DISCUSSION PAPER SERIES

No. 2468

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INTERNATIONAL TRADE

Centre for Economic Policy Research

ISSN 0265-8003

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Discussion Paper No. 2468
June 2000

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CEPR Discussion Paper No. 2468

June 2000

ABSTRACT

On the Welfare Effects of Competition for Foreign Direct Investments*

This Paper studies the effects of subsidy competition for the location of a multinational enterprise (MNE). We assume that a (poorer) region enjoys larger gains from the positive externalities associated with the inward investment but that the MNE would find it more profitable to locate to the other (richer) region, subsidies being equal. In this setting, subsidy competition can improve aggregate welfare relative to a policy that bans grants because it gives the chance to the region that needs it more to attract the investment. The Paper analyses under which conditions this is the case, assuming either that the multinational *a priori* decided to invest abroad or that exports are a feasible alternative to foreign direct investments (FDI). The welfare effects of subsidy competition can, accordingly, be extremely different.

JEL Classification: F23, H73, H87
Keywords: tax competition, foreign direct investments, business location

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* I am especially grateful to Massimo Motta for his guidance and encouragement. I would also like to thank Pedro Barros, Antonio Cabrales, Bruno Cassiman and Stephen Martin for their helpful comments and suggestions. Comments from seminar participants at Universitat Pompeu Fabra, LSE, ESEM98, IUE, University of Copenhagen and Humbold University are also gratefully acknowledged. The usual disclaimer applies. This Paper is produced as part of a CEPR research network on Foreign Direct Investment and the Multinational Corporation: New Theories and Evidence, funded by the European Commission under the Training and Mobility of Researchers Programme (Contract No ERBFMRX-CT98-0215).

Submitted 20 September 1999

NON-TECHNICAL SUMMARY

Since foreign investments are increasingly courted worldwide as providers of jobs and new technology, when a company announces it is looking for a new site, fierce competition among eager suitors often arises. This happened with Toyota, which announced its intention to produce its smallest car in Europe and made it clear it planned to take advantage of financial assistance where it was offered. Similarly, bids from various regional development agencies were solicited by Acer, Taiwan's biggest computer company, when it announced it was considering locations for its first full-scale European manufacturing plant. For this reason, the debate about the consequences of bidding wars for Foreign Direct Investment (FDI) is open.

The aim of this Paper is to provide some insight into this issue. It is often held that competition for FDI results in a waste of resources: either the firm receives a transfer from a jurisdiction where it would have located anyway, in the absence of any incentive; or competition escalates into a bidding crescendo that injures all the involved jurisdictions. This argument motivates the attempts of some Governments to limit competition in this sphere.

However, this Paper suggests that competition for FDI can facilitate efficiency-enhancing location decisions that would have not been made otherwise.

In particular, we assume that benefits associated to a firm's investment differ across potential locations but the investing firm ignores these externalities. In other words, we assume that a (poorer) region enjoys larger gains from the positive externalities associated with the inward investment but that the multinational enterprise (MNE) would find it more profitable to locate to the other (richer) region, subsidies being equal.

In this setting, first, we show that under some conditions the possibility to offer subsidies allows the depressed region to overbid the other one and to 'win' the location of the MNE. This would never happen if subsidies were forbidden or standardized. For this reason, the depressed region never loses from subsidy competition (relative to a situation in which incentives are banned), while the more advanced one never gains.

Moreover, we show that subsidy competition increases total welfare if the depressed region obtains the investment, if the positive externality associated to it is sufficiently strong and if the difference (for instance in terms of unemployment or technological level) between the two regions is sufficiently high. In such a case, subsidy competition leads the investment where otherwise it would not have gone, namely in the region where it generates the

largest welfare gain, so large as to outweigh the costs in terms of rents transferred to the MNE and of losses of the other country.

We also show that the welfare gains associated with this possibility can be maximized if an institution, concerned with total welfare, makes the two countries collude to transfer to the MNE the lowest possible subsidy compatible with the aim of leading the investment where it is valued the most. The conclusions obtained are consistent with the European regulation in this sphere.

These results have been derived assuming that the MNE has *ex-ante* decided to invest abroad, in the sense that it finds it more profitable to invest rather than to export, even if subsidies are not offered. We also study the case in which the MNE *a priori* does not exclude the possibility to export instead of investing in one of the two regions. The distinction is relevant because the welfare effects of subsidy competition can significantly change.

In particular, the beneficial effects associated to subsidy competition are stronger or weaker according to how much the fact that the MNE exports is valued by each region.

The intuition is that while the fact that the MNE exports is quite undesirable for the regions, the possibility to offer incentives prevents the worst alternative occurring and whenever the MNE locates, total welfare increases. Conversely, when the welfare level associated with the fact that the MNE exports is not that low, while the welfare gain relative to its location in the rival region is more relevant, subsidies create the incentive for the regions to waste resources competing strongly one against the other and therefore banning the option of offering them would be welfare improving. This argument emphasizes that the alternatives available to the MNE play an important role in determining whether subsidy competition has negative consequences or not.

Finally we study some extensions to the basic model. We evaluate how the conclusions can change according to the distribution of the bargaining power between countries and the MNE; we briefly analyse the case in which there is uncertainty about the benefits associated to the FDI when the countries offer their bids.

1 Introduction

When establishing new plants overseas, multinational firms (MNEs) are often offered substantial investment incentives by host countries. Examples can be found in a number of sectors and countries[1]. Just to mention some striking cases, LG Electronics, the South Korean group, received Pounds 247m for an investment in a semiconductor and electronics plant in South Wales[2]; Alabama attracted a Mercedes-Benz factory with a package worth over $250m[3] in what is considered a high-water mark in the annals of state-aid. When Ford and Volkswagen inaugurated AutoEuropa, a joint venture which is Portugal's biggest foreign investment and the largest manufacturing project ever undertaken in the country, one third of the Es395bn invested were contributed by the Government[4].

Since foreign investments are increasingly courted worldwide as providers of jobs and new technology, when a company announces it is looking for a new site, fierce competition among eager suitors often arises. This happened with Toyota, which announced its intention to produce its smallest car in Europe and made it clear it planned to take advantage of financial assistance, where it was offered[5]. Similarly, bids from various regional development agencies were solicited by Acer, Taiwan's biggest computer company, when it announced it was considering locations for its first full-scale European manufacturing plant. Eventually the company decided to locate in Wales, but the North-East England Development Agencies alleged that Wales had involved in "unfair" practices to win the FDI to the detriment of North-East England.[6].

These few examples show that bidding wars among countries or regions to attract FDI are often intense and the debate about their consequences is open[7].

The aim of this paper is to provide some insight into this issue. It is often held that competition for FDI results in a waste of resources: either the firm receives a transfer from a jurisdiction where it would have located anyway, in the absence of any incentive; or competition escalates into a bidding *crescendo* that injures all the involved jurisdictions. This argument motivates the attempts of some Governments to limit competition in this sphere. For instance, in UK the IBB (Investment in Britain Bureau) has established common guidelines that financial assistance offered by the single regional agencies should respect. In the USA, there is support for Congress to mandate an end to the incentives wars by banning subsidies[8].

However, this paper suggests that competition for FDI might have a positive role: it might facilitate efficiency-enhancing location decisions that would have not been made otherwise. In

[1] To our knowledge, very few data have been collected about these deals. For this reason, most studies refer to anecdotal data.

[2] Financial Times, July 24, 1997.

[3] Financial Times, November 18, 1997.

[4] Financial Times, November 8, 1995.

[5] Financial Times, April 14, 1997.

[6] Financial Times, December 22, 1997.

[7] For example, see The Economist, February 1, 1997.
Besides, this issue was the focus of a Conference (The Economic War Among the States) held in Washington D.C. on May 21-22, 1996. For a review of the main points raised by the discussion, see the magazine of the Federal Reserve Bank of Minneapolis, "The Region" (special issue), June 1996.

[8] See Burstein and Rolnick (1995).

particular, it assumes that one potential location (for instance, a depressed region) benefits more from the inward FDI; yet, the MNE finds it more profitable to locate in the other (richer) region, subsidies being equal. In this case, subsidy competition might succeed in changing the firm's incentives and might be the "invisible hand" that channels society's resources where they are valued the most and where they would have not gone if subsidies were banned or standardized. Hence, a trade off arises: banning subsidies (or imposing uniformity) helps avoiding that incentives reach excessively high levels due to the "externality problem", but it prevents competition from performing its allocative function and is not necessarily beneficial. Indeed, subsidy competition is shown to increase total welfare if the depressed region obtains the investment, if the positive externality associated to it is quite strong and if the difference between the two regions is sufficiently high.

Obviously, the previous trade-off could be solved by a supra-national authority which would try to capture the positive role of subsidies avoiding that countries waste resources bidding one against the other. To do it, it would allow only the depressed region to offer subsidies and only when it competes with a rival one sufficiently advanced and the positive externality is sufficiently strong or when the externality is extremely strong. Both the regions are forbidden to offer subsidies otherwise. These conclusions are consistent with the European regulation in this sphere (art. 87-89 of the EU Treaty) and emphasize an idea that is receiving support also at WTO level.

These results have been derived assuming that the MNE has pre-committed to investing in one of the two countries. We also study the case where the firm has the option to serve both markets by exporting from its home base. It is shown that the national and aggregate welfare effects of subsidy competition can be very different in these two cases. This suggests that all the feasible alternatives available to the MNE must be taken into account when assessing whether subsidy competition might have negative consequences or not.

This paper is related to several strands of literature. First, to the public finance literature which has studied the problem of competition among jurisdictions according to two main approaches. The "Tiebout tradition" emphasizes that intergovernmental competition leads to an efficient provision of local public goods and allocation of the economic activity, thereby pointing out the risks of imposing uniformity and of preventing competition. However, this approach is not very reasonable when dealing with state-aid schemes for FDI, especially with incentives to specifically targeted firms.

A second approach addresses the issue of tax competition assuming different jurisdictions attempting to tax capital earnings within their boundaries, when capital is mobile among them and using tax revenues to provide public goods. For the well known externality problem, the resulting competition is inefficient because it determines too low tax rates and the underprovision of public goods. Anything that limits this kind of competition is, therefore, desirable[9].

[9]See Wildasin and Wilson(1991) for a comprehensive overview of models with symmetric countries; Bucovesky(1991) and Wilson(1991) for models with countries different in size.

Yet, this literature is more appropriate when dealing with *competition for portfolio investments* rather than *for FDI*[10]. Recently the distinction between capital and firm mobility has been stressed[11], and the characterizing features of FDI have been taken into account in modelling intergovernmental competition. However, as long as it is assumed that countries are symmetric, conclusions are very similar to the previous ones. Since there is no social gain from the MNE's location in a jurisdiction rather than in another, the only element at work is the externality problem which keeps subsidies away from their efficient level. This would give a rationale for a ban on subsidies or to a policy of state-aid control[12] like in Markusen, Morey and Olewiler (1995) and in Haaland and Wooton (1999). Similarly, when the benefits associated to the FDI are assumed to differ across potential locations[13] but the investment profile determined by subsidy competition is the same as in the case in which incentives cannot be offered, conclusions do not change: competition has no positive effects and merely results in a waste of resources, as in Haufler and Wooton (1999).

The results of the analysis might dramatically change if letting governments compete through subsidies alters the MNE's incentives with respect to the case in which subsidies are ruled out. Competition performs this role in the model of Black and Hoyt (1989) and of Haaparanta (1996), but the welfare effects associated to it are not studied. Barros and Cabral (1999) investigate this issue. They show that a small country with higher unemployment benefits from engaging in a subsidy game and that total welfare may be higher in equilibrium with respect to the case in which subsidies are forbidden. Their work is the closest to ours, but we generalize their analysis in many respects. First, a general set up is adopted which encompasses different sources of welfare gains associated to a firm's investment and which relies on general payoffs. Moreover, while they assume that FDI is always done in one of the two countries, we study also the case with an exporting option. Finally, this paper considers a number of extensions to the basic framework: first, it analyses the solution that maximizes the total welfare of the two countries; second, it briefly discusses how the conclusions can change according to the distribution of the bargaining power between countries and the MNE and the case where there is uncertainty about the benefits associated to the FDI when the countries offer their bids.

Competition for FDI has been studied also in a dynamic framework by King and Wellig (1992), King, McAfee and Wellig (1993) and by Besley and Seabright (1999). In particular the last work shows that intergovernmental competition may induce an inefficient investment profile because countries' bids for the investment today may be distorted by the burden of the subsidies expected for the future, thereby failing to reflect the intrinsic benefits yielded by the investment.

[10] See Markusen (1995), for a distinction between the two.

[11] Doyle and van Wijnbergen (1984) and Bond and Samuelson (1986) first take into account this distinction and study the location choice of a specific profit-making firm. However, they assume that the firm bargains with only one government at a time and do not describe a proper bidding war. Black and Hoyt (1989) introduce the auction in the framework, assuming a firm that simultaneously negotiates with several governments.

[12] This kind of models can be essentially associated to the literature on "strategic trade policy".

[13] As suggested by the literature on the "new economic geography".

The rest of the paper is organized as follows. In section 2, the model is presented. Section 3 solves the subsidy game and analyses its welfare effects when exports are not an alternative to FDI. Section 4 relaxes this hypothesis and presents a parametric model which helps clarifying the issue. Section 5 concludes the paper.

2 The model

We consider two countries or regions, (A and B), each one willing to attract a manufacturing plant of a producer from a third country, that we denote as the MNE.

The MNE's problem is whether to set up an affiliate in one of the two regions (and in which of the two) or not to invest abroad and hence to export from its country of origin. If the MNE exports, it bears a trading cost per unit of output equal to t (which is the same for serving both regions). We assume that t is significantly higher than the transportation costs (say t'[14]) between the two regions. If the MNE invests abroad, it incurs a set-up cost F, independent of the volume of output[15].

When locating in a region, the MNE determines a positive externality, for which a variety of explanations have been identified. For instance, FDI can have a positive impact on local employment[16] and on real wages[17]; the MNE's more advanced technology may spill over local firms[18] (through imitation, reverse engineering or turnover of domestic employees from the MNE to local firms) which thus, may increase their productivity; obviously technological spillover may benefit also consumers; FDI, as channel of technological diffusion may have a positive impact on the rate of technological progress and on the growth rate of the host economies[19]; the MNE's entry in an industry may introduce additional competition, thereby increasing overall welfare; moreover, even if such competition may damage local firms, it may stimulate the development of the local suppliers' industry which, in turn, can benefit final-goods local producers through subsequent forward-linkages. In some cases, MNEs can act as catalyst for the development of local production[20]; MNEs' location can also increase the variety of goods and services available in the host market, or may provide them at a lower price.

Obviously, there may be also costs associated to the MNEs' location in a region. They com-

[14] t' can be interpreted as a measure of the integration between the two regions. If $t' = 0$, the two regions are completely integrated. In the parametric example illustrated in Section 4 we adopt this assumption and we discuss its consequences.

[15] We assume that fixed costs are high enough so that the MNE does not find it profitable to set up a plant in each region; equivalently that transportation costs between the two regions are low enough.

[16] The creation of jobs related to FDI can be substantial. For instance, in UK, the new foreign investments recorded from January to April 1997 created nearly 50,000 jobs; 6,000 of them were generated by the investment of LG Electronics in South Wales (Financial Times, November 5, 1997).

[17] See DeBartolome and Spiegel (1995).

[18] For an extensive review of theoretical results and empirical evidence about technological spillovers see Blomström and Kokko (1998). More recently Braconier and Sjöholm (1999), Baldwin et al. (1999) and Bloström and Sjöholm (1999) find evidence of international R&D spillovers through inward FDI.

[19] For recent contributions see Baldwin et al. (1999) and Barrell and Pain (1997, 1999).

[20] See Markusen and Venables (1999) and Haaland and Wooton (1999) for a theoretical analysis of this role of MNEs and Hobday (1995) for case-study findings.

prehend the costs of foreign ownership of local factors of production and of the loss of control of the domestic economic activity; MNEs might extract know-how from the host economy[21] or might exploit all the locational advantages without creating stable linkages; FDI might also determine anti-competitive effects; moreover, the high dependency on foreign MNEs might lead to instability: the perceived danger is that the external circumstances might change in such a way that the economy over a very short period loses its attractiveness for FDI, entailing substantial adjustment costs. However, in this model the benefits of inward FDI are assume to dominate the costs, otherwise countries or regions would not actively promote FDI's attraction.

The previous observations are translated in the assumptions that the welfare of a region when obtaining the location of the MNE (denoted by W_i^{Ii}, $i = A, B$) is higher than the welfare when the MNE locates in the rival region (denoted by W_i^{Ij}, $i, j = A, B$):

$$\begin{aligned} \Delta W_A &= W_A^{IA} - W_A^{IB} \geq 0 \\ \Delta W_B &= W_B^{IB} - W_B^{IA} \geq 0 \end{aligned} \tag{1}$$

Moreover, the welfare gains positively depend on the intensity of the externality, captured by the parameter ϕ (the more effective the diffusion of the modern technology or the larger the creation of new jobs the higher the benefit enjoyed by the host region):

$$\Delta W_i = \Delta W_i(\phi) \qquad \text{with } \frac{\partial \Delta W_i(\phi)}{\partial \phi} > 0 \tag{2}$$

where $i = A, B$ and $\phi \in \left[\phi^{\min}, \phi^{Max}\right]$ [22].

Since the aim of the paper is to analyze the effects of subsidy competition when regions differ in the way they benefit from inward FDI, one region (region B) is assumed to enjoy a higher welfare gain than the other:

$$\Delta W_B(\phi) \geq \Delta W_A(\phi) \qquad \text{for } \phi \in \left[\phi^{\min}, \phi^{Max}\right] \tag{3}$$

B can be thought as a *depressed region* while A is a *more advanced economy,* for instance with a lower level of unemployment or technologically more advanced. The idea is that a given amount of new jobs is valued less where the level of unemployment is lower or that the lower the technological lag of a region, the lower its increase of productivity as a consequence of the imitation of a MNE's modern technology[23]. Hence, the additional welfare gain enjoyed by region B increases with the difference between the two regions, expressed by the parameter α. A simple way to model this idea is to assume that:

$$\Delta W_B(\phi) - \Delta W_A(\phi) = g(\alpha)\,\Delta W_A(\phi) \equiv \Delta(\alpha, \phi) \tag{4}$$

[21] Kogut and Chang (1991) and Neven and Siotis (1996) find evidence for technology sourcing as a motive for FDI.

[22] The idea is that if $\phi < \phi^{\min}$ the externality is not strong enough so that the benefits of inward FDI dominate the costs and $\Delta W_i(\phi) < 0$. For instance, if the spillover effect and hence the increase of productivity of local firms is not strong enough, it does not outweigh the "competition effect" and local firms are driven out of the market.

[23] Barrell and Pain (1997) provide some evidence that the spillover effects generated by inward investments are more apparent and more quickly felt where domestic producers are relatively less productive.

where $\alpha \in [0,1]$ while $g(\alpha)$ is strictly increasing and convex in α and it is such that $g(0) = 0$ (when the regions are perfectly symmetric they enjoy the same welfare gain).

Note that the previous formulation also implies that:

$$\frac{\partial \Delta(\alpha, \phi)}{\partial \phi} = g(\alpha) \frac{\partial \Delta W_A}{\partial \phi} \geq 0 \tag{5}$$

In other words, the stronger the externality, the higher the difference between the benefits enjoyed by the two regions. For instance, the higher the creation of employment, the more relevant is the additional welfare gain that the depressed region enjoys relative to the more advanced one; the more effective the diffusion of the MNE's modern technology, the higher the increase of productivity of the country lagged behind relative to the increase of the more advanced country and thus the higher the difference between the benefits enjoyed.

Finally, it is required that when the difference between the region is at the highest the additional welfare gain of the depressed region is sufficiently high (*i.e.* $g(1) > 1$) and so it is when the externality is very strong $\left(i.e.\ \Delta W_A\left(\phi^{Max}\right) > \max\left\{\frac{\Pi_M^{IA}}{g(1)-1}, \frac{\Pi_M^{IA}}{g'(0)}\right\}\right)$.

The two regions differ also from the point of view of the MNE, in the sense that its profits (denoted by Π_M^{Ii}, with $i = A, B$) are higher when it locates in the region that needs less the investment. For instance, this region is more advanced and has better infrastructures, higher per-capita income and better access to adjacent markets; skilled labour force or specialized input suppliers are available and it offers agglomeration economies[24] to exploit. Obviously, the more advanced is the region, the stronger the MNE's preference for locating there. These ideas are translated in the assumptions that $\Pi_M^{IA} \geq \Pi_M^{IB}$ and that, for simplicity:

$$\Pi_M^{IA} - \Pi_M^{IB} = \alpha \Pi_M^{IA} \geq 0 \tag{6}$$

Overall, the higher the difference between the two regions, the higher the additional welfare gain of the region that needs more the investment, but also the higher its "handicap" in the MNE's location choice[25].

In order to attract the MNE, the two regions offer lump-sum subsidies[26] denoted by T_A and T_B. The government is assumed to make a valid commitment about subsidies whose burden is distributed across the population in a lump-sum fashion. Each country's objective function is total

[24] Head et al (1995) and Barrell and Pain (1999) provide evidence that agglomeration economies can be relevant for location decisions.

[25] The assumption that both the difference of welfare gains between the two regions and the difference of the MNE's profits depend on the same parameter α is a simplification. There could exist different reasons why the MNE finds it less profitable to locate in one region and why the same region benefits more from the investment. However, the essence of the results would remain the same. It could also be the case that the MNE finds it more profitable to locate in the depressed region, for instance, to take advantage of lower factor costs. In this case without paying subsidies the region which values more the investment would be able to obtain it, so that letting government compete through subsidies would be definitely inefficient. However, it should be noted that, recently, the fast-growing companies are shifting to higher rather than lower factor cost areas, to benefit from elements like the ones previously described.

[26] Actually, incentives can be provided in a very wide range of forms: cash grants, like we are assuming, tax breaks or tax holidays, favourable financing or loans at below market rates, public expenditure for roads or airports or workers training. Moreover these kind of incentives are more and more often complemented by an intensive promotional and assistance activity.

domestic welfare. The ownership of the MNE is assumed to be dispersed around the world so that its profits are not included in the regional welfare.

The timing of the game is the following:

- at $t = 0$, the MNE announces it is considering the possibility to invest abroad.
- at $t = 1$, both regions simultaneously set the level of subsidies offered to the MNE (conditional on her locating in its territory).
- at $t = 2$, the MNE decides whether to export or to invest abroad and in the latter case where to locate.
- at $t = 3$, the externality associated to the investment of the MNE (if done) provides its effects and the equilibrium payoffs for the MNE and for the competing regions are determined.

The analysis begins with the last stage and works backward to solve for the subgame perfect Nash equilibrium.

Three possible configurations can arise at the last stage[27]: (i) The MNE decides to export. This case is denoted by **(E)**. (ii) The MNE decides to invest in region A. This case is denoted by **(IA)**. (iii) The MNE decides to invest in region B. This case in denoted by **(IB)**. For each configuration the MNE's equilibrium profits and the welfare of the two regions are denoted as follows:

*Case (***E***):* the MNE exports.

$\pi_M^E = \Pi_M^E(t)$

$w_i^E = W_i^E$ with $i = A, B$.

*Case (***IA***):* the MNE invests in region A.

$\pi_M^{IA} = \Pi_M^{IA} - F + T_A$.

$w_A^{IA} = W_A^{IA} - T_A$

$w_B^{IA} = W_B^{IA}$.

*Case (***IB***):* the MNE invests in region B.

$\pi_M^{IB} = \Pi_M^{IB} - F + T_B$.

$w_A^{IB} = W_A^{IB}$

$w_B^{IB} = W_B^{IB} - T_B$.

The analysis is continued distinguishing two main cases. One in which the MNE has decided *ex−ante* to invest abroad; a second case in which the MNE *a priori* does not exclude the possibility to export instead of investing in one of the two regions.

This distinction in relevant because, as the next two sections will make clear, the welfare effects of the subsidy game can be very different according to which one is the case.

[27] We exclude the uninteresting case where the MNE finds it more profitable not to sell in the market.

3 Exports are not an alternative to investments

This section assumes that the MNE finds it more profitable to invest abroad rather than to export even if no subsidies are offered.

More formally:

$$\pi_M^{IA}\left(T_A = 0\right) > \pi_M^E \tag{7}$$

This condition is more likely to be satisfied the lower the fixed set-up costs and the higher the transportation costs from the MNE's country of origin.

3.1 Choice of location by the multinational

The MNE decides to locate in region B when $\pi_M^{IB} > \pi_M^{IA}$, that is when

$$T_B > T_A + \Gamma \tag{8}$$

where $\Gamma = \Pi_M^{IA} - \Pi_M^{IB} = \alpha \Pi_M^{IA} \geqslant 0$.

When the two regions are perfectly symmetric $(\alpha = 0)$, they are absolutely equivalent for the MNE's location choice and each one would only need to offer a subsidy slightly higher than the other to obtain the FDI. Instead, if $\alpha > 0$, the MNE makes higher profits when locating in the more advanced region and hence, to attract the investment, the depressed region has to pay a subsidy greater by the amount Γ than the subsidy offered by the rival one. The higher the difference between the two regions (the higher α), the higher the additional costs that the MNE bears when locating in the depressed one, the higher the "premium" to be paid by such region to obtain the investment.

3.2 The subsidy game

In this section the equilibria resulting from the subsidy game[28] are studied and it is shown that, even if the multinational has a "preference" for the more advanced region, there are cases in which the depressed one succeeds in winning the subsidy game.

The maximum bid that each region is willing to offer is the one for which it is indifferent between attracting the MNE and the MNE locating in the other region:

$$T_A^{Max} \text{ is such that } w_A^{IA}\left(T_A = T_A^{Max}\right) = w_A^{IB}\text{; therefore, } T_A^{Max} = \Delta W_A$$
$$T_B^{Max} \text{ is such that } w_B^{IB}\left(T_B = T_B^{Max}\right) = w_B^{IA}\text{; therefore, } T_B^{Max} = \Delta W_B$$

[28] Our analysis, for semplicity's sake, is developed assuming complete information; however, this subsidy game gives the same equilibrium outcome as the one resulting in a more realistic framework with incomplete information about the bidders' valuations, with heterogeneity of the seller preferences over the bidders and in which the bidding process is conducted according to an "open ascending auction" with full handicaps. A number of examples provide likelihood to this kind of auction. They illustrates cases in which the firm approaches sequentially the various locations, somehow negotiating a recruitment subsidy with the first jurisdiction and then going to another and asking it to match the offer or offer a better deal, with the previous one still allowed to win the location decision by making further counteroffers. See Nunn, Klacik and Schoedel (1996) or Gibson and Rogers (1994) for a detailed description of some examples.

Obviously, since region B benefits more than region A from the FDI, it is willing to offer more. Yet, it is not obvious that it wins the auction, because it suffers the disadvantage Γ in the MNE's location choice. Indeed, region B must benefit so much that, despite the premium to be paid, succeeds in overbidding region A. In other words,

(i) the region that needs more the investment wins the auction when $T_B^{Max} - \Gamma > T_A^{Max}$[29]. An equilibrium exists if region A offers any subsidy belonging to $\left[T_A^{Max}, T_B^{Max} - \Gamma\right]$ and region B offers Γ more than its rival. Among all these equilibria, the unique one that is not weakly dominated is chosen:

$$\begin{cases} T_A = T_A^{Max} \\ T_B = T_A^{Max} + \Gamma \end{cases} \tag{9}$$

(ii) the more advanced region obtains the FDI when $T_A^{Max} \geq T_B^{Max} - \Gamma$. The possible equilibria are such that region B offers any subsidy belonging to $\left[T_B^{Max}, T_A^{Max} + \Gamma\right]$ and region A offers $T_B - \Gamma$. The equilibrium that is not weakly dominated is:

$$\begin{cases} T_A = T_B^{Max} - \Gamma \\ T_B = T_B^{Max} \end{cases} \tag{10}$$

The following Lemma describes which equilibrium is likely to emerge according to the values of the relevant parameters.

Lemma 1 *: There exists critical values ϕ^* and ϕ^{**} (with $\phi^* < \phi^{**}$) such that:*

- if $\phi \leq \phi^*$ the region that needs more the MNE's investment never obtains it.

- if $\phi^* < \phi < \phi^{**}$ the region that needs more the MNE's investment obtains it iff $\alpha > \alpha^*(\phi)$

-if $\phi \geq \phi^{**}$ the region that needs more the MNE's investment obtains it for any $\alpha > 0$.

Proof. See the Appendix.

According to Lemma 1, the region that needs more the investment manages to obtain it either when the externality is extremely strong or when the latter is sufficiently strong and competition takes place between two regions which are sufficiently different, for instance a depressed region and a rival one advanced enough. The intuition is that the weaker the externality, the lower the difference of the welfare gains between the two regions; hence, when ϕ is low enough, the additional welfare gain of the region that needs more the investment is never sufficiently large to compensate its disadvantage in the MNE's location choice and, therefore, to win the auction. Conversely, when the externality is extremely strong, this region overbids the rival one in any case. Instead, when ϕ lies in-between these two extreme values, the difference between the two regions must be sufficiently relevant in order to make the additional welfare gain of the "depressed" one high enough to compensate the higher costs the MNE incurs when locating there. Note that the threshold $\alpha^*(\phi)$ is decreasing in ϕ. The reason is that the higher ϕ, the higher the additional welfare gain of the region that values more the investment and the easier for it to win the auction.

[29]For simplicity, we assume the following tie-breaking rule:

region A wins all ties if $T_A^{Max} \geq T_B^{Max} - \Gamma$
region B wins all ties if $T_B^{Max} - \Gamma > T_A^{Max}$.

3.3 The welfare analysis

3.3.1 The non-cooperative solution

It is usually thought that intergovernmental competition to support the location of firms in particular countries or regions mainly results in a waste of resources: either the firm receives a transfer from a jurisdiction where it would have located anyway or competition escalates into a bidding *crescendo* that injures all the involved jurisdictions. Therefore, all the participants would be at least as well off if no subsidies were given.

This section shows that this argument fails to be true when countries or regions are asymmetric in the benefit they enjoy from the MNE's investment. In such a case, as the following Propositions will illustrate, the region that needs more the investment suffers a welfare loss if subsidies are forbidden. On top of this, also the joint welfare of the two regions may decrease when subsidies are ruled out with respect to the case in which governments are allowed to "bid" for firms.

Proposition 2 *: When exports are not an alternative to FDI, the region that needs less the investment always loses from the existence of a subsidy game.*

Proof: When region A overbids the rival region, its welfare change relative to the case in which subsidies are banned is $w_A^{IA}\left(T_A = T_B^{Max} - \Gamma\right) - w_A^{IA}\left(T_A = 0\right)$. It is clearly negative since the MNE locates in region A anyway if no subsidies are paid and this region has to waste resources to maintain the same location decision. When region B wins the subsidy game, the welfare change is $w_A^{IB} - w_A^{IA}\left(T_A = 0\right) = -\Delta W_A$ which is negative by assumption. ■

Proposition 3 *: When exports are not an alternative to FDI, the region that needs more the investment never loses from the existence of a subsidy game.*

Proof: When region A obtains the FDI, the equilibrium welfare of region B does not change relative to the case in which subsidies can not be offered. When region B overbids region A the result is just the opposite; first, when subsidies are not allowed it never succeeds in obtaining the location of the MNE; second, region B's equilibrium bid is strictly lower than the level of subsidy for which it is indifferent between having or not having the MNE; thus, $w_B^{IB}(T_B = T_A^{Max} + \Gamma) > w_B^{IA}$ and the welfare change of the depressed region is positive. ■

Thus, when the "advanced" region obtains the FDI, subsidy competition is obviously inefficient, since regions waste resources in the counterbidding process and the MNE receives a grant from the region where it would have located anyway. However, as shown, the possibility to offer subsidies generates a welfare gain when it changes the MNE's decision, so that it locates in the other region. In this case, competition leads the investment where it is needed more and where otherwise it would not have gone and a trade-off arises: banning subsidies (or imposing uniformity) helps avoiding that incentives reach excessively high levels due to the externality problem but it prevents

competition from performing its allocative function. This might indeed cause a reduction of the joint welfare of the two regions with respect to the case in which offering subsidies is allowed. As shown in Proposition 4, this happens when the positive externality associated to the inward FDI is sufficiently strong and when competition takes place between very different regions, for instance between a depressed region and a region which is significantly advanced. When this is the case, the additional welfare gain of the region that needs more the investment is so high that not only allows to overbid the rival region and to obtain the MNE's location but also compensates the rival region's welfare loss.

Proposition 4 *: When exports are not an alternative to FDI, total welfare increases iff the region that needs more the investment obtains it,* $\phi > \phi^{***}\ (> \phi^{*})$ *and* $\alpha > \alpha^{**}(\phi)\ (> \alpha^{*}(\phi))$.

Proof. See the Appendix.

3.4 Extensions

3.4.1 The cooperative solution

The trade-off between the externality problem and the allocative function associated to subsidy competition could be solved by a supra-national authority, concerned with the joint welfare of the two regions but unable to control the behaviour of the MNE, which can enforce rules about the possibility to offer subsidies. Such an institution would try to capture the positive role of subsidies to facilitate an efficient allocation of the economic activity, paying the minimum amount needed for this to happen. Thus, first it would forbid the "advanced" region to offer subsidies, so that the other one has to pay only the amount Γ to win the auction. Second, it would allow the region that needs more the investment to offer subsidies only when its welfare gain, net of the subsidy paid, is larger than the welfare loss of the other region. This is the case either when the intensity of the positive externality is sufficiently high and the "depressed" region competes with a rival sufficiently advanced or when the externality is extremely strong. Both the regions are forbidden to offer subsidies otherwise. Obviously both regions are better off with respect to the uncooperative case, even if individually they would always have incentive to deviate from this solution.

Proposition 5 *:To maximize total welfare, only the region which needs more the investment is allowed to offer subsidies, and only when* $\phi > \phi^{**}$ *or* $\phi^{*} < \phi \leq \phi^{**}$ *and* $\alpha > \alpha^{*}(\phi)$.

Proof. : See the proof of Lemma 1: the condition for the region that needs more the investment to be allowed to offer subsidies ($\Delta W_B - \Gamma > \Delta W_A$) and the condition for such region to win the auction coincide. ■

This analysis reflects the rationale of the European regulation in this sphere. In the EU there does not exists a specific discipline for MNEs' incentives, which are regulated applying the general legislation about state-aids (which, however, cover most of FDI incentives), contained in art. 87-89

(ex 92-94) of the Treaty of the EU. In principle, state aids are forbidden because they threaten fair competition between Member States. However the Commission can allow to offer incentives when they promote a development in the interests of the Union, like reviving depressed regions (art. 87(3a)). Each case must be notified to the Commission which will judge whether the previous criterion is satisfied or not, and will assess whether the type and volume of the aid are appropriate for the objectives which are hoped for.

In other words, the Commission distinguishes between *advanced* and *depressed* regions; only the latter can provide grants[30] and only when the investment is likely to generate a *significative benefit*. Besides, to avoid that too high resources are wasted when depressed regions compete one against the other, the Commission tries to curb the amount of incentives paid and imposes specific ceilings to the financial support that can be offered: in the case of regions falling under Art. 87(3a) the net aid allowed varies from region to region, with the maximum being 75% of the investment cost of the project[31]; for those regions under Art 88(3c) the net aid allowed also varies from region to region: the highest is 30%. Moreover, the European Court of Justice has decided that the Commission can forbid regional aid for an investment that would increase overcapacity in the Union or aid that would relocate an investment from a less to a more prosperous region.

3.4.2 The MNE has more bargaining power than the competing countries

In the previous sections it was implicitly assumed that the MNE has less bargaining power than the competing regions who move first and make an offer which can only be accepted or left.

Imagine a different bargaining process: the MNE moves first and chooses one of the two regions to which it proposes its location, conditional on being paid a given amount of subsidy; the selected region can take it or leave it; if the first proposal is rejected, the MNE makes a second offer to the other region. In this case, the MNE would ask for the maximum amount that the selected region is willing to offer and would make the first offer to the depressed (advanced) one whenever $T_B^{Max} - \Gamma > T_A^{Max}$ $\left(T_B^{Max} - \Gamma \leq T_A^{Max}\right)$. As a result, it would be able to entirely capture the welfare gains determined by its location and subsidy competition would never be welfare improving. Obviously, this is an extreme case, but it suggests that in order to assess whether there can be welfare gains associated to subsidy competition it is important to take into account the capability of the MNE to extract rent from the potential host countries.

[30] The idea of strategically targeting incentives toward areas with high unemployment and depressed economic activity is gaining support also at WTO level and in the US. See, for instance, Farrell (1996).

[31] Following this criterion, a number of state-aid projects has been blocked and the repayment of funds has been demanded. However, in practise, no objections are raised to the majority of State-aid cases. One reason is that incentives are offered in many ways other than grants, which can considerably more complicated and less easily identifiable. Thus, the official position on incentives often bears little relation to the full extent of financial help made available, which the Commission can hardly assess. To solve this problem, the Commission is trying to implement a more transparent and efficient policy of state-aid control, in particular strenghtening its ability to have complete information at disposal (see, for example, the Proposal for a Council Regulation laying down detailed rules for the application of Art. 88 of the EC Treaty, 18 February 1998).

3.4.3 The winner's curse

The basic set-up presented in the previous sections can also be easily adopted to analyse a problem which is receiving a great deal of attention in the debate about the abolition of subsidies.

Imagine that when countries offer their bids the intensity of the positive externality is unknown (yet, it is common knowledge that ϕ is distributed according to a given distribution function). In expected terms the conclusions of the analysis have the same flavour as in the case in which the intensity of the externality is perfectly anticipated. However, *ex-post* when the uncertainty reveals and the true externality realizes, the actual value can be lower than expected so that the bidders may have overestimated the benefits associated to the FDI and the winner can overpay for the investment. Hence, it may be that the region that values more the investment suffers an *ex-post* welfare loss from having engaged in a subsidy game and having obtained the FDI. This issue is commonly indicated as the *winner's curse*[32] and has been discussed especially in the United States where it happened that States have paid millions dollars for a plant that promised to employ thousands workers, but the jobs actually created resulted significantly lower than promised or the plant shut down within few years[33]. At present, the problem is capturing attention also in Europe, since the severe crisis in the Far East has induced some Asiatic firms to significantly reduce the investments made in the past or indeed to close the plants installed. Investments for which generous financial incentives were paid[34].

Note, however, that it may also be the case that the realized externality is higher than expected so that the regions gain more than what estimated *ex-ante.* In other words, the message here is that banning subsidies can prevent losses occurring when future is surprisingly disappointing, but can also prevent relevant gains when anticipations are accurate or indeed cautious relative to what realizes ex-post. Hence, banning subsidies does not solve this problem[35] in which overestimations and ex-post losses may occur because the future cannot be perfectly anticipated and not for strategic behaviours. A completely different problem is the case in which the MNE realizes relevant investments and afterwards uses this fact to increase its bargaining power threatening the host country to reduce the investment or to relocate if it does not receive further financial incentives. This issue will be the focus of future research.

3.4.4 Exports are the alternative to investments

An interesting case to analyze is the one where the MNE has not pre-committed to investing in one of the two countries and may decide to serve both markets by exporting from its home base.

[32] The expression winner's curse in used a bit "loosely" relative to its precise meaning as defined by the auction theory.

[33] A famous case is the one of Pennsylvania, which spent some $70 million convincing VW to build a factory with its promised 20,000 jobs; yet the plant employed 6,000 workers and shut down within a decade. The same has happened in a number of smaller deals that did not generate headlines.

[34] Financial Times, 7 September 1998.

[35] A more appropriate instrument might be, like in the UK, to condition the grant to a "claw back" clause which enables the government to recover the grant or stop payment if the targets of capital expenditures and job creation are not being met.

As the following Section will make clear, in this context the key element is whether or not a region prefers that the MNE exports with respect to its investment in the rival location. If the MNE's exports is a quite undesirable alternative, the welfare gains associated to the possibility to offer subsidies are highly improved. The opposite might hold when the fact that the MNE exports is not that unpleasant for the competing regions. Overall, the results of the welfare analysis can dramatically change.

There are many elements to take into account when reasoning on whether a region prefers the MNE to export or to invest in the rival one. For instance, in both cases the region (say region i) does not benefit from job creation and, from this point of view, it is indifferent between the two alternatives. Eventually, it may find the latter more desirable, if some positive effects related to the increased employment in the rival region spill over it. However, locating in region j implies, for the MNE, the possibility to serve region $i's$ market baring lower costs than when it exports from its home country. This is beneficial for consumers of region i, but it may be prejudicial for its local firms. Besides, region i's local firms may be damaged by the fact that the producers of the rival region are made more efficient by the technological spillovers, when the MNE invests there, while region i's consumers may benefit from this as well as from the higher degree of competition introduced in region j's market by the MNE's entry (if the two economies are to some extent integrated). Overall, consumers tend to find the MNE's investment in the rival region more desirable than the fact that the MNE exports, while local firms have opposite preferences.

To understand which alternative is preferred to the other and to what extent, these countervailing elements must be weighed. However, to do it, it is necessary to depart form the general set up adopted up to now and to resort to a more specific model presented in the following Section. Studying this model it will be possible to compare the welfare effects of subsidy competition when exports are not a feasible alternative to FDI (Section 4.4.1) with the welfare effects when exports are an alternative to FDI (Section 4.4.2).

4 A parametric model

4.1 The set up of the model

The competing regions and the MNE: in each region there is a local firm (also denoted with A, B) that produces the same good as the MNE (denoted with M). The demand functions of this good in the two regions are given by:

$$Q_i = (1 - P_i)\,\frac{S_i}{2} \qquad\qquad i = A, B \tag{11}$$

where Q_i is total output sold in region i, P_i the associated market price and S_i a measure of the size of region i. Since differences in size are not relevant to the purpose of this work, the two regions are assumed to have the same size ($S_A = S_B = S$). Their overall market is integrated ($t' = 0$ so that exports between the two regions do not incur in transportation costs; besides, firms cannot

discriminate the price between the two markets) and $Q = q_A + q_B + q_M$ denotes the total output sold by the firms. The three firms compete *à la* Cournot and their variable production costs are assumed to be constant and are denoted, respectively, by c_A, c_B, and c_M. The MNE uses the most efficient technology while region B is the least technologically advanced so that $c_M = 0$, $c_B = \frac{1}{6}$ and $0 \leq c_A < \frac{1}{6}$. Thus, the value of c_A indicates the difference of technological level between the two regions: the lower c_A the higher the difference. Each region's total domestic welfare is given by the consumer surplus, plus the profits of the local firm minus the subsidy eventually paid. The trading cost per unit of output t born by the MNE is assumed to belong to $\left[0,\ \frac{7+6c_A}{18}\right]$ [36]. Since the overall market is integrated and the MNE incurs a set-up cost F to establish a plant, it invests only in one of the two regions if it opts for FDI.

The externality associated to the FDI: this model focuses on the *technological spillover* determined by the MNE's investment: the local firm gains partial or total access to the MNE's technology so that its production costs become $c_i\,(1-\phi)$, with $i = A, B$ and $\phi \in [0,1]$[37]. The creation of such an externality represents the reason why a region is interested in having the FDI. The parameter ϕ expresses the per cent reduction in the costs of the local firm; when $\phi = 0$ no technological spillover occurs; when $\phi = 1$ the spillover is complete: the local firm entirely appropriates the MNE's technology and becomes as efficient as it is. Note that this formulation implies that the benefits generated by the FDI are more apparent and more quickly felt where domestic firms are relatively less productive. Moreover, the stronger the spillover (the higher ϕ), the higher the absolute reduction of production costs of the region technologically lagged behind with respect to the absolute reduction of the advanced region.

The structure of the game and all the elements not specified are the same as in the general model presented in Section 2.

4.2 The last stage of the game

Solving the standard Cournot model, the equilibrium payoffs for each configuration arising at the last stage of the game are obtained.

If the MNE exports:

$$\pi_M^E = \frac{S(1+c_A+c_B-3t)^2}{96} \tag{12}$$

$$w_i^E = \frac{S(3-c_i-c_j-t)^2}{64} + \frac{S(1-3c_i+c_j+t)^2}{16} \tag{13}$$

with $i, j = A, B$ and $i \neq j$.

[36] This assumption and $c_B = \frac{1}{6}$ guarantee to have positive quantities produced by the firms in any configuration. Moreover, the latter is the maximum value of c_B such that the country lagged behind benefits from the FDI more than the advanced one.

[37] Note that, it is assumed that the spillover has only a local effect, while the market between the two regions is completely integrated. A justification of this apparent contraddiction is that a major channel for technological diffusion is the migration of local workers from MNEs to local firms. In many cases, for instance in Europe, while the goods market is highly integrated, the opposite holds for the labour market. This prevents the techonological spillover from spreading on a wide area. Morevoer, there is evidence that spillovers are local. See, for instance, Eaton and Kortum (1996), Caballero and Jaffe (1993) and Keller (1998).

The cases in which the MNE locates in region A and in region B are perfectly symmetric. Hence, if the MNE invests in region i:

$$\pi_M^{Ii} = \frac{S(1+c_i(1-\phi)+c_j)^2}{16} + T_i - F$$

$$\begin{aligned} w_i^{Ii} &= \frac{S(3-c_j-c_i(1-\phi))^2}{64} + \frac{S(1+c_j-3c_i(1-\phi))^2}{16} - T_i \\ w_j^{Ii} &= \frac{S(3-c_j-c_i(1-\phi))^2}{64} + \frac{S(1-3c_j+c_i(1-\phi))^2}{16} \end{aligned} \tag{14}$$

with $i, j = A, B$ and $i \neq j$.

4.3 The two regions' welfare gains

Profits of the local firm: the profits of the local firm are higher when the MNE invests in its region rather than in the rival's one, because in the former case it benefits from the reduction of its own costs:

$$\Delta\pi_i = \pi_i^{Ii} - \pi_i^{Ij} = \frac{S\phi}{16}(3c_i + c_j)[2 + (2-\phi)(c_j - 3c_i)] \geq 0 \tag{15}$$

for any $\phi \in [0,1]$ and $0 \leq c_A < c_B = \frac{1}{6}$. Obviously, the stronger the spillover, the higher the gain in terms of profits. Note also that $\Delta\pi_i > 0$ for any $\phi > 0$. In other words, the local firm gains in terms of profits even if the spillover is very weak. The intuition is that, given that the overall market is integrated, the "competition effect" associated to the MNE's investment that the domestic firm has to face is the same both if the MNE locates in its region or in the other one[38]. Therefore, the profit of the local firm is higher in the former case, regardless how small is ϕ, because at least it gains something from the MNE's entry in the market.

Consumer surplus: both regions' consumer surplus is higher when the MNE locates in the region technologically lagged behind (region B):

$$\Delta CS = CS^{IB} - CS^{IA} = \frac{S\phi}{64}(c_B - c_A)[6 - (2-\phi)(c_A + c_B)] \geq 0 \tag{16}$$

for any $\phi \in [0,1]$ and $0 \leq c_A < c_B = \frac{1}{6}$. The idea is that, owing to the technological spillover, the production costs of the least efficient firm are reduced and this reduction is higher than the one that would have occurred if the MNE had located in the more advanced region. Given the assumption of integrated markets, the consumers of both regions benefit from this. The gain in terms of consumer surplus rises with the intensity of the spillover because the higher ϕ the higher the additional reduction in the costs of the firm technologically lagged behind.

Overall, the difference between a region's welfare when obtaining the location of the MNE and when the MNE invests in the rival one is given, respectively, by:

$$\begin{aligned} \Delta W_A &= \Delta\pi_A - \Delta CS \\ \Delta W_B &= \Delta\pi_B + \Delta CS \end{aligned} \tag{17}$$

They verify the basic assumptions illustrated in Section 2:

[38] This would not be true if there were transportation costs between the two countries.

- Both ΔW_A and ΔW_B are positive if the technological spillover occurs. Note that in the case of the advanced region, the gain in terms of profits more than compensates the loss in terms of consumer surplus.

- They are both increasing in the intensity of the spillover. This is obvious for the region lagged behind, since $\Delta\pi_B$ and ΔCS are increasing in ϕ. Instead, in the case of the advanced region, a stronger spillover implies a larger loss in terms of consumer surplus; however, $\Delta\pi_A$ is increasing in ϕ and this effect prevails.

- $\Delta W_B \geq \Delta W_A$ because, for a given ϕ, the region which is technologically lagged behind enjoys a larger absolute reduction of production costs when obtaining the MNE's location and gains not only in terms of profits but also of consumer surplus. Since the more region B is lagged behind the larger its additional reduction of production costs, the difference between the benefits increases as the difference of technological levels increases. $\Delta W_B = \Delta W_A$ when they are perfectly symmetric (i.e. when $c_A = c_B$).

- The difference between the benefits increases as the intensity of the spillover increases. Again, the higher ϕ the higher the additional reduction of costs of the region lagged behind[39]. If no spillover occurs $(\phi = 0)$, $\Delta W_A = \Delta W_B = 0$.

- The MNE's profits are higher when it locates in the more advanced region (subsidies being equal) and the premium Γ amounts to $\frac{S}{16}\phi\left(c_B - c_A\right)\left[2 + \left(c_A + c_B\right)\left(2 - \phi\right)\right] \geq 0$. The intuition is that, locating in a region, the MNE makes the production costs of the local firm decrease (of ϕ per cent). Since the overall market is integrated, it turns out that it is more profitable to benefit the more competitive local firm (the one in country A) because the absolute reduction of costs is lower. For the same reason, $\frac{\partial\Gamma}{\partial c_A} < 0$: the lower c_A, the higher the MNE's advantage from locating in region A, the higher the "premium" to be given by region B. Similarly, the stronger the spillover, the higher the additional reduction of the region lagged behind, the higher the"premium" to be paid. Note that in this model it is the existence of the technological spillover that creates the disadvantage of the region lagged behind in the MNE's location choice. In fact, if no technological spillover occurs, $\Gamma = 0$ and the MNE is indifferent between locating in region A and in region B subsidies being equal.

4.4 The welfare effects of subsidy competition

4.4.1 Exports are not an alternative to investments

The MNE finds it more profitable to invest abroad rather than to export even if no subsidies are offered, when the following condition is satisfied:

$$F < \frac{S}{16}\left(3t - \phi c_A\right)\left[2 + c_A\left(2 - \phi\right) + \frac{1}{3} - 3t\right] \tag{18}$$

[39]The convexity assumption and the condition imposed when the difference of technological levels and the intensity of the externality are the largest are also satisfied.

Lemma 1 bis and Proposition 4 bis illustrate, in the present context, the results obtained in Section 3.

In particular, the region technologically lagged behind always obtains the FDI when the technological spillover is sufficiently strong. Instead when the spillover is positive but not that high, the less advanced region wins the auction when the difference of technological level between the competing regions is high enough ($c_A < c^*(\phi)$)[40]. When no spillover occurs, $\Delta W_A = \Delta W_B = \Gamma = 0$ for any c_A and c_B and, given the tie-breaking rule assumed, the more advanced region always wins the auction.[41]

Total welfare increases relative to a situation in which subsidies are banned when competition takes place between a region technologically lagged behind and a rival one significantly advanced.

Lemma 1 bis: *If* $\frac{16}{23} \leq \phi \leq 1$, *the MNE locates in the region technologically lagged behind for any feasible value of* c_A.

if $0 < \phi < \frac{16}{23}$, *the MNE locates in the region technologically lagged behind iff* $0 \leq c_A < \frac{14+23\phi}{138(2-\phi)} = c^*(\phi)$.

if $\phi = 0$, *the MNE never locates in the region technologically lagged behind.*

Proposition 4 bis: *When exports are not an alternative to FDI, total welfare increases iff the less advanced region obtains the FDI,* $\phi > 0$ *and* $c_A < c^{**}(\phi)$[42].

When exports are the alternative to investments, the welfare effects of subsidy competition can be dramatically different as it will appear neatly comparing these results with the ones presented in what follows.

4.4.2 Exports are the alternative to investments

This section analyzes the case in which, when no subsidies are given, the MNE finds it more profitable to export than to invest abroad; in particular, fixed costs are assumed to be slightly higher than the level for which there is indifference:

$$F = \frac{S}{16}(3t - \phi c_A)\left[2 + c_A(2-\phi) + \frac{1}{3} - 3t\right] + \varepsilon \tag{19}$$

The equilibria of the subsidy game are unchanged compared to the case studied in the previous section, but the results of the welfare analysis can dramatically change. As anticipated, to assess the welfare effects of subsidy competition when the MNE exports in absence of subsidies it is crucial to study whether each region prefers the MNE to export or to invest in the rival location. In this

[40] The model has been solved also for a generic value of $c_B \leq \frac{1}{6}$. We do not illustrate this part because it does not add anything to the basic intuition. The main difference is that there is a scale effect and if $c_B \leq \frac{5}{23(2-\phi)}$ the region lagged behind obtains the FDI for any feasible value of $c_A < c_B$.

[41] Notice that, in this model, $\phi^{\min} = \phi^* = 0$. The intuition is that for $\phi = 0 = \phi^{\min}$ not only ΔW_A and ΔW_B are equal to zero but also the premium Γ.

[42] $c^{**}(\phi) = \frac{50 - \sqrt{2500 - \frac{2}{3}(83\phi - 166)\left(-18 + \frac{51}{3} - \frac{51}{6}\phi\right)}}{2(166 - 83\phi)}$

specific model two opposite effects are relevant to this purpose. On the one hand, the consumer surplus of a region is higher when the MNE locates in the rival region than when it exports. In the former case transportation costs are saved and the production costs of the firm in the region that hosts the MNE are decreased by the technological spillover. Since the overall market is integrated, also the consumers of the region where the MNE does not locate benefit from this. On the other hand, the profits of the local firm are higher when the MNE exports because in such a case the other two competitors are less aggressive: the MNE has to bear transportation costs while the local firm of the other region does not benefit of the technological spillover. In other words, for the local firm of a region the investment of the MNE in the rival region just represents the entry in the market of a very efficient competitor whose positive effects (the technological spillover) it does not even enjoy.

Which one of these effects prevails depends first upon the transportation costs from the MNE's home country. In particular, in this model the fact that the MNE exports becomes more and more desirable as transportation costs increase: actually, the higher t the lower the consumer surplus but the less competitive the MNE and the higher the profit of the local firm; with a linear demand the latter receives more weight than the consumer surplus in the welfare function so that it increases at a rate which is higher than the one at which the consumer surplus decreases. Therefore, the higher the transportation costs the less likely a region prefers that the MNE invests in the rival location rather than it exports.

On top of this, which of the two alternatives generates a higher welfare depends upon the technological level of the region. Let us consider first the more advanced region and then the region lagged behind[43].

The welfare effects of subsidy competition on the more advanced region. In the more advanced region (region A) it is more likely that the welfare achieved when the MNE exports is lower than the welfare achieved when the MNE invests in the rival one *the less efficient is the local firm*. The reason is that with a linear demand the less efficient the local firm the less it benefits from having weaker competitors when the MNE exports. Therefore, when $c_A > \overline{c_t}$, the gain in terms of local profits is dominated by the loss in terms of consumer surplus. Obviously, the threshold is increasing in t.

Overall, the lower the transportation costs and the less advanced the region, the more likely it gains from engaging in subsidy competition with respect to the case in which subsidies are ruled out (as summarized in Table 1). More details will be provided in the following lines and in the Appendix; however, what is really relevant is that when exports are the alternative to FDI the more advanced region *can gain from subsidy competition*, while this possibility never occurs when the MNE always invests in one of the two countries. The intuition is that in the latter case the

[43] In what follows, the value of ϕ has been set equal to $\frac{2}{3}$ to make the algebra simpler. The flavour of the result is the same for any value of ϕ but this particular value has been chosen because it allows to consider both the case in which the more advanced region wins the auction and the case in which the regions lagged behind wins it.

MNE locates in the more advanced region if subsidies are ruled out. Hence, such a region cannot but lose from the introduction of subsidy competition. This is not obvious when the MNE exports if subsidies are prohibited, as exports may be an undesirable alternative, while offering subsidies serves at avoiding it and may be beneficial.

In particular, when transportation costs are sufficiently low, the fact that the MNE exports is quite undesirable for region A and $w_A^{IB} > w_A^E$ for a wide range of values of c_A[44]. Therefore, unless the local firm is extremely efficient, the region gains from the fact that subsidies can be offered because this serves at avoiding its least preferred outcome. In other words, anything is better than exports, either having to pay to obtain the MNE's location (when $w_A^{IB} > w_A^E$, $w_A^{IA}(T_A^*) - w_A^E > w_A^{IA}(T_A^*) - w_A^{IB} > 0$), or indeed losing the investment $\left(w_A^{IB} - w_A^E > 0\right)$.

Table1: *Welfare change of region A*

transportation costs	$\mathbf{\Delta w}_A\mathbf{> 0}$
$\frac{1}{27}$[45] $\leq t < \frac{82}{1035}$	for $\bar{c}_t < c_A < \frac{1}{6}$
$\frac{82}{1035} \leq t < \frac{1}{9}$	for $\hat{c}_t < c_A < \frac{1}{6}$
$\frac{1}{9} \leq t \leq \frac{7}{18}$	never

Conversely, when transportation costs are very high w_A^{IB} is never higher than w_A^E. Hence, the region necessarily suffers a welfare loss when it does not obtain the FDI $\left(w_A^{IB} - w_A^E < 0\right)$ but, in principle it might gain when it is chosen as a location by the MNE $\left(w_A^{IA}(T_A = 0) > w_A^E\right)$. However, since the fact that the MNE exports is quite desirable and the region ends up competing fiercely to avoid that the MNE chooses the rival location, once paid the equilibrium subsidy it achieves a welfare which is lower than the one attained banning subsidies and letting the MNE export. Overall, the region never gains from engaging in a subsidy game.

For intermediate transportation costs $w_A^{IA}(T_A = 0) - w_A^E$ can be large enough to more than compensate the equilibrium subsidy that the region pays to obtain the FDI. This is the case on condition that c_A is higher than the critical value $\hat{c}_t$. The reason is that the less efficient the region, the higher the absolute reduction of production costs determined by the technological spillover, the higher the gain in terms of consumer surplus when it obtains the FDI relative to the case in which the MNE exports. In addition, note that, given the level of transportation costs, if c_A is sufficiently low, the profit of the local firm is higher when the MNE exports than when the region obtains the FDI $\left(\pi_A^{IA} - \pi_A^E < 0 \text{ when } c_A < \frac{t}{2}\right)$: if the local firm is already sufficiently efficient, it does not benefit so much from the technological spillover and the loss in terms of profits due to the "competition effect" associated to the MNE's arrival dominates. Therefore, the higher c_A, the more limited the loss in terms of profits if $\pi_A^{IA} - \pi_A^E$ is negative or the higher the gain in terms of profits, if $\pi_A^{IA} - \pi_A^E$ is positive.

[44] $\overline{c_t} < c^*\left(\frac{2}{3}\right)$ for $\frac{1}{27} \leq t < \frac{82}{1035}$ where $c^*\left(\frac{2}{3}\right)$ is the threshold which determines who wins the auction.

[45] Transportation costs higher than $\frac{1}{27}$ ensure that, for any c_A, the contraint (19) is satisfied by positive values of the fixed set-up costs.

The welfare effects of subsidy competition on the region lagged behind. In the region technologically lagged behind (region B) it is more likely that $w_B^{IA} > w_B^E$ the *more efficient is the local firm of the rival region.* The reason is that if the local firm of region A is already quite efficient, region B does not benefit so much from the fact that the rival one fails to enjoy the technological spillover when the MNE exports instead of investing there, and the loss of consumer surplus prevails.

Overall, as illustrated in Table 2, the lower the transportation costs and the higher the difference of technological level between the two regions, the more likely the one lagged behind gains from engaging in a subsidy game.

In particular, when t is sufficiently low region B draws so little benefit from the fact that the MNE exports that w_B^E is always lower than w_B^{IA}. Hence, the region lagged behind *always strictly gains from subsidy competition* (both when it obtains the MNE's location and when it does not) as subsidies prevent exports, alternative which the region finds worse than the investment in the rival location. Instead, when exports are not a feasible alternative to FDI, the MNE invests in the more advanced region in absence of subsidies, and region B strictly gains from subsidy competition only when it obtains the FDI.

Table 2: *Welfare change of region B*

transportation costs	$\mathbf{\Delta w}_B > \mathbf{0}$
$\frac{1}{27} \leq t \leq \frac{1}{9}$	always
$\frac{1}{9} < t < \frac{25}{207}$	$0 \leq c_A < \overline{\overline{c}}_t$
$\frac{25}{207} \leq t \leq \frac{7}{18}$	$0 \leq c_A < \approx{c}_t$

As transportation costs increase the fact that the MNE exports becomes more attractive for region B and $w_B^{IA} > w_B^E$ on condition that $c_A < \overline{\overline{c}}_t$. This threshold is decreasing in t so that for intermediate transportation costs $w_B^{IA} > w_B^E$ for a wide range of values of c_A[46] and region B gains from subsidy competition when it obtains the location of the MNE and in some cases even when it does not[47]. However, when c_A is higher than the threshold, region B loses the auction and would have been better off if subsidies had been banned and the MNE had exported. Hence, in this context, *also the region lagged behind can lose from participating to the subsidy game* as losing the auction may be worse than what happens when subsidies are banned (i.e. exports); instead, it never suffers a loss when exports are not an alternative to FDI as at worst it does not succeed in obtaining the FDI and this is exactly what happens when subsidies cannot be offered. For high transportation costs, the MNE's exports are quite desirable for region B so that it always suffers a welfare loss when the MNE invests in the more advanced region[48] but it can enjoy a welfare gain when it obtains the location of the MNE. This is the case when the difference of technological level is sufficiently high, as the more advanced region is not willing to offer too much for the FDI and

[46] $\overline{\overline{c}}_t > c^*\left(\frac{2}{3}\right)$ for $\frac{1}{9} < t < \frac{25}{207}$.
[47] See the Appendix for a detailed explanation.
[48] $\overline{\overline{c}}_t < c^*\left(\frac{2}{3}\right)$ for $\frac{25}{207} \leq t \leq \frac{7}{18}$.

the equilibrium subsidy is not that high; thus, once paid it, the welfare of region B is higher than the welfare associated to a ban on subsidies and to exports.

To conclude the Section let us consider the impact of allowing to bid for firms on total welfare.

The effects of subsidy competition on the two regions' joint welfare. When transportation costs are sufficiently low (see Table 3), subsidy competition *always increases total welfare* relative to the case in which subsidies are banned. In fact, it may be that both regions gain from subsidy competition, so that total welfare obviously increases. In this case banning subsidies is definitely inefficient because it makes the regions' least desirable alternative occur while allowing to offer them would prevent this and just for this reason would make each region better off wherever the MNE locates. Alternatively, it may be that the region lagged behind gains and the advanced one loses, but the welfare gain of the former prevails and total welfare increases again. Note that since the fact that the MNE exports is quite undesirable for the two regions, *the beneficial effects associated to subsidy competition are much stronger than in the case in which exports are not an alternative to FDI*[49].

Conversely, for transportation costs sufficiently high *total welfare is never increased by subsidy competition*. In this case, either both regions lose from subsidy competition and total welfare obviously decreases or the region lagged behind gains but not enough to dominate the welfare loss of the advanced region. The intuition is that the fact that the MNE exports has become very attractive for the two regions; this implies that a region does not value that much the FDI if the alternative is that the MNE exports while it values much more the FDI if the alternative is that the MNE locates in the rival region. Therefore, letting governments offer subsidies gives them the incentive to strongly compete one against the other dissipating the benefits associated to the MNE's investment. Instead, banning subsidies would avoid this waste of resources and would determine an outcome (exports) that is for sure better for the region that loses the auction and that is not that bad even for the region that obtains the FDI. As a result, once paid the equilibrium subsidy, either also this region suffers a welfare loss with respect to the case in which subsidies are ruled out or it gains but not enough to compensate the welfare loss of the other region.

For intermediate transportation costs total welfare increases for c_A belonging to a particular set[50] and as transportations costs increase the range of c_A for which total welfare increases restricts till the point in which subsidy competition is never welfare improving.

To conclude, the outcome of the welfare analysis is definitely different from the case in which exports are not an alternative to FDI. In particular, the beneficial effects associated to subsidy competition are stronger or weaker relative to the case in which the MNE is assumed to always invest in one of the two countries, according to the level of transportation costs or, equivalently,

[49] Recall that, when exports are not an alternative to FDI, it is never the case that both regions enjoy a welfare gain and total welfare increases only when the MNE locates in the region technologically lagged behind and the local firm of region A is extremely efficient. In particular, $c^{**}\left(\frac{2}{3}\right) \simeq 0.0234$.

[50] See the Appendix for a detailed explanation.

according to how much the fact that the MNE exports is desirable.

Table 3: *Change of total welfare*

transportation costs	$\mathbf{\Delta w}_A + \mathbf{\Delta w}_B > \mathbf{0}$
$\frac{1}{27} \leq t < \frac{-864+60\sqrt{5289}}{48654}$	always
$\frac{-864+60\sqrt{5289}}{48654} \leq t < \frac{-1863+207\sqrt{46441}}{428490}$	$0 \leq c_A < c_1$ and $c_2 < c_A < \frac{1}{6}$
$\frac{-1863+207\sqrt{46441}}{428490} < t < \frac{1}{9}$	$0 \leq c_A < c_1$ and $c_3 < c_A < \frac{1}{6}$
$\frac{1}{9} \leq t < \frac{-27+3\sqrt{681}}{276}$	$0 \leq c_A < c_1$
$\frac{-27+3\sqrt{681}}{276} \leq t < \frac{7}{18}$	never

5 Conclusion

This paper investigates the welfare effects of subsidy competition for FDI. It considers two regions and it assumes that a region enjoys higher welfare gains when it obtains the location of the MNE, for instance because unemployment is higher in this region. Yet, the MNE finds it more profitable to locate in the other region, subsidies being equal, for instance because this latter region has a higher per-capita income.

In such a framework, it has been shown that under some conditions the possibility to offer subsidies allows the depressed region to overbid the other one and to "win" the location of the MNE. This would never happen if subsidies were forbidden or standardized. For this reason, the depressed region never loses from subsidy competition, while the more advanced one never gains. Moreover, it has been shown that subsidy competition increases total welfare (relative to a situation in which incentives are banned) if the depressed region obtains the investment, if the externality associated to it is sufficiently strong and if the difference between the two regions is sufficiently high. In such a case, subsidy competition leads the investment where otherwise it would not have gone, namely in the region where it generates the largest welfare gain, so large to outweigh the costs in terms of rents transferred to the MNE and of losses of the other country.

It has also been shown that the welfare gains associated to this possibility can be higher if an institution, concerned with total welfare, makes the two countries collude to transfer the MNE the lowest possible subsidy compatible with the aim of leading the investment where it is valued the most. The conclusions obtained are consistent with the European regulation in this sphere.

These results have been derived assuming that the MNE has ex-ante decided to invest abroad, in the sense that it finds it more profitable to invest rather than to export, even if subsidies are not offered. Relaxing this assumption, the welfare effects of subsidy competition can totally change. To have some insights about this issue, a parametric examples has been developed which helps understanding some of the elements at work. For low transportation costs from the MNE's home country, it may be the case that both countries gain from subsidy competition and even that they gain when they do not obtain the investment. Thus, the beneficial effects of subsidy competition are much stronger than in the case in which the MNE always invests in one of the two countries. However, when transportation costs are very high the opposite occurs so that social competition

is never welfare improving. This analysis emphasizes that the alternatives available to the MNE play an important role in determining whether subsidy competition has negative consequences or not.

Finally, all these results strongly depend on the implicit assumption that the MNE has less bargaining power than the competing countries. In the opposite case, subsidy competition never increases total welfare because the MNE captures all the gains associated to the investment.

6 Appendix

Proof of Lemma 1:

The depressed region wins the auction when $\Delta W_B - \Gamma > \Delta W_A$. Equivalently, when

$$g(\alpha)\,\Delta W_A(\phi) - \alpha\pi_M^{IA} > 0$$

Define $H(\alpha,\phi) = g(\alpha)\,\Delta W_A(\phi) - \alpha\pi_M^{IA}$.

(i) Consider $H(1,\phi) = g(1)\,\Delta W_A(\phi) - \pi_M^{IA}$.

By assumption, $H\left(1,\phi^{\min}\right) < 0$[51], $H\left(1,\phi^{Max}\right) > 0$, $H(1,\phi)$ is continuous over $\left[\phi^{\min},\phi^{Max}\right]$ and $\frac{\partial H(1,\phi)}{\partial\phi} = g(1)\frac{\partial\Delta W_A}{\partial\phi} > 0$. For the intermediate value theorem, there exist a unique ϕ^* such that $H(1,\phi^*) = 0$ and $H(1,\phi) > 0$ for $\phi > \phi^*$.

(ii) Take a $\phi \in \left[\phi^{\min},\phi^*\right]$ and consider H as a function of α only. By assumption and by step (i), $H(0,\phi) = 0$, $H(1,\phi) \leq 0$ and $H(\alpha,\phi)$ is convex[52] over $[0,1]$. This implies that when ϕ is chosen in $\left[\phi^{\min},\phi^*\right]$, $H(\alpha,\phi) \leq 0$ for any $\alpha \in [0,1]$ and the depressed region never succeeds in winning the auction.

(iii) Consider $\frac{\partial H(\alpha,\phi)}{\partial\alpha} = g'(\alpha)\,\Delta W_A(\phi) - \pi_M^{IA}$. By assumption, if $\phi = \phi^{\min}$, $\left.\frac{\partial H\left(\alpha,\phi^{\min}\right)}{\partial\alpha}\right|_{\alpha=0} < 0$. Moreover, for any $\phi \in \left(\phi^{\min},\phi^*\right]$, $\left.\frac{\partial H(\alpha,\phi)}{\partial\alpha}\right|_{\alpha=0}$ must be negative: since in this interval $\frac{\partial^2 H(\alpha,\phi)}{\partial^2\alpha} > 0$, if $\left.\frac{\partial H(\alpha,\phi)}{\partial\alpha}\right|_{\alpha=0}$ were positive or equal to zero, it should be strictly positive for any $\alpha > 0$; hence, $H(\alpha,\phi)$, which is equal to 0 in $\alpha = 0$, would be strictly positive for any $\alpha > 0$ and this contradicts the fact that $H(1,\phi) \leq 0$ for $\phi \leq \phi^*$.

(iv) Consider $\left.\frac{\partial H(\alpha,\phi)}{\partial\alpha}\right|_{\alpha=0}$. By assumption, it is negative if $\phi = \phi^{\min}$ and it is positive if $\phi = \phi^{Max}$. Moreover, it is continuous and strictly increasing in ϕ. Therefore, there exists a unique ϕ^{**} such that $\left.\frac{\partial H\left(\alpha,\tilde{\phi}\right)}{\partial\alpha}\right|_{\alpha=0} \geq 0$ if $\phi \geq \phi^{**}$, with $\phi^{**} > \phi^*$ for (iii).

(v) Take a $\phi \in (\phi^*,\phi^{**})$ and consider H as a function of α only. By assumption and by step (i), $H(0,\phi) = 0$, $H(1,\phi) > 0$, $\frac{\partial^2 H(\alpha,\phi)}{\partial^2\alpha} > 0$ and $\left.\frac{\partial H(\alpha,\phi)}{\partial\alpha}\right|_{\alpha=0} < 0$. It is straightforward that there exists a unique $\alpha^*(\phi)$ such that $H(\alpha^*,\phi) = 0$ and $H(\alpha,\phi) > 0$ for $\alpha \in (\alpha^*(\phi),1]$. Moreover, for the Implicit Function Theorem, $\left.\frac{\partial\alpha^*(\phi)}{\partial\phi}\right|_{\alpha^*,\phi} = \frac{-g(\alpha^*)\left.\frac{\partial\Delta W_A}{\partial\phi}\right|_{\phi=\phi}}{g'(\alpha^*)\Delta W_A(\phi)-\pi_M^{IA}}$ and it is negative because $g(\alpha^*) > 0$ and $\frac{\partial\Delta W_A}{\partial\phi} > 0$ by assumption, while $g'(\alpha^*)\,\Delta W_A(\phi) - \pi_M^{IA} > 0$ because $\alpha^* > \hat{\alpha}$[53].

[51] Recall that $\Delta W_A\left(\phi^{\min}\right) = 0$.

[52] Strictly convex for $\phi > \phi^{\min}$.

[53] $\hat{\alpha}$ is the value that makes $\frac{\partial H(\alpha,\phi)}{\partial\alpha}$ equal to zero. When $\alpha > \hat{\alpha}$, $\frac{\partial H(\alpha,\phi)}{\partial\alpha} > 0$.

(vi) Finally, take a $\phi \geq \phi^{**}$. $H(0,\phi) = 0$, $H(1,\phi) > 0$, $\frac{\partial H(\alpha,\phi)}{\partial \alpha}\Big|_{\alpha=0} \geq 0$ and $\frac{\partial^2 H(\alpha,\phi)}{\partial^2 \alpha} > 0$. Therefore, $H(\alpha,\phi) > 0$ for any $\alpha > 0$. ■

Proof of Proposition 4:

Proof. The welfare gain of the depressed region, net of the equilibrium subsidy to be paid is $\Delta W_B - \Delta W_A - \Gamma$. The welfare loss of the advanced region is $-\Delta W_A$. Therefore, subsidy competition increases total welfare relative to the case in which subsidies are forbidden, iff $F(\alpha,\phi) = [g(\alpha) - 1]\Delta W_A(\phi) - \alpha\pi_M^{IA}$ is positive.

(i) By assumption, $F\left(1,\phi^{\min}\right) < 0$, $F\left(1,\phi^{Max}\right) > 0$ and $\frac{\partial F(1,\phi)}{\partial \phi} = [g(1) - 1]\frac{\partial W_A(\phi)}{\partial \phi} > 0$. Therefore, there exists a unique $\phi^{***} \in \left[\phi^{\min},\phi^{Max}\right]$ such that $F(1,\phi^{***}) = 0$ and $F(1,\phi)$ is positive for $\phi > \phi^{***}$. Note that ϕ^* is such that $g(1)\Delta W_A(\phi^*) - \pi_M^{IA} = 0$ and hence $\phi^{***} > \phi^*$.

(ii) Take a $\phi \in \left[\phi^{\min},\phi^{***}\right]$ and consider F as a function of α only. By assumption and by step (i), $F(0,\phi) = -\Delta W_A(\phi) \leq 0$, $F(1,\phi) \leq 0$ and $F(\alpha,\phi)$ is convex[54] over $[0,1]$. This implies that choosing any $\phi \in \left[\phi^{\min},\phi^{***}\right]$, $F(\alpha,\phi) \leq 0$ for any $\alpha \in [0,1]$ and subsidy competition never increases total welfare.

(iii) Take a $\phi \in \left(\phi^{***},\phi^{Max}\right]$ and consider F as a function of α only. By assumption and by step (i), $F(0,\phi) < 0$, $F(1,\phi) > 0$, $\frac{\partial^2 F(\alpha,\phi)}{\partial^2 \alpha} > 0$. Regardless the sign of $\frac{\partial F(\alpha,\phi)}{\partial \alpha}\Big|_{\alpha=0}$, there exists a unique $\alpha^{**}(\phi)$ such that $F(\alpha^{**},\phi) = 0$ and $F(\alpha,\phi) > 0$ for $\alpha \in (\alpha^{**}(\phi),1]$. Note that $\alpha^*(\phi)$ is such that $g(\alpha^*)\Delta W_A(\phi) - \alpha^*\pi_M^{IA} = 0$ so that $\alpha^{**}(\phi) > \alpha^*(\phi)$.

(iv) Finally, for the Implicit Function Theorem, $\frac{\partial \alpha^*(\phi)}{\partial \phi}\Big|_{\alpha^*,\phi} = \frac{-[g(\alpha^{**})-1]\frac{\partial \Delta W_A(\phi)}{\partial \phi}\Big|_{\phi=\phi}}{g'(\alpha^{**})\Delta W_A(\phi) - \pi_M^{IA}}$ and it is negative because $\frac{\partial \Delta W_A(\phi)}{\partial \phi} > 0$ by assumption, $[g(\alpha^{**}) - 1] > 0$ because if it were less or equal to zero it would contradict the fact that $[g(\alpha^{**}) - 1]\Delta W_A\left(\bar{\phi}\right) - \alpha^{**}\pi_M^{IA} = 0$ and $g'(\alpha^{**})\Delta W_A(\phi) - \pi_M^{IA} > 0$ because $\alpha^{**} > \overset{\wedge}{\alpha}$. ■

Proof of the results contained in Table 1

Let us define $\bar{c_t} = \frac{14}{99} + \frac{5}{22}t$ the value of c_A such that country A achieves the same level of welfare when the MNE exports and when it invests in the other country. If $c_A > \bar{c_t}$, $w_A^{IB} > w_A^E$. Recall also that, according to Lemma 1 bis, country B obtains the FDI when $c_A < c^*\left(\frac{2}{3}\right) = \frac{11}{69}$.

1) $\frac{1}{27} \leq t < \frac{82}{1035}$.

In this case, $\bar{c_t} < c^*$. Therefore, if $0 \leq c_A < \bar{c_t}$, the MNE locates in country B and given that $w_A^{IB} < w_A^E$, $\Delta w_A < 0$. Instead, when $\bar{c_t} < c_A < c^*$, the MNE locates in country B but, since $w_A^{IB} > w_A^E$, $\Delta w_A > 0$. Finally, when $c^* \leq c_A < \frac{1}{6}$, the MNE locates in country A. Since country A offers a subsidy lower or equal to the level for which it is indifferent between having the MNE or not, $w_A^{IA}\left(T_B^{Max} - \Gamma\right) \geq w_A^{IB} > w_A^E$, and $\Delta w_A > 0$. As a whole, Δw_A is positive for $c_A > \bar{c_t}$.

2) $\frac{82}{1035} \leq t < \frac{1}{9}$.

[54] Strictly convex for $\phi > \phi^{\min}$.

In this case, $\bar{c}_t \geq c^*$. Therefore, when the MNE locates in country B $(0 \leq c_A < c^*)$, $w_A^{IB} < w_A^E$ and $\Delta w_A < 0$. When the MNE locates in country A $\left(c^* \leq c_A < \frac{1}{6}\right)$, Δw_A is positive or negative according to how large is w_A^E. If $c^* \leq c_A < \bar{c}_t$, $w_A^E > w_A^{IB}$ and Δw_A, which is equal to $\frac{S\left(-116+1278c_A-3312c_A^2-297t+1782c_At-405t^2\right)}{1024}$, is positive for $\hat{c}_t < c_A < \bar{c}_t$ [55] where $\hat{c}_t \in (c^*, \bar{c}_t)$. If $\bar{c}_t < c_A < \frac{1}{6}$, $\Delta w_A \geq 0$ because $w_A^{IA}\left(T_B^{Max} - \Gamma\right) > w_A^{IB} \geq w_A^E$. As a whole, Δw_A is positive for $c_A > \hat{c}_t$. Note that when $t = \frac{82}{1035}$, $\bar{c}_t = \hat{c}_t = c^*$ and when $t = \frac{1}{9}$, $\hat{c}_t = \bar{c}_t = \frac{1}{6}$.

3) $\frac{1}{9} \leq t \leq \frac{7}{18}$ [56].
In this case, $\bar{c}_t \geq \frac{1}{6}$ so that w_A^{IB} is never larger or equal to w_A^E. Therefore, when the MNE locates in country B, $\Delta w_A < 0$. When the MNE locates in country A, $\hat{c}_t \geq \bar{c}_t \geq \frac{1}{6}$ and, again, $\Delta w_A < 0$. As a whole, Δw_A is never positive. ■

Proof of the results contained in Table 2:

Let us define $\bar{\bar{c}}_t = \frac{1-3t}{4}$ the value of c_A such that $w_B^{IA} = w_B^E$. If $c_A < \bar{\bar{c}}_t$ $w_B^{IA} > w_B^E$.

1) $\frac{1}{27} \leq t \leq \frac{1}{9}$.
In this case, $w_B^{IA} > w_B^E$ for any value of c_A. Therefore, country B gains from subsidy competition both when the MNE locates in the other country $\left(\Delta w_B = w_B^{IA} - w_B^E > 0\right)$ and when it obtains the FDI. In the latter case, country B offers a subsidy lower than the level for which it is indifferent between having the MNE or the MNE locating in country A. Hence, $w_B^{IB}\left(T_A^{Max} + \Gamma\right) > w_B^{IA} > w_B^E$ and Δw_B is positive.

2) $\frac{1}{9} < t < \frac{25}{207}$. In this case, $w_B^{IA} > w_B^E$ only for $0 \leq c_A < \bar{\bar{c}}_t$. In this interval, for the reason just explained, Δw_B is positive both when the MNE locates in country B $(0 \leq c_A < c^*)$ [57] and when the MNE locates in country A $\left(c^* \leq c_A < \bar{\bar{c}}_t\right)$. When $c_A \geq \bar{\bar{c}}_t$, country A obtains the investment and since $w_B^{IA} \leq w_B^E$, $\Delta w_B \leq 0$. As a whole, Δw_B is positive for $0 \leq c_A < \bar{\bar{c}}_t$.
3) $\frac{25}{207} \leq t < \frac{1}{3}$. Again, $w_B^{IA} > w_B^E$ only for $0 \leq c_A < \bar{\bar{c}}_t$ but now $\bar{\bar{c}}_t \leq c^*$. Therefore, when $0 \leq c_A < \bar{\bar{c}}_t$, country B obtains the MNE and Δw_B is positive.

When $\bar{\bar{c}}_t \leq c_A < c^*$, the MNE locates again in country B but $w_B^E \geq w_B^{IB}$ and Δw_B, which is equal to $\frac{S\left(88-990c_A+2952c_A^2+135t-810c_At-405t^2\right)}{5184}$, is positive for $\bar{\bar{c}}_t \leq c_A < \approx{c}_t$ [58]. When $c_A \geq c^*$, country A obtains the investment and since $w_B^{IA} \leq w_B^E$, $\Delta w_B \leq 0$. As a whole, Δw_B is positive for $0 \leq c_A < \approx{c}_t$. Note that when $t = \frac{25}{207}$, $\approx{c}_t = \bar{\bar{c}}_t = c^*$, while when $t = \frac{1}{3}$ $\bar{\bar{c}}_t = 0$.
4) $\frac{1}{3} \leq t < \frac{7}{18}$. Now $\bar{\bar{c}}_t \leq 0$ and w_B^{IA} is never larger than w_B^E. When the MNE locates in country B $(0 \leq c_A < c^*)$ Δw_B is positive for $0 \leq c_A < \approx{c}_t$. When the MNE locates in country A, $\left(c^* \leq c_A \leq \frac{1}{6}\right) \Delta w_B$ is negative since $w_B^{IA} < w_B^E$.

[55] $\hat{c}_t = \frac{1278+1782t-\sqrt{(1278+1782t)^2-13248(116+297t+405t^2)}}{6624}$. The other root of $\Delta w_A = 0$ is bigger than $\frac{1}{6}$ and we disregard it.
[56] $t \leq \frac{7}{18}$ ensures that $\pi_M^E \geq 0$ for any c_A.
[57] In this interval, $c^* < \bar{\bar{c}}_t$.
[58] $\approx{c}_t = \frac{990+810t-\sqrt{(-990-810t)^2-11808(88+135t-405t^2)}}{5904}$; we diregard the other root.

Proof of the results contained in Table 3:

1) $\frac{1}{27} \leq t < \frac{-864+60\sqrt{5289}}{48654}$.

In this case, when $\bar{c_t} < c_A < \frac{1}{6}$, $\Delta w_A > 0$ and $\Delta w_B > 0$, so that $\Delta w_A + \Delta w_B > 0$. Instead, when $0 \leq c_A \leq \bar{c_t}$ $(< c^*)$, $\Delta w_A \leq 0$ and $\Delta w_B > 0$. In this interval the MNE locates in country B and $\Delta w_A + \Delta w_B$ which is equal to $\frac{S\left(10-132c_A+492c_A^2-27t+162c_A t-135t^2\right)}{864}$ is positive, since the determinant of this equation is negative[59].

2) $\frac{-864+60\sqrt{5289}}{48654} \leq t < \frac{82}{1035}$.

In this case, when $\bar{c_t} < c_A < \frac{1}{6}$, $\Delta w_A > 0$ and $\Delta w_B > 0$ so that $\Delta w_A + \Delta w_B > 0$. Instead, when $0 \leq c_A \leq \bar{c_t}$ $(< c^*)$, the MNE locates in country B, $\Delta w_A \leq 0$ and $\Delta w_B > 0$. Defining $c_1 \leq c_2$ the two roots of $\Delta w_A + \Delta w_B$, total welfare increases when $0 \leq c_A < c_1$ and $c_2 < c_A \leq \bar{c_t}$. As a whole, in this interval, total welfare increases when $0 \leq c_A < c_1$ and $c_2 < c_A < \frac{1}{6}$.

3) $\frac{82}{1035} \leq t \leq \frac{1}{9}$.

In this case, when $\hat{c_t} < c_A < \frac{1}{6}$, $\Delta w_A > 0$ and $\Delta w_B > 0$ so that $\Delta w_A + \Delta w_B > 0$. Instead, when $0 \leq c_A \leq \hat{c_t}$, $\Delta w_A \leq 0$ and $\Delta w_B > 0$. Note that $\hat{c_t} > c^*$ and thus, in this interval it may be either that the MNE locates in A or in B so that further specifications are needed. Recall that, when country B wins the subsidy game $\Delta w_A + \Delta w_B$ is positive for $0 \leq c_A < c_1$ and $c_2 < c_A < c^*$. When country A obtains the investment, $\Delta w_A + \Delta w_B = \frac{S\left(-58+684c_A-1836c_A^2-81t+486c_A t-405t^2\right)}{1024}$. We define c_3 its smallest root[60] and total welfare increases for $c_3 < c_A \leq \hat{c_t}$. $t = \frac{-1863+207\sqrt{46441}}{428490}$ is the value of transportation costs for which $c_2 = c^* = c_3$.

Therefore,

(i) if $\frac{82}{1035} \leq t < \frac{-1863+207\sqrt{46441}}{428490}$, when the MNE locates in country B $(0 \leq c_A < c^*)$ $\Delta w_A + \Delta w_B > 0$ for $0 \leq c_A < c_1$ and $c_2 < c_A < c^*$; when the MNE locates in country A $\left(c^* \leq c_A \leq \hat{c_t}\right)$ $\Delta w_A + \Delta w_B > 0$ because $c_3 < c^*$. As a whole, if t belongs to this interval, total welfare increases for $0 \leq c_A < c_1$ and $c_2 < c_A < \frac{1}{6}$.

(ii) if $\frac{-1863+207\sqrt{46441}}{428490} \leq t < \frac{1}{9}$, when the MNE locates in country B $0(0 \leq c_A < c^*)$ $\Delta w_A + \Delta w_B > 0$ for $0 \leq c_A < c_1$ because $c_2 \geq c^*$; when the MNE locates in country A $\left(c^* \leq c_A \leq \hat{c_t}\right)$ $\Delta w_A + \Delta w_B > 0$ for $c_3 < c_A \leq \hat{c_t}$. As a whole, if t belongs to this interval, total welfare increases for $0 \leq c_A < c_1$ and $c_3 < c_A < \frac{1}{6}$.

4) $\frac{1}{9} \leq t < \frac{25}{207}$.

In this case, Δw_A is always negative, while Δw_B is positive when $c_A < \bar{\bar{c_t}}$. When country B obtains the FDI $(0 \leq c_A < c^*)$ total welfare increases if $0 \leq c_A < c_1$; when the MNE locates in country A, either $\Delta w_A < 0$, $\Delta w_B > 0$ $\left(\text{when } c^* \leq c_A < \bar{\bar{c_t}}\right)$but the welfare gain of country B is not large enough to compensate the welfare loss of country A $\left(c_3 \geq \frac{1}{6}\right)$; or both country suffer a welfare loss $\left(\text{when } \bar{\bar{c_t}} \leq c_A < \frac{1}{6}\right)$ so that total welfare obviously decreases . As a whole, in this interval, total welfare increases for $0 \leq c_A < c_1$.

[59] $t = \frac{-864+60\sqrt{5289}}{48654}$ is the value of transportation costs such that the determinant is equal to zero.

[60] The other root is bigger than $\frac{1}{6}$ so that we disregard it.

5) $\frac{25}{207} \leq t < \frac{7}{18}$.

In this case, Δw_A is negative, while Δw_B is positive for $0 \leq c_A < \widetilde{\widetilde{c}}_t$. Note that $\widetilde{\widetilde{c}}_t \leq c^*$[61]. $t = \frac{-27+3\sqrt{681}}{276}$ is the value of transportation costs such that $c_1 = 0$. Therefore,

(i) if $\frac{25}{207} \leq t < \frac{-27+3\sqrt{681}}{276}$, when $0 \leq c_A < \widetilde{\widetilde{c}}_t$ the MNE locates in country B, $\Delta w_A < 0$, $\Delta w_B > 0$ and total welfare increases for $0 \leq c_A < c_1$. When $\widetilde{\widetilde{c}}_t \leq c_A < \frac{1}{6}$, both countries suffer a welfare loss from subsidy competition and total welfare obviously decreases.

(ii) $\frac{-27+3\sqrt{681}}{276} \leq t < \frac{7}{18}$, either both countries suffer a welfare loss and total welfare decreases; or country B gains and country A loses, but the welfare gain of country B is never large enough to compensate the welfare loss of the other country. In this interval, total welfare in never improved by subsidy competition. ■

[61] $\widetilde{\widetilde{c}}_t = c_A^*$ for $t = \frac{25}{207}$.

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