{F}$, as may be seen from:

$$\frac{\partial \widetilde{F}}{\partial \tau} = \frac{1}{72}\left[(a_1 - 2a_2)(2 + 7\alpha) + (5\alpha + 18)c_1 - (2 + 7\alpha)c_2 + (35\alpha + 10)\tau + 9\alpha - 14\right]$$

which is negative. Thus, regional integration triggers new investments leading to Equilibrium 1.

Second, trade integration also affects the prevailing equilibrium for a given fixed cost. Whenever $F < \widetilde{F}$, only Equilibria 1 and 3 may occur. Under Equilibrium 3 subsidy competition has no effect, while Equilibrium 1 implies social waste. We first prove how integration may lead to an equilibrium with intervention from government 1, and then assess the welfare loss in comparison to the absence of such subsidies. Straightforward calculations show that:

$$\chi_{21}^{GG}(2) - \Delta_{12}^{GG} = -\tau\frac{1}{32}\left(2 + 8a_1 - 14a_2 + 2c_2 + 2\alpha + 19\tau\right)$$

Rearranging, we find that for $F < \widetilde{F}$ an equilibrium with subsidies (Eq. 1) exists if and only if:

$$a_2 > \frac{4}{7}a_1 + \frac{1}{7}\left(1 + c + \alpha\right) + \frac{19}{14}\tau \iff \tau < \frac{14}{19}a_2 - \frac{8}{19}a_1 - \frac{2}{19}\left(1 + c + \alpha\right) \tag{15}$$

Therefore country differences or trade costs must be low enough to allow for subsidy competition. We denote by $\overline{\tau}$ the above threshold trade cost. It follows that trade integration beyond this threshold causes socially harmful subsidy competition.

Finally, let us determine how integration affects the amount of subsidies. Observe that the derivative of Equilibrium 1 subsidies with respect to τ equals:

$$\frac{\partial \chi_{21}^{GG}(2) - \Delta_{12}^{GG}}{\partial \tau} = \frac{1}{16}(7a_2 - 4a_1 - c_1 - c_2 - 19\tau - 1) \tag{16}$$

This derivative will be positive only at intermediate stages of trade integration (in particular, when $\tau > \frac{\overline{\tau}}{2}$). Beyond this threshold, trade integration increases the amount of subsidies under Equilibrium 1. It therefore increases the transfer of social surplus to the MNC.

Significant trade integration raises the likelihood and extent of harmful subsidy competition.

Proof of Proposition 6

In the high-fixed-cost interval, the fixed cost determines which equilibrium prevails. We prove the first part of the Proposition by showing how integration widens the fixed-cost interval consistent with beneficial subsidy competition. We then show that subsidy expenditure decreases in τ.

The first part means that equilibrium 2 is more likely with lower transport costs. To prove it, we need to differentiate $\overline{F}$ and F^{***}. Recall from Lemma 1 that $\overline{F} = \widehat{F}$. Hence:

$$\begin{aligned}\frac{\partial \widehat{F}}{\partial \tau} = & \quad \tfrac{1}{144}(-35+9a_1-8a_2+45c_1-11c_2+13\tau)\\ \frac{\partial F^{***}}{\partial \tau} = & \quad \tfrac{1}{144}(-37+27c_1-13c_2+a_2(55-28\alpha)+18\alpha\\ & +10c_1\alpha-14c_2\alpha+2a_1(-16+7\alpha)-151\tau+70\alpha\tau)\end{aligned}$$

To sign these, we need to distinguish between symmetric and asymmetric regions, in the sense of Equation (15). For a symmetric region, both derivatives are positive. The first one makes Equilibrium 2 less likely, while the second one makes it more likely, so we need to sign $\frac{\partial \widehat{F}}{\partial \tau} - \frac{\partial F^{***}}{\partial \tau}$ in order to find the net effect. Since this is negative, Equilibrium 2 will be more likely. For an asymmetric region, we know from (15) that government 2 never intervenes. Therefore, only Equilibria 4 or 2 obtain. Since the derivative in (17) is negative for sufficiently different countries, Equilibrium 2 will be more likely as integration proceeds. This proves the first part.

Notice that under Equilibrium 1 subsidies increase with integration. Also, subsidies under Equilibrium 2 equal Δ_{11}^{AG}, the derivative of which with respect to τ may be written as:

$$\frac{\partial \Delta_{11}^{AG}}{\partial \tau} = \frac{1}{72}(14-9\alpha-c_1(5\alpha+18)+c_2(7\alpha+2)-(a_1-2a_2)(7\alpha+2)-10\tau-35\alpha\tau)$$

This is positive for sufficiently similar sizes. Hence subsidy expenses rise with integration.

Proof of Proposition 7

Whenever Equilibrium 1 prevails, there is social waste. We should simply look how α affects resulting equilibrium. Differentiating the relevant thresholds with respect to α yields:

$$\begin{aligned}\frac{\partial F^{***}}{\partial \alpha} = \frac{\partial \widetilde{F}}{\partial \alpha} &= \frac{1}{9}\left[(a_2-2c_1+c_2-2\tau)^2+(a_1-2c_1+c_2+\tau)^2\right]\\ &\quad -\frac{1}{16}\left[(a_2-3c_1+1+c_2-2\tau)^2+(a_1-3c_1+1+c_2+\tau)^2\right]\\ \frac{\partial \widehat{F}}{\partial \alpha} = \frac{\partial \chi_{21}^{GG}(2)-\Delta_{12}^{GG}}{\partial \alpha} &= 0\end{aligned}$$

where the last expression determines whether subsidy competition takes place for low fixed costs, as shown in Equation (16). Recalling that $c_1 \geq 1$, it becomes evident that the sign of the first derivative is positive.[24] Recall as well that an increase in both $\widetilde{F}$ and F^{***} expands the areas in which Equilibrium 1 is possible. We know from Proposition 3 that Equilibrium 1 (for high acquisition prices) implies social waste. Thus tougher competition for corporate targets should lead to increased harmful subsidy competition, all else equal. This completes the proof.

[24] Notice that it is equal to twice the acquisition price when $\alpha = \frac{1}{2}$, and hence must be positive.