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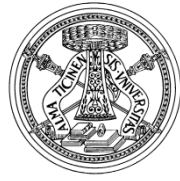
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Quaderni di Dipartimento

**Tax Competition for Foreign Direct Investments
and the Nature of the Incumbent Firm**

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Tax Competition for Foreign Direct Investments and the Nature of the Incumbent Firm

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Abstract

In this paper we investigate tax/subsidy competition for FDI between countries of different size when a domestic firm is the incumbent in the largest market. We investigate how the nature (public or private) of the incumbent firm affects policy competition between the two governments seeking to attract FDI. We show that the country hosting the incumbent always benefits from FDI if the domestic firm is a public welfare-maximizing firm, while its welfare may decrease when it is a private firm, as already shown by Bjorvatn and Eckel (2006). We also show that, contrary to the case of a private domestic incumbent, a public firm acts as a disciplinary device for the foreign multinational that will always choose the efficient welfare-maximizer location. Finally, an efficiency-enhancing role of policy competition may only arise when the domestic incumbent is a private firm, while tax competition is always wasteful when the incumbent is a public firm.

Keywords: Foreign Direct Investment; Tax/subsidy competition; Public firm; International mixed oligopoly

JEL Classification: F12; F23; H25; H73; L13; L33

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1 Introduction

One of the most well documented trends in the world economy over the last two decades has been the rise in foreign direct investments (FDI) by multinational enterprises (MNEs). At an aggregate level, the empirical evidence indicates that FDI grew rapidly in the last 15 years of the 20th century, far outpacing the growth of international trade among industrialized countries.¹ Moreover, because of the widely held advantages of receiving FDI (e.g., cheaper or higher-quality goods for domestic consumers, technological spillovers to domestic producers, job creation, etc.), an increasing number of national governments offers MNEs countervailing incentives to attract their investments and competition mostly takes place at an intra-regional level, i.e., between countries belonging to the same economic area (e.g., Latin America, South-East Asia, Central and Eastern Europe, and so on).² In spite of that, FDI can be an issue to the extent that foreign investors often operate in the same sector as some incumbent local firm, which is, in some cases, a public state-owned enterprise. In some industries, the relative importance of state-owned enterprises is even expanding in recent years also (but not only) because of the global financial crisis that has prompted many governments worldwide to increase their stakes in private corporations. In the oil industry, state-owned companies such as Saudi Aramco, Gazprom (Russia), China National Petroleum Corp., National Iranian Oil Co., Petroleos de Venezuela, Petrobras (Brazil) and Petronas (Malaysia), now control more than 75% of all crude oil production.³ Since national oil companies generally hold exclusive rights to exploration and development of petroleum resources within the home country, they can also decide on the degree to which they require participation by private companies in those activities. This might negatively affect the investment decisions of foreign MNEs as it was the case in Venezuela in June 2007, when ExxonMobil Corporation and ConocoPhillips, two of the largest U.S. oil companies, abandoned their multi-billion dollar investments in the heavy oil deposits of the Orinoco basin.

In the automotive sector, state-owned and state-controlled companies play a major role in many developed and emerging countries markets: in China, for instance, two of the largest carmakers (Shanghai Automotive Industry Corporation and First Automobile Works) are state-owned enterprises and at the same time partner companies of the Volkswagen Group.

The telecommunications industry also provides several examples of FDI in the presence of a state-owned incumbent.⁴ In 1996 the U.S. company Mediaone invested in Telnet, a cable and fixed-line operator in Belgium competing against the government-owned incumbent Belgacom. Today, Telnet is controlled by the U.S. company MediaOne and has achieved a share of about 15% of a market where the public firm Belgacom retains the largest market share.⁵ In 1993, the US Company Bell South launched its mobile phone network in New Zealand to compete

¹See, e.g., Markusen (1995), Markusen and Venables (1998), and Barba Navaretti et al. (2004).

²For an overview of this issue, see Oman (2001).

³The Wall Street Journal (2010).

⁴See OECD (2011) for a full account of the presence of state-owned incumbents in OECD Telecommunications markets, their market shares and new entrant market shares.

⁵Source: Telnet corporate website (2011)

against the state-owned incumbent Telecom NZ. In 1998 the company was bought by the British Vodafone that now is the largest mobile operator in the country. Another example is Slovenia where in 1999 the joint venture Sl.mobil including the Swedish company Telia entered the mobile TLC market as direct competitor for the state-owned incumbent Mobitel. In 2001 the Austrian MobilKom became the largest shareholder and in 2003 a partnership agreement was signed with Vodaphone.⁶

At the same time, state-owned companies are becoming international players with operations that spread outside national boundaries. For example, Norway's state-owned oil company Statoil operates not only in the Norwegian continental shelf (where it faces the competition of two MNEs, Esso Norge and Norske Shell), but also in West Africa, the Gulf of Mexico, and off the coast of Brazil, it owns two refineries (one in Norway and one in Denmark) and its gasoline retail activities span across Scandinavia and the Baltic States.⁷

We believe that is therefore interesting to analyze the impact of FDI taking into account its potentially negative consequences on the profitability of a local incumbent. These consequences might be different depending on the nature of the local firm, private or government-owned. Our theoretical framework builds on the literature about policy competition for FDI. Namely, on those contributions considering imperfect product market competition, country-size asymmetry, and intra-regional trade costs. This strand of the literature grows out of the paper by Haufler and Wooton (1999) (henceforth H&W), which analyzes competition between two countries of unequal size trying to attract a foreign-owned monopolist.⁸ Both countries are willing to offer a subsidy to the firm but, in equilibrium, the large country wins the competition for FDI since the firm prefers locating in the big market in order to save on trade costs. Moreover, if the market-size difference is large enough, the large country may be able to levy a positive lump-sum tax on the foreign firm's profit. Ferrett and Wooton (2010) extend H&W's model to study policy competition for FDI by two firms from the same industry producing homogeneous goods in either of the two countries. A general conclusion stemming from this paper is that tax competition under duopoly does not create a "race to the bottom" in corporate tax rates since firms are always taxed in equilibrium. Haufler and Wooton (2006) develop a three-country model of competition for FDI between a union of two countries and a third potential-host country. Countries' willingness to attract the foreign firm stems from trade costs' saving, which are lower within the union than between the union and the outside country. In such a scenario, coordination of regional tax/subsidy policies at the union level is

⁶Hrovatin et al. (2004).

⁷See Flores-Macias and Musacchio (2009).

⁸A different set of papers looks at two-country policy competition by incorporating positive (or negative) spillovers from FDI. The presence of potential benefits from the investment – due to the existence of, e.g., regional unemployment, vertical industry linkages with domestic producers and agglomeration effects, technological spillovers, etc. – induces countries to a subsidy competition to attract the foreign MNE. See, for instance, Black and Hoyt (1989), Haaparanta (1996), Haaland and Wooton (1999), Barros and Cabral (2000), and Fumagalli (2003). By contrast, when the location of a foreign firm causes negative externalities for the host country (e.g. by polluting its environment), policy competition may result in excessively high tax rates. See Markusen, Morey and Olewiler (1995).

shown to bring about welfare gains to the union countries.

The issues we are interested in are also related to the theoretical literature on mixed oligopoly. The latter has generally focused on the optimal strategies of the public firm, the characterization of market equilibria and the effects of privatization by adapting the standard models of oligopolistic competition to the welfare-maximizing behavior of public firms.⁹ More recently, closer attention has been paid to international mixed oligopoly given that the public firm's behavior is sensitive to the nationality of its private competitor (Fjell and Pal, 1996; Fjell and Heywood, 2002). In particular, some work has been devoted to the analysis of instruments, such as production subsidies, that are alternative to direct public provision (Pal and White, 1998; Sepahvand, 2004); to the study of partial privatization and optimum tariffs (Chao and Yu, 2006); or to make the timing of competition endogenous (Cornes and Sepahvand, 2003; Matsumura, 2003). Other contributions (Norbäck and Persson, 2004; 2005) have studied competition between foreign and domestic private firms as potential buyers of state-owned assets which are sold at an auction during the privatization process.

In this paper, we apply the analysis of international mixed oligopoly to a context where two active governments seek to attract FDI by a foreign firm from a third country. In our model we follow Bjorvatn and Eckel (2006) that modify H&W's set-up by introducing a domestic firm - in the big country - which competes with the foreign investor on the regional market. As a consequence, the FDI decision is driven by a trade-off between the advantage of locating in the big market (*market size* effect) and the benefit of being a monopolist in the small market (*competition* effect). The intensity of policy competition and the resulting equilibrium policy (i.e., a subsidy or a tax) depend on the relative location advantages offered by the two countries. An interesting result in their model is that the country hosting the incumbent firm does not always gain from the investment of the MNE. The benefit for consumers may be in fact offset by the shift of profit from the domestic incumbent to the foreign firm. Another important contribution of their paper concerns the evaluation of tax/subsidy competition to attract FDI. Bjorvatn and Eckel (2006) show that the introduction of policy competition may improve the efficiency of the location choice of the MNE. The reason is that imperfect competition distorts the FDI choice of the foreign firm so that the profit-maximizing location may not coincide with the efficient (i.e, aggregate welfare maximizer) location. Introducing policy competition between the government of the two countries has the effect of internalizing the external effect of the location choice in the MNE's decision which therefore becomes efficient. This efficiency-enhancing property of tax competition is also highlighted by Fumagalli (2003) in the presence of positive technological spillovers from the investment and by Barros and Cabral (2000) when countries differ in unemployment levels. Additionally, policy competition may even enhance regional welfare when the gains from a more efficient location choice of the MNE more than compensate the subsidy paid and there is potential for Pareto improvement *via* side payment.

The main contribution of our paper is to show that these positive effects of the introduction of policy competition crucially depend on the nature (public or private) of the domestic

⁹See Rees (1984), Bös (1986), de Fraja and Delbono (1989), and Beato and Mas-Colell (1984).

incumbent firm. We show that the efficiency enhancing feature of policy competition does not hold when the incumbent is a welfare-maximizer public firm. The reason is that the public firm acts as a disciplinary device leading the foreign MNE to the efficient location choice.¹⁰ Therefore the introduction of policy competition does not change the location choice of the MNE and, in the presence of transaction costs, it becomes inefficient. Furthermore it may also result in a waste of resources for the region when the two countries actively compete to attract FDI.¹¹ Finally, contrary to the result in Bjorvatn and Eckel (2006), the country hosting the incumbent firm always benefits from the FDI when the incumbent is public and is therefore always willing to offer a subsidy to attract the investment.

The rest of the paper is organized as follows. In Section 2, we analyze the investment decision of a foreign MNE when the incumbent in the big country is a welfare-maximizing public firm and provide the main results of the model. In Section 3 we discuss the impact of the nature – public or private – of the domestic incumbent, while in Section 4 we generalize the result obtained in a simple linear model. In Section 5, we discuss the robustness of our results to some specific issues and, finally, Section 6 summarizes the main conclusions emerging from our work.

2 FDI decision in the presence of a public firm

In this Section, we illustrate the model we use to analyze the impact of policy competition between countries on the investment decision of a multinational firm when the incumbent in the big market is a welfare-maximizing public firm and the final good is traded within the region.

An example of such competition occurred in 1997 between UK and France for the biggest Japanese investment in Europe in a decade proposed by the carmaker Toyota. French market was characterized by the presence of the government-controlled incumbent Renault that commanded the largest share in the domestic market. Under the European rules to date, countries could have offered subsidies up to a third of the total investment of \$1.6 billion, even though Toyota officials in London insisted that the government aid offered to lure inward investment would have played only a small part in such decisions.¹² In December 1997 Toyota, announced that it had chosen the northern French town of Valenciennes as the site for its new car assembly plant. The French Government agreed to provide around 10% of the initial investment and [t]his was a key factor in the Japanese manufacturer’s choice of location for its new factory. (EIROOnline - European Industrial Relation Observatory on-line, 1997).

In the theoretical model proposed, we represent such policy competition by a three-stage

¹⁰The disciplinary role of a public firm in imperfectly competitive markets as already been highlighted in the literature on mixed oligopolies; see for example Anderson et al. (1997).

¹¹If the location advantage of one of the countries is very large that policy competition becomes an additional tax instrument on the foreign firm. However in such a case it would be difficult to describe the situation as one of “competition” to attract the investment.

¹²The Economist (1997).

game characterized by the following sequence of decisions:

- In stage 1, the governments of the two countries simultaneously and irreversibly post bids – lump-sum taxes/subsidies – to attract the foreign investor.
- In stage 2, the foreign multinational decides in which country to locate its production plant to serve the regional markets.
- In stage 3, the foreign multinational and the incumbent public firm compete à la Cournot in the regional markets and payoffs (profits and welfare) are realised.

We solve our three-stage game by backward induction to find its subgame perfect Nash equilibrium in pure strategies.

2.1 The basic set-up

We develop a model in which a firm from a third-country (we will refer to it as firm 1, the MNE or the foreign firm) has to decide in which of two countries to invest in order to provide some final good to the consumers of the whole region.

The markets of the two countries are of unequal size. Namely, in line with Haufler and Wooton (1999), we assume that there is a single consumer in country A and $n \geq 1$ identical consumers in country B . Hence, when $n > 1$, country B represents the “big” market for the final good. Consumers’ preferences are such that each of them has linear demand for the commodity, $Q = \alpha - p$. So, in country A the two firms face the total demand $Q_A = \alpha - p_A$ and in country B the total demand $Q_B = n(\alpha - p_B)$. The two inverse demands are therefore:

$$p_A(Q_A) = \alpha - Q_A \quad p_B(Q_B) = \alpha - \frac{Q_B}{n}$$

Prior to entry of the MNE in the region, no production takes place in the small country, whereas the big country already hosts a welfare-maximizing public firm (firm 0).¹³ The latter sells the same product as the MNE but it is *less efficient* than the former, i.e., it produces the final good at a higher marginal cost, $c_0 > c_1 \geq 0$, with c_i denoting the constant marginal production cost of firm $i = 0, 1$. To make the analysis simpler, we assume that the public incumbent cannot serve the other market in the region; this assumption will be relaxed later on.

The MNE has to incur a fixed cost $F > 0$ to establish a production plant in either country since trade costs associated with exporting from its residence country to the region are assumed to be prohibitively high compared to trade costs within the region (τ).¹⁴ As an example, we

¹³We do not exclude from the outset the symmetric-country case, which simply requires $n = 1$. However, we do not consider the case where the public firm operates in the small country, which is equivalent to $n < 1$. As it will become evident below, this leads to the trivial conclusion that the MNE always prefers to invest in the biggest country with no local competitor.

¹⁴In what follows, we assume that the fixed cost F is symmetric across countries and so high that it will never be profitable for the MNE to pay it twice but not so high to make FDI in the favorite country unprofitable.

can think of a German multinational which has to pick one location between Argentina and Chile where to build a production plant with the purpose of servicing the consumers of this Latin American region.

The marginal cost of serving a market depends on the efficiency of the firm, and on the location of firms and consumers. When the final good is produced and sold locally, the marginal cost for the firm is equal to c_i , $i = 0, 1$; by contrast, when the firm exports the final good to the other country, the marginal cost is higher since it also includes some intra-regional trade costs, $\tau > 0$. The latter separates the two markets so that consumer prices for the same final good will be different in the two countries.¹⁵ But since the two firms sell a homogeneous good, its consumer price in a given market, in equilibrium, will be the same irrespective of where production takes place.¹⁶

If we denote by q_{ij} the quantity of the final good sold by firm i on country j 's market so that $q_{0j} + q_{1j} = Q_j$, ($j = A, B$), we can write total cost functions of firms 0 and 1 as follows:

$$C_0(q_{0A}, q_{0B}) = c_0(q_{0A} + q_{0B}) + \tau q_{0A}$$

$$C_1(q_{1A}, q_{1B}) = F + c_1(q_{1A} + q_{1B}) + \tau(I_A q_{1A} + I_B q_{1B})$$

where $I_j = 0$ if FDI goes to j and $I_j = 1$ otherwise.

Production and trade costs are assumed not to exceed the consumers' maximal willingness to pay, i.e., $c_0, c_1, \tau \leq \alpha$. In addition, to keep our analysis as simple as possible, we normalize firm 1's marginal production cost to 0 ($c_1 = 0$) and set $\alpha = 1$, so that $c_0, \tau \in [0, 1]$.

The objective of the public firm is to maximize social welfare in B , $W_B(q_{0A}, q_{0B}, q_{1A}, q_{1B})$, which corresponds to the sum of consumer surplus and firm 0's profits

$$\begin{aligned} & \underbrace{\int_0^{Q_B} p_B(s) ds - p_B(Q_B)(q_{0B} + q_{1B})}_{CS_B(Q_B)} + \underbrace{p_B(Q_B)q_{0B} + p_A(Q_A)q_{0A} - C_0(q_{0A}, q_{0B})}_{\Pi_0(q_{0A}, q_{0B}, q_{1A}, q_{1B})} \\ & = \int_0^{Q_B} p_B(s) ds - p_B(Q_B)q_{1B} + p_A(Q_A)q_{0A} - C_0(q_{0A}, q_{0B}) \end{aligned} \quad (1)$$

from which it is evident that W_B increases with the overall quantity sold on the domestic market - due to the lower consumer price - and decreases with the revenues the MNE collects by serving the big market.

The foreign firm is instead interested in maximizing profits whose amount depends on where it locates its production plant:¹⁷

$$\Pi_1^j(q_{0A}, q_{0B}, q_{1A}, q_{1B}) = p_A(Q_A)q_{1A} + p_B(Q_B)q_{1B} - C_1(q_{1A}, q_{1B}), \quad j = A, B \quad (2)$$

¹⁵Several empirical studies show that the *market segmentation* assumption is consistent with the price-setting behavior of firms even within the European Union, where, in principle, there should be no official barriers to cross-border trade. See, for instance, Head and Mayer (2000), Haskel and Wolf (2001), and Lutz (2004).

¹⁶In this respect, our model is very similar to the "reciprocal dumping" model of Brander and Krugman (1983) whose focus is, however, on the welfare effects of trade.

¹⁷Throughout the paper, the superscript indicates the country where the MNE invests. In what follows, we will drop the subscript 1 from the expression denoting the MNE's profits in order to ease the notation.

Since the dynamic game is solved by backward induction, in what follows we analyse each stage of the game starting from market competition in stage three.

2.2 Market competition

Suppose that governments have defined in the first stage of the game the lump-sum taxes or subsidies to offer to the MNE and, in the second stage, the latter has decided in which country to locate. In the last stage of the game the MNE and the public incumbent compete à la Cournot on the two markets of country A and B .¹⁸ Under the lump-sum assumption taxes or subsidies do not affect firms' quantity decisions and can be disregarded. Then, the public firm's reaction function is given by:

$$q_{0B} = n(1 - c_0)$$

and we assume for the time being that $q_{0A} = 0$. We must stress here that the public firm's output choice for its domestic market is independent of the MNE's behaviour; that is, it always produces the same quantity.¹⁹ The consequence of this output strategy is that the public firm runs losses or at most breaks even. Indeed, in the absence of any rival, it behaves as a public monopoly and follows the usual marginal-cost pricing rule, which leads to zero profits. But when the MNE supplies a positive quantity, total output increases and the price decreases below the public firm's marginal cost. If the public firm may earn negative overall profits, we postulate that lump-sum transfers from country B 's residents occur in order to balance the firm's deficit.²⁰

Using (2), we easily derive the reaction functions of the MNE, which can be written as

$$q_{1A} = \frac{1 - I_A \tau}{2} \quad \text{and} \quad q_{1B} = \max \left\{ n \frac{1 - I_B \tau}{2} - \frac{q_{0B}}{2}, 0 \right\} \quad (3)$$

It is to be noted that the linearity of costs allows the MNE to choose the quantity produced for, say, the market of country A independently of that produced for the market of country B . Straightforward computations yield equilibrium quantities for the two firms.

On the one hand, if the MNE invests in the big country (superscript B), we obtain:

$$q_{0A}^B = 0, \quad q_{1A}^B = \frac{1 - \tau}{2}$$

and

$$q_{0B}^B = n(1 - c_0), \quad q_{1B}^B = \frac{nc_0}{2}.$$

¹⁸We get qualitatively similar results by allowing for endogenous timing in the order of moves by firms. Relying on Cournot competition to illustrate our conclusions is a way to facilitate the exposition.

¹⁹This is so because the marginal benefit (hence, the optimal choice) of public firm's production does not change with the quantity supplied by the MNE on that market. The welfare-maximizing output choice of the public firm is such that its marginal benefit equals its marginal cost, i.e., $p_B(Q_B) - p'_B(Q_B)q_{1B} = C'_0(q_{0A}, q_{0B})$. The effect of a change in the MNE's output, q_{1B} , on the marginal benefit is given by $p'_B(Q_B) - p'_B(Q_B) - p''_B(Q_B)q_{1B}$ which is nil since $p''_B(\cdot) = 0$ if demand is linear.

²⁰In Section 5, we discuss the effects of imposing a budget balance requirement on the public firm.

On the other hand, if the MNE invests in the small country, we have:

$$q_{0A}^A = 0, \quad q_{1A}^A = \frac{1}{2}$$

and

$$q_{0B}^A = q_{0B}^B = n(1 - c_0) \geq 0, \quad q_{1B}^A = \max \left\{ \frac{n(c_0 - \tau)}{2}, 0 \right\}.$$

By locating in A , the MNE has to incur trade costs to service country B 's consumers. Hence, exporting is going to be a viable option to the MNE as long as the cost of supplying the final good to the big country's market does not exceed the production cost of the local public firm.

2.3 Investment decision of the MNE

The governments of the two countries compete to attract FDI by the foreign firm. In particular, they can either tax or subsidize both local consumers and the MNE in a lump-sum fashion. The results we present in this Section are derived in the absence of policy competition or, similarly, for a situation where the two countries use identical tax/subsidy policies to induce the MNE to invest within their borders.

In order to pick the best location for the investment, the MNE compares its operating profits from FDI in country A or in country B . Namely, it invests in, say, A as long as $\Pi^A > \Pi^B$. When the latter holds with equality, the MNE is indifferent between investing in either country. Straightforward computations show that:

$$\Pi^A = \frac{1}{4} - F \quad \text{if } c_0 \leq \tau \quad (4)$$

$$\frac{1}{4} + \frac{n(c_0 - \tau)^2}{4} - F \quad \text{if } c_0 > \tau \quad (5)$$

and

$$\Pi^B = \frac{(1 - \tau)^2}{4} + \frac{nc_0^2}{4} - F \quad (6)$$

When the two countries have the same market size ($n = 1$), the presence of a public firm – although less efficient than the MNE – is a strong disincentive to invest in B . **non si vede da sopra!!** Intuitively, as there exist positive trade costs separating the two markets, the MNE prefers to locate as distant as possible from its competitor. Hence, it will always invest in A .

In general, however, the investment decision of the MNE is driven by a “market size”, a “cost”, and a “competition” effect. The market size effect is such that, as we let n increase, the relative profitability of investing in the big country increases and investment is more likely to take place there. The cost effect reflects the efficiency of the incumbent firm in country B : intuition suggests that the higher c_0 , the higher the attractiveness of country B since the MNE faces a weaker competitor on the big market. Finally, higher trade costs τ increase the relative profitability of investing in the small country because the more separated are the markets the more profitable is to be as far as possible from the local competitor.²¹

²¹The latter effect is also shown by Bjorvatn and Eckel (2006) to hold when a private domestic incumbent is considered.

From equations (4), (5), and (6) it is possible to identify the threshold value $\tau^*(c_0, n)$ such that the firm is indifferent between investing in country *A* and *B*:

$$\tau^*(c_0, n) = \begin{cases} 1 - \sqrt{1 - nc_0^2} & \text{if } c_0 \leq \tau \quad (\text{and } = 1 \text{ if } n > \frac{1}{c_0^2}) \\ \frac{2(nc_0 - 1)}{n - 1} & \text{if } c_0 > \tau \end{cases}$$

Figure 1 depicts the threshold value τ^* in the space $\{\tau, n\}$ for different values of c_0 . When $\tau > \tau^*$ the MNE invests in the small country *A*. Moreover, as it is clear from the graph $\frac{\partial \tau^*}{\partial n} > 0$ and $\frac{\partial \tau^*}{\partial c_0} > 0$. There is therefore a clear trade-off between the competition effect that works against the big country *B* and the effects of cost and market size that increase the attractiveness of country *B*.

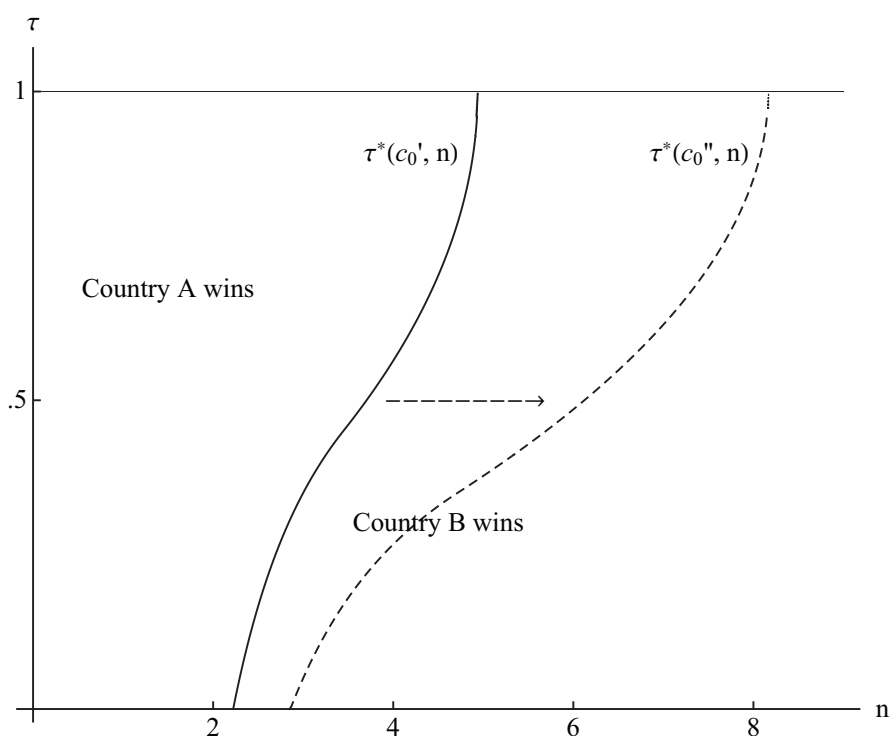


Figure 1: Location choice of the multinational firm absent policy competition.

When $\tau > \tau^*(.)$ the MNE locates in the small country *A*. Since $c'_0 > c''_0$ the picture shows that the more efficient the public incumbent is, the more attractive the small country *A* becomes as the location for the multinational firm.

2.4 Policy competition for FDI

We now investigate how the introduction of tax/subsidy competition between the two countries can affect the investment decision of the MNE. We assume that the country receiving FDI can levy a lump-sum tax on the foreign firm's profits or has to offer a lump-sum subsidy in

order to induce it to establish a production plant within its frontiers. We denote country j 's tax/subsidy by S_j , $j = A, B$.

We first need to identify the maximum subsidy each country is willing to offer to the MNE. We define such a subsidy as the welfare gain of receiving the investment, i.e., $S_j^{max} \equiv W_j^j - W_j^k$, for $j, k = A, B$, $j \neq k$, with W_j^k denoting country j 's welfare when FDI goes to country k . While welfare in country B consists of consumer surplus and public firm's profits as given by equation (1), welfare in country A simply coincides with consumer surplus as no local firm operates there prior to the MNE's entry on the regional market. Evidently, country A always benefits from FDI as consumer surplus is higher by having the final good produced and sold locally instead of being served through exports. As for country B , we easily show that the same is true; in fact welfare is always higher when the MNE invests there than otherwise. Indeed,

$$W_A^A = \frac{1}{8} \quad \text{and} \quad W_A^B = \frac{1}{8}(1 - \tau)^2$$

and

$$\begin{aligned} W_B^A &= \frac{(1 - c_0)^2 n}{2} && \text{if } c_0 \leq \tau \\ &= \frac{n}{8}(2 - c_0 - \tau)^2 - \frac{n}{2}(1 - c_0)(c_0 - \tau) && \text{if } c_0 > \tau \\ W_B^B &= \frac{n}{8}(2 - c_0)^2 - \frac{n}{2}(1 - c_0)c_0 \end{aligned}$$

It is easy to show that $W_j^j > W_j^k$, $\forall j, k = A, B$, $j \neq k$. This allows us to state

Proposition 1 *In the presence of a welfare-maximizing public firm, both countries always benefit from the investment of the multinational.*

The intuition for the result in Proposition 1 is the following. Since the public firm always produces the same quantity, the MNE acts as a monopolist on the (constant) residual demand. Therefore there is no crowding out of domestic production and consumers benefit from a more efficient additional producer if FDI occurs in their own country.

As each country is better off by receiving FDI, both of them are willing to offer a positive subsidy to the MNE, which will invest in country j if and only if

$$\Pi^j + S_j^{max} > \Pi^k + S_k^{max}, \quad \text{for } j, k = A, B, \quad j \neq k \quad (7)$$

i.e., when profits from locating in j – inclusive of the lump-sum subsidy country j offers – exceed those – subsidy inclusive – from investing in k .

When we evaluate whether and how tax/subsidy competition affects the MNE's investment decision the following result holds.

Proposition 2 *Tax/subsidy competition between countries does not change the investment decision of the multinational.*

Such an *irrelevance* result rests on the absence of strategic interaction on both markets which is essentially due to the linearity assumptions in the model and on the fact that the public incumbent does not react to changes in the output of the rival firm; i.e., its reaction function is flat. The MNE, indeed, enjoys monopoly power on the small market, whereas the public firm always produces the same quantity for the big market, where the MNE serves as a monopolist the constant residual demand. When the MNE is indifferent between investing in A or in B , the gain in local profits on A 's market from locating in A over B exactly compensates the gain in local profits on B 's market from locating in B over A . In addition, each country's welfare gain of receiving the investment is a fixed proportion of the local profit gain for the MNE. Therefore, when local profit gains are equal, the same holds for welfare gains, and since welfare gains represent the maximum subsidy each country is willing to offer to attract FDI, the introduction of tax/subsidy competition does not modify the MNE's investment decision.

From Proposition 2, it immediately follows

Corollary 1 *In the presence of a welfare-maximizing public firm, policy competition to attract FDI is wasteful for the region.*

This result has to be qualified since it holds only when the location advantage of the receiving country is not too large and therefore a subsidy is paid to the MNE.²² In general, although one country's welfare is higher when the MNE locates within its borders, policy competition turns out to be just a waste of resources for the region as a whole since it does not change the investment decision of the foreign firm and the host country has to grant the firm a subsidy to win the competition for FDI.

If we are interested in the aggregate welfare, defined as the sum of the regional welfare (the welfare of two countries) and the MNE's profits, it is interesting to notice that the investment decision of the MNE with policy competition maximizes aggregate welfare. In fact, condition (7) can be rewritten as

$$\begin{aligned} \Pi^j + W_j^j - W_j^k &> \Pi^k + W_k^k - W_k^j \text{ or} \\ \Pi^j + W_j^j + W_k^j &> \Pi^k + W_j^k + W_k^k, \text{ for } j, k = A, B, j \neq k \end{aligned}$$

In addition, since policy competition does not affect the investment decision of the MNE, as shown by Proposition 2, we can state the following result:

Corollary 2 *In the presence of a welfare-maximizing public firm the investment decision of the MNE absent tax/subsidy competition is efficient and maximizes aggregate welfare.*

2.5 Equilibrium policy

Because of different market size, cost-asymmetry, and the presence of positive costs for intra-regional trade, the MNE may prefer to invest in a country where part of its profits are taxed

²²If the location advantage is large there is no real competition between the countries and policy competition becomes in fact an additional instrument to tax the foreign MNE.

away in spite of the fact that the other country offers a subsidy. In particular, provided that country k sets its maximum subsidy, country j receives FDI by setting a positive lump-sum tax on the MNE's profits if and only if the following condition holds:

$$\Pi^j - T_j > \Pi^k + S_k^{max}, \text{ for } j, k = A, B, j \neq k \quad (8)$$

If this is the case, the subsidy country k is able to offer to the MNE cannot offset its disadvantage relative to country j . For instance, country B attracts the MNE by taxing its profits when its market is large enough compared to country A 's and the public firm is very inefficient. When the public firm instead represents a fierce competitor for the big market, country A receives FDI even if it taxes away part of the MNE's profits.

The equilibrium policy (subsidy or tax) is the result of an auction where the country making the most attractive offer receives the investment by the MNE.²³ When both countries offer the maximum subsidy to attract FDI, country j wins the auction if condition (7) holds; however, country j needs not actually to pay the maximum subsidy it is willing to offer but just the one which is necessary to out-bid the rival country, which is given by:

$$S_j^* \equiv \Pi^k + S_k^{max} - \Pi^j > 0, \text{ for } j, k = A, B, j \neq k$$

By contrast, when country j represents the most attractive location for FDI without offering any subsidy and despite the fact that country k offers its maximum affordable subsidy, condition (8) holds. In this case, country j wins the auction by taxing away part of the MNE's profits and the equilibrium lump-sum tax is given by:²⁴

$$T_j^* \equiv \Pi^j - \left(\Pi^k + S_k^{max} \right) > 0, \text{ for } j, k = A, B, j \neq k$$

Figure 2 depicts the equilibrium policy resulting from competition in lump-sum taxes/subsidies to attract FDI. The figure depicts the spaces of parameters $\{n, \tau\}$ where countries A or B win the race by taxing or subsidizing the firm. Evidently, the introduction of such a policy instrument can leave a country better off to the extent that the latter can extract part of the foreign firm's profits. By contrast, if a country has to pay a subsidy to attract the MNE, which would have invested there anyway absent tax competition, only the MNE will be better off.²⁵

3 The impact of the nature of the domestic incumbent

The result in Proposition 1 crucially depends on the nature of the incumbent firm: if it is a public firm, the country hosting it would always benefit from the additional investment of

²³See the Appendix for a formal proof. The simultaneous auction equilibrium outcome is equivalent to the equilibrium of a policy competition game where the two governments of the two countries post bids à la Bertrand.

²⁴In such a situation, i.e., when the relative advantage for the foreign firm of investing in country j is so large that country k can never succeed in attracting FDI, we can regard the lump-sum tax as an *entrance fee* that country j charges the firm for establishing its production plant there.

²⁵See Appendix for the computations.

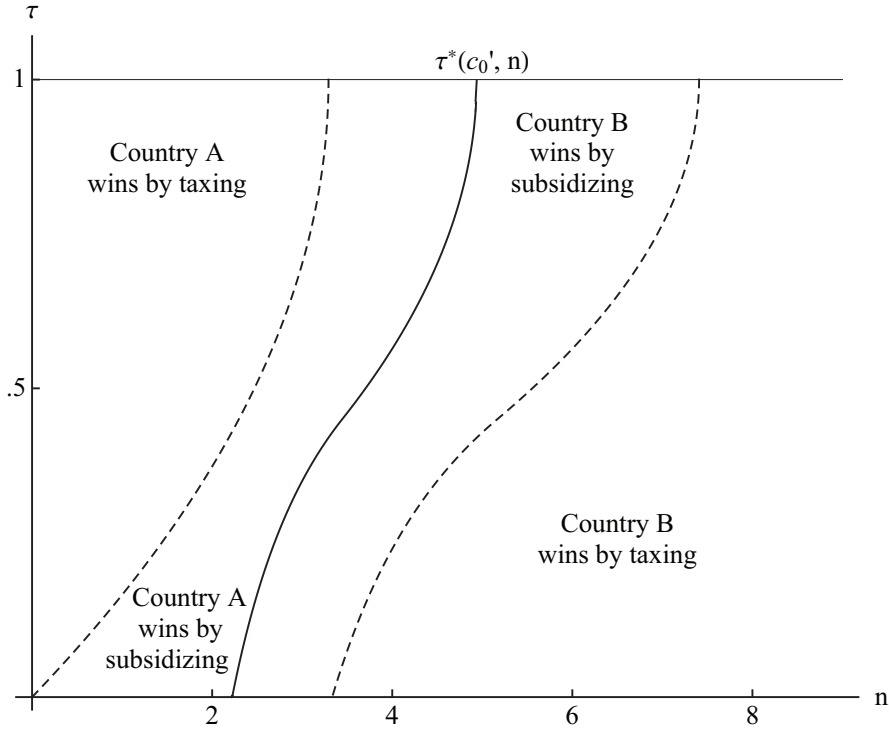


Figure 2: FDI decision with tax/subsidy competition

a multinational enterprise. This result contrasts with the one by BJORVATN and ECKEL (2006) according to which the big country “benefits [from FDI] if trade costs and the size of its market are not too large” (Lemma 2, p. 1897). Their theoretical framework differs from ours in that the big country hosts a *private* incumbent firm. When trade costs are sufficiently high, the local private firm prefers keeping the MNE as far as possible and the big country does not benefit from receiving FDI as the gain in consumer surplus would not compensate for the loss in the local firm’s profits.²⁶

The nature of the incumbent firm is also relevant for the efficiency of MNE’s location choice, i.e., the effect on aggregate surplus or welfare. Our result in Corollary 2 shows that absent policy competition the investment choice of the MNE is efficient. However this is only true when the incumbent is a public firm while it does not hold with a private incumbent, as shown by BJORVATN and ECKEL (2006). In the latter case, in fact, imperfect competition between private firms may distort the choice of the MNE resulting in an inefficient location of the investment from the aggregate surplus perspective. The presence of a public firm, instead, acts as a disciplinary device leading the foreign MNE to the efficient location choice. Given the efficiency result in Corollary 2, policy competition cannot increase the aggregate welfare in the framework of our paper and any change in the resource allocation is just a transfer

²⁶A similar reasoning applies when the market of the big country is larger enough compared to the one of the small country.

from countries to the MNE, or *vice versa*.²⁷ This efficiency-enhancing role of tax competition is instead possible when the domestic incumbent is a private firm (Bjorvatn and Eckel, 2006, Proposition 5). As a consequence, whenever the location advantage is not too different between the two countries and a tax is paid in equilibrium, the welfare of the region (the sum of the two countries' welfare) can increase only if the domestic firm is private (Bjorvatn and Eckel, 2006, Proposition 6). If the domestic firm is public then tax competition is always wasteful from the perspective of the regional welfare as highlighted by Corollary 1 in the present paper.

4 A more general framework

In the present Section we explore the effects of policy competition for FDI in a more general framework. Consider a general individual demand function $Q(p)$ decreasing and twice continuously differentiable so that $Q_A = Q(p_A)$ and $Q_B = nQ(p_B)$. Define the inverse demand functions $p_A(Q_A) = Q_A^{-1}(\cdot)$ and $p_B(Q_B) = Q_B^{-1}(\cdot)$. In the following Proposition we extend the result of Proposition 1 to a more general framework.

Proposition 3 *Consider a general decreasing individual demand $Q(p)$. In the presence of a welfare maximizing public firm located in country B , both countries always benefits from FDI.*

Proof. Whatever the demand, consumers in Country A prefer a monopolist with lower marginal cost; therefore welfare in country A is higher when the MNE locates within its borders. To see whether the welfare of country B is higher when FDI occurs within its borders rather than in country A it is enough to check the net effect of an increase in the quantity produced by the MNE. In fact, if the MNE invests in country B , its cost of serving the local consumers is lower and its best response to any quantity produced by the public incumbent is larger than in the case of FDI in country A . Therefore the equilibrium quantity sold by the MNE in country B increases if FDI occurs in country B rather than in country A .²⁸ We have to consider the equilibrium change in welfare of country B taking into account the optimization behaviour of the public firm. To this end we define $V_B(q_1) = W_B(r_0(q_1); q_1)$ the value function of the welfare maximization problem of the public firm. The effect of a marginal change in q_1 is therefore:

$$\frac{dV_B(q_1)}{dq_1} = \frac{\partial W_B(r_0(q_1); q_1)}{\partial q_1} + \frac{\partial W_B(r_0(q_1); q_1)}{\partial q_0} \frac{dr_0(q_1)}{dq_1}$$

However, since the public firm is optimizing

$$\frac{\partial W_B(r_0(q_1); q_1)}{\partial q_0} = 0$$

²⁷Therefore, in the presence of any transaction cost, policy competition results in a pure waste of resources since aggregate welfare would be reduced.

²⁸However, as Bjorvatn and Eckel (2006) show in their paper, this is not enough to say that welfare increases since there is a trade off between consumer surplus and the profit of the incumbent and there are cases in which the loss in profit is larger than the increase in consumer surplus. While their analysis is carried out considering a profit-maximizer private incumbent, our analysis consider the case of a welfare-maximizer public firm.

and therefore by the Envelope Theorem,

$$\frac{dV_B(q_1)}{dq_1} = \frac{\partial W_B(r_0(q_1); q_1)}{\partial q_1} = -p'_B(\cdot)q_1 > 0 \quad \text{always.}$$

Since the effect of a marginal change in q_1 is positive, it follows that a discrete increase of q_1 always increases the welfare of country B . This completes the proof. ■

The *irrelevance* result of Proposition 2 can be generalized to include any positive and increasing cost function.

Proposition 4 *Consider a cost function $C_0(q_0)$ positive, increasing and twice continuously differentiable, and a linear demand. In the presence of a public welfare-maximizing incumbent in the large market the introduction of policy competition does not change the investment choice of the multinational enterprise.*

Proof. As discussed in the proof of Proposition 2, this irrelevance result rests on the absence of strategic interaction between the two firms. In fact, as long as the public firm does not react to changes in the output of the rival firm (that is, its reaction function is flat), the MNE behaves as a monopolist on the constant residual demand on the large market and the introduction of policy competition does not change the investment choice of the MNE. Making use of the theory of supermodular games, when the objective function is twice continuously differentiable, the slope of the reaction function has the same sign as the second cross-derivative of the objective function. As the demand function is linear, the objective function of the public firm is welfare as defined by equation (1), and $\frac{\partial^2 W(q_0, q_1)}{\partial q_0 \partial q_1} = p''(\cdot) = 0$. So the reaction function of the public incumbent is flat and the firm always produces the same quantity. This quantity depends on the cost structure of the firm and solves the equation:

$$a - bq_0 = C'_0(q_0) \tag{9}$$

As $C_0(q_0)$ is assumed to be increasing, equation (9) has always a solution that is independent of the quantity choice of the MNE. ■

5 Other Issues

In this Section, we discuss the robustness of our results to some specific issues in order to understand to what extent our conclusions depend on the details of the model. The good news is that several assumptions could be relaxed without qualitatively changing our main findings.

The public firm exports

In the model presented in Section 2 we have assumed that the public firm does not export to country A . if we remove this assumption the relevance of the nature (public or private) of the firm for the outcome of the policy competition for FDI becomes even more evident.

First of all, since its objective function is to maximize the welfare of country B , the public firm will behave as a *profit maximizer* on the market of country A . As a consequence, the result of Proposition 1 that not only country A , but also country B always benefit from FDI is reinforced. Now country B enjoys not only a larger consumer surplus but also an increase in the profits that the public firm earns on the market of country A . In fact, when locating in country B , the MNE is a weaker competitor on the market of country A .

This result has also consequences on the equilibrium outcome of the policy competition. When the public firm exports to country A the willingness of the government of country B to subsidize the MNE increases because the welfare gain from FDI increases as explained above. In addition, the maximum subsidy the government of country A is willing to offer decreases because the presence of another firm reduces the benefit of the location of the MNE within its borders. Therefore the overall effect is summarized in the following Proposition:

Proposition 5 *In the presence of a welfare-maximizing public firm which does export to the small country, tax/subsidy competition increases the attractiveness of the big country.*

Proposition 5 sharply contrasts with the finding by Bjorvatn and Eckel (2006) according to which policy competition increases the attractiveness of the small country. They highlight the fact that, in the presence of a private incumbent, there is a trade-off between consumer surplus and profits that decreases the willingness of the big country to subsidize the MNE. This result emphasizes the relevance of the nature of the incumbent firm for the outcome of the policy competition for FDI. It may also cast light on the different incentives to deviate from tax agreements and start a subsidy competition for big a small countries. While small countries may benefit from policy competition in the presence of foreign private incumbents, the big country would prefer policy competition only when the incumbent is its own public firm.

Arbitrage

In our model, we have implicitly left out the possibility that consumers - or other economic agents - take advantage of *arbitrage opportunities* when the difference in prices between the two markets exceeds the trade cost. This assumption would well represent markets, such as utilities and the like, where it is not possible to buy the final good or service in a country and sell it to the other country. However, if arbitrage were possible, instead, firms would be constrained in their output choices since any consumer price should not be higher than the other price plus the trade cost.

In the presence of a welfare-maximizing and relatively inefficient public firm in country B , it is easy to show that arbitrage can be profitable just when the consumer price in country A exceeds that in country B . The arbitrage constraint could thus be binding on country A 's market only. A first effect is that the public firm would never find it profitable to export to the small country. Since $p_B \leq c_0$ always holds and $p_A \leq p_B + \tau$ because of the arbitrage constraint, the consumer price in country A is always smaller (or at most equal) to the marginal cost for the public firm of producing and supplying the good to country A 's consumers, i.e.,

$p_A \leq c_0 + \tau$. Hence, the public firm would never export the final good to the small country market and our irrelevance result in Proposition 2 would hold true without the unnecessary assumption of no export for the public incumbent. A second effect of the arbitrage constraint is the increase in the relative profitability for the MNE of investing in country A . Everything else equal, by locating its production plant in A , the MNE relaxes the arbitrage constraint on p_A . This is because when FDI goes to A , the price in country B 's market is higher than in the case of FDI to B , and this, in turn, loosens the pressure exerted by the possibility of arbitrage on the price in country A . As a result, the attractiveness of country A increases despite the fact that the arbitrage constraint might negatively affect the profits the foreign firm realizes on the small country market.

Budget balance constraint

Another assumption that one can call into question is the absence of a *budget constraint*, i.e., a break even condition, in the public firm's welfare maximization problem. Indeed, we have assumed that country B 's government can impose lump-sum taxes on domestic consumers to subsidize public firm's production in the same way as it subsidizes the MNE to attract FDI. In reality, however, public firms may be required to balance their budget in order to avoid the use of distortionary taxation to cover their deficit. If we introduce such a break even condition for the public firm, its maximization problem turns out to be equivalent to a problem where the public firm's objective function is a weighted average of welfare and profits. Indeed, if country B 's government instructs the public firm to maximize welfare subject to a budget balance requirement, the firm's problem can be written as

$$\begin{aligned} \max_{\{q_{0A}, q_{0B}\}} \quad & W_B = CS_B(\cdot) + \Pi_0(\cdot) \\ \text{s.t.} \quad & \Pi_0(\cdot) = \pi_{0A} + \pi_{0B} \geq 0 \end{aligned}$$

where $\pi_{0A} \geq 0$ and $\pi_{0B} \leq 0$ represent the profits the public firm earns in country A and the losses it may have to face in country B , respectively. Denoting by λ the Lagrange multiplier for the constraint of this problem, the corresponding Lagrangian function is

$$L = CS_B + \pi_{0A} + \pi_{0B} + \lambda(\pi_{0A} + \pi_{0B})$$

and the complementary slackness condition is given by

$$\lambda(\pi_{0A} + \pi_{0B}) = 0, \quad \lambda \geq 0.$$

This is equivalent to

$$L = \frac{1}{1+\lambda} W_B + \frac{\lambda}{1+\lambda} (\pi_{0A} + \pi_{0B}) = (1-\theta) W_B + \theta (\pi_{0A} + \pi_{0B})$$

with

$$\theta(\pi_{0A} + \pi_{0B}) = 0, \quad \theta \equiv \frac{\lambda}{1+\lambda} \in [0, 1].$$

As a consequence, the behavior of the public firm is somehow halfway between an unconstrained welfare-maximizer and a profit-maximizer firm. In particular, when the profits the firm realizes by serving the small market are large enough to cover the losses on its domestic market, i.e., $\pi_{0A} + \pi_{0B} > 0$, the constraint is not binding ($\theta = 0$) and the firm behaves as in our original set-up. Otherwise, when it is binding, the constraint makes the public firm a less fierce competitor for the MNE, thereby increasing the attractiveness of country B .

6 Conclusions

In this paper, we have highlighted the relevance of the nature of the incumbent firm for the outcome of the competition for FDI between two countries of (possible) asymmetric size. We have shown that when the incumbent in the big market is a public rather than a private firm, both countries always benefit from receiving the investment of the MNE. In particular, differently from Bjorvatn and Eckel (2006), when the MNE locates in the big country, the gain in consumer surplus of domestic residents is always greater than the loss in profits for the domestic firm. Hence, both governments are always ready to offer a subsidy to attract FDI. However, when the public firm does not export to the small country, tax/subsidy competition turns out to be *irrelevant* to the investment decision of the foreign firm. The consequence is that policy competition is wasteful for the region and the MNE is the only beneficiary of it. Moreover, contrary to Bjorvatn and Eckel (2006), the location choice of the MNE is always Pareto efficient and there is no need to introduce policy competition to increase efficiency.

When the public firm exports to the small country, policy competition increases the attractiveness of the big country. In this case, indeed, there is an extra-benefit from receiving FDI for the big country because the public firm will have to face a weaker competitor on the small market.

To sum up, the result provided by Bjorvatn and Eckel (2006) according to which policy competition may be beneficial because induces an efficiency location choice is not general and it is sensible to the particular features of the market. The present paper provides evidence that the nature – public or private – of the firm matters and if the incumbent is a welfare maximizing firm the benefit of the introduction of tax/subsidy competition between countries disappears.

Appendix

Equilibrium of the policy-competition-for-FDI game

The policy-competition-for-FDI game is equivalent to a Bertrand-competition game in prices between countries A and B and it is characterized by a multiplicity of equilibria. Denoting by j the country that receives FDI by the foreign firm and by k the other country ($j, k =$

$A, B, j \neq k$), the equilibrium can be generally defined as follows:

$$\begin{aligned} S_k^*(S_j) &= \epsilon, \text{ with } \epsilon \in (0, S_k^{max}) \\ S_j^*(S_k) &\text{ such that } \Pi^j(S_j^*) = \Pi^k(S_k^{max}) \end{aligned}$$

and the proof is a straightforward application of the Bertrand-competition solution.

Suppose that condition (7) holds, so that for country j to win the competition for FDI, it has to pay a positive subsidy to the foreign firm. If this is the case, the equilibrium strategy pair of the two countries is given by:

$$\begin{aligned} S_k^*(S_j) &= \epsilon, \text{ with } \epsilon \in (0, S_k^{max}) \\ S_j^*(S_k^{max}) &\equiv \Pi^k + S_k^{max} - \Pi^j > 0 \end{aligned}$$

For country k , any bid $\epsilon \in (0, S_k^{max})$ is a best reply to country j 's equilibrium strategy since k 's payoff is always nil. Indeed, it can never attract the foreign investor even by offering its maximum subsidy. For country j , any other bid $S_j'(\cdot) < S_j^*(S_k^{max})$ is not an equilibrium strategy since country k will have the opportunity of attracting FDI by offering the foreign firm S_k^{max} , which would imply $\Pi^k(S_k^{max}) > \Pi^j(S_j')$. By contrast, any other bid $S_j'(\cdot) > S_j^*(S_k^{max})$ is not a best reply to $S_k^*(S_j)$ because it leaves some extra-money on the table, i.e., to the foreign firm.

Suppose instead that condition (8) holds, so that the profit gain from investing in country j is so large that country j can win the competition for FDI by levying a positive lump-sum tax on the foreign firm's profits in spite of the fact that country k offers its maximum subsidy. In this case, the equilibrium strategy pair of the two countries is given by:

$$\begin{aligned} S_k^*(S_j) &= \epsilon, \text{ with } \epsilon \in (0, S_k^{max}) \\ T_j^*(S_k^{max}) &\equiv \Pi^j - (\Pi^k + S_k^{max}) > 0 \end{aligned}$$

As before, any bid $\epsilon \in (0, S_k^{max})$ is country k 's best reply to country j 's equilibrium strategy since k 's payoff is always nil. For country j , any other bid $T_j'(\cdot) > T_j^*(S_k^{max})$ is not an equilibrium strategy since country k will have the opportunity of attracting FDI by offering the foreign firm S_k^{max} , which would imply $\Pi^k(S_k^{max}) > \Pi^j(T_j')$. By contrast, any other bid $T_j'(\cdot) < T_j^*(S_k^{max})$ is not a best reply to $S_k^*(S_j)$ because it leaves money to the foreign firm.

Proof of Proposition 1. If the MNE invests in country B , its production for that market is larger than in case of FDI in A . Since the public firm's output for country B 's market is fixed, the MNE's larger quantity fully translates into an increase in total output which lowers price, and country B 's welfare is larger because:

- (i) consumers benefit from the lower price on the total quantity that is produced if the MNE invests in A ; hence, given that the loss in public firm's profits simply represents a neutral transfer to consumers, there is a net gain in welfare due to the lower price for the MNE's quantity;

(ii) consumers also benefit from the larger quantity produced by the MNE.

■

Proof of Proposition 2. To show this result we rely on the properties of a monopoly with linear cost and demand. In fact, when the public firm does not export to country A , there is no strategic interaction between firms since the MNE enjoys monopoly power on the small market and serves as a monopolist the constant residual demand on the big market. The residual demand in B is given by:

$$Q_{ResB} = n(1 - p_B) - n(1 - c_0) = n(c_0 - p_B) \implies p_B = c_0 - \frac{Q_{ResB}}{n}$$

Absent tax/subsidy competition, if the MNE is indifferent between A and B , the gain in local profits from FDI to A is equal to the gain in local profits from investing in B . In the presence of tax/subsidy competition, instead, the indifference condition is given by (7) holding with equality.

Since the public firm always produces the same quantity in B , any change in its own profits is a neutral transfer to consumers. Then, any change in welfare due to the investment decision of the MNE is entirely measured by the change in the consumer surplus on the residual demand, i.e.,

$$S_B^{max} \equiv W_B^B - W_B^A = CS_{ResB}^B - CS_{ResB}^A$$

where CS_{ResB}^j stands for the consumer surplus on the residual demand in country B 's market when the MNE invests in country $j = A, B$. So, from (7), the indifference condition with tax/subsidy competition can be rewritten as follows:

$$\pi_A^A - \pi_A^B + CS_A^A - CS_A^B = \pi_B^B - \pi_B^A + CS_{ResB}^B - CS_{ResB}^A \quad (10)$$

and we can easily show that when $\Pi^A = \Pi^B$ then (10) holds true because

$$CS_j^j - CS_j^k = \frac{1}{2} (\pi_j^j - \pi_j^k), \quad \forall j, k = \{A, ResB\}, \quad j \neq k$$

Consider now a monopoly market with linear (inverse) demand, $p = a - bq$ and cost, $C(q) = cq$, so that the equilibrium quantity and price are $q^* = \frac{a-c}{2b}$ and $p^* = \frac{a+c}{2}$. We analyze the change in consumer surplus and profits due to a change in c by assuming that marginal costs fall to zero. The new equilibrium quantity and price are $q^{**} = \frac{a}{2b}$ and $p^{**} = \frac{a}{2}$, respectively.

The change in consumer surplus has two components:

(i) the effect of the reduction in price on the initial quantity

$$\Delta_1 CS = (p^* - p^{**}) q^* = \frac{c(a-c)}{4b}$$

(ii) the effect of the increase in quantity

$$\Delta_2 CS = \frac{1}{2} (p^* - p^{**}) (q^{**} - q^*) = \frac{1}{2} \frac{c^2}{4b}$$

Similarly, we can define two components of the change in profits:

(i) the increase in profits on the initial quantity

$$\Delta_1 \pi = cq^* - (p^* - p^{**})q^* = \frac{c}{2}q^* = \frac{c(a-c)}{4b}$$

(ii) the profits on the quantity increase

$$\Delta_2 \pi = (q^* - q^{**})p^{**} = \frac{ca}{4b}$$

and it is immediate to check that the following relations hold:

$$\Delta_2 \pi = \Delta_1 CS + 2\Delta_2 CS \quad \text{and} \quad \Delta_1 \pi = \Delta_1 CS \implies \Delta CS = \frac{1}{2}\Delta \pi$$

In order to apply this result to our framework, let $c = \tau$, $a = 1$ and $b = 1$ for country A 's market, and $a = c_0$ and $b = \frac{1}{n}$ for country B 's market residual demand. ■

Proof of Corollary 2. When the MNE chooses to invest in, say, country A in the absence of policy competition, it must be that $\Pi^A > \Pi^B$. The irrelevance result stated in Proposition 2 further suggests that

$$\Pi^A + S_A^{max} > \Pi^B + S_B^{max} \iff \Pi^A > \Pi^B$$

where $S_A^{max} \equiv W_A^A - W_A^B$ and $S_B^{max} \equiv W_B^B - W_B^A$. Therefore, if we follow Bjorvatn and Eckel (2006) and define aggregate welfare as the sum of the two countries' welfare and the MNE's profits, it is straightforward to obtain

$$W_A^A + W_B^A + \Pi^A > W_A^B + W_B^B + \Pi^B \iff \Pi^A > \Pi^B$$

which completes the proof. ■

Proof of Proposition 5. When the MNE invests in country B rather than in country A , it becomes a weaker competitor on the small market and the public firm always enjoys larger profits there. Thus, country B can offer a subsidy which enhances its attractiveness relative to A . In fact, the new indifference condition for the MNE becomes:

$$\pi_A^A - \pi_A^B + CS_A^A - CS_A^B = \pi_B^B - \pi_B^A + CS_{ResB}^B - CS_{ResB}^A + \pi_{0A}^B - \pi_{0A}^A \quad (11)$$

where the RHS of (11) is larger than in (10) and bigger than its LHS when $\Pi^A > \Pi^B$. ■

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