Targeting FDI

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Abstract

We study the tax/subsidy competition between two countries to attract the FDI projects of two firms. We assume that governments lack the capacity to target every potential inward investor such that each can only bid for a single firm. When the characteristics of the two countries are common knowledge, subsidy competition never arises in equilibrium. Both governments may target the same firm if there is uncertainty as to the more profitable location for that firm's plant, such that both governments believe they may win the competition. We also explore how such uncertainty affects the firms' after-tax profits.

Keywords Foreign direct investment · Tax/subsidy competition · Efficiency

JEL Classification F12 · F23 · H25 · H73

1 Introduction

Attracting inward FDI is an important goal of government policy, given the perceived benefits that it generates in terms of employment (more and better jobs), technological spillovers to indigenous firms, increased demand for local services, etc. Consequently, a country may be willing to spend resources trying to persuade firms to locate their plants within its national frontiers. As production becomes increasingly mobile, countries will face an increasingly wide choice of which firms to target with their fiscal incentives.

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Our analysis begins from the assumption that governments are constrained in the number of potential inward investors they can, in fact, target with investment incentives. If incentive packages typically take forms that are specific to the FDI projects concerned (e.g. the provision of certain types of infrastructure that would complement the MNE's plant), then it seems natural that a public bureaucracy should be constrained in terms of the number of such packages that it can devise annually.¹ Most obviously, such constraints might arise for administrative reasons. For example, decisions taken this year to hire specialised public servants to research and negotiate firm-specific incentive packages create an administrative-capacity constraint in future years (given that recruitment of highly specialised workers is often a lengthy process).²

We assume that such a "targeting constraint" on government behaviour is binding. Consequently, it is infeasible for a national government to develop a project-specific incentive package for every potential inward investor. In this environment, we seek to answer the following two questions. First, which firm (or firms) will a government choose to target? Secondly, in what circumstances will more than one government compete to attract a particular firm's production facilities?

We examine these questions in a two-firm, two-country model, where both countries are constrained to target a single firm, with each firm being from a different industry. We assume that each country perceives one firm's FDI as being more valuable than that of the other firm, with the two potential host countries having different valuations of the firms' plants. We further assume that the two countries differ in terms of their "geographic advantage" such that a firm's pre-tax profits differ across production locations, where the pattern of geographic advantage is industry-specific and is initially known with certainty to all players.³ In this setting, we show that subsidy competition, where both governments choose to target the same firm, will never intentionally arise in equilibrium. Where the outcome of each FDI contest is perfectly anticipated, the losing country is better to opt out of a contest and target the other firm.⁴

We consequently suggest that uncertainty about the pattern of geographic advantage may be important in explaining the occurrence in equilibrium of subsidy competition for FDI. Intuitively, when governments are unclear about international differences in a firm's pre-tax profits, subsidy competition can arise in equilibrium, because both countries perceive a chance of winning the firm's FDI and

¹ "State aid" rules, which limit the scope for simple cash subsidies, might increase the use of such project-specific bidding packages. For European examples, see Table 2 in Haufler and Wooton (2010), which lists firm-specific (i.e. "targeted") state aid deals that were approved by the European Commission. The authors describe the targets of such firm-specific deals thus: "(s)uch investment subsidies have become commonplace, in particular in sectors that combine the use of modern technology with the creation of new jobs" (Haufler and Wooton 2010, p. 239). For examples of targeted investment subsidies granted by US states, see Davies (2005, Table 1).

² Note that our "targeting constraint" on government behaviour differs from a standard public sector budget constraint, which could be relaxed through additional tax revenue.

³ Formally, by "geographic advantage", we mean the difference in a firm's pre-tax profits between the two countries.

⁴ The reasoning here is similar to that used to explain the persistence of monopoly in a homogeneous good market under Bertrand competition. With even infinitesimal entry costs, no firm would enter such a market because, under Bertrand competition, price is driven down to unit cost.

consequently have an incentive to participate in the contest. In this vein, we extend our basic model by injecting some uncertainty into the pattern of geographic advantage. Specifically, we assume that one of the firms operates in a sector where there is uncertainty on the part of governments concerning the international pattern of geographic advantage. We show that subsidy competition for this firm can arise in equilibrium, and we find a necessary condition for such subsidy competition is that the countries place a sufficiently high value on the FDI of the firm concerned.

We view a government's choice of the firm to target as being made prior to its decision as to the level and form of investment incentives to offer. Most of the existing literature on tax/subsidy competition for FDI in imperfectly competitive markets takes the identities of the targeted firm or firms as given, and thus, our analysis is of a prior stage in the behaviour of governments. A central reference is Haufler and Wooton (1999), which examines the fiscal competition between two governments for a monopolist's plant. Fumagalli (2003) and Bjorvatn and Eckel (2006) both also consider the fiscal competition for a single firm's FDI, but in the presence of indigenous firms who are assumed to be immobile and thus not targeted with investment incentives. In a similar vein, Black and Hoyt (1989) consider the fiscal competition for a single, large firm in the presence of a competitive fringe of untargeted firms. Ferrett and Wooton (2010a) relax the assumption that a single firm is targeted with subsidies and present a duopolistic model where each government makes a uniform offer to the two firms. These previous contributions all take the governments' targets as given. Our purpose in the present paper is to allow the governments to choose which firms to target.

Within the broader literature on tax competition for mobile capital under competitive market conditions (i.e. when there are many competing capital owners), our paper is closest in spirit to the small number of models that allow governments to discriminate between different tax bases.⁵ Janeba and Peters (1999) and Marceau et al. (2010) both present models of capital-tax competition where governments face both internationally mobile and immobile (or domestic) tax bases. Both papers explore the consequences of allowing governments to discriminate between the two tax bases by setting different tax rates on mobile and immobile capital. However, these papers differ in important respects from our analysis. Most significantly, such discriminatory tax-setting differs from our concept of targeted fiscal incentives in that we assume that a government only has the administrative capacity to set a policy in relation to a *single* tax base (i.e. firm).⁶

The remainder of the paper is organised as follows: In Sect. 2, we set out our model and preview how, given the countries' targeting choices, equilibrium fiscal

⁵ For surveys of the broader theoretical literature on tax competition, see Wilson (1999) and Wilson and Wildasin (2004).

⁶ Another notable difference is that both Janeba and Peters (1999) and Marceau et al. (2010) assume Leviathan (i.e. revenue-maximising) governments, whereas we assume that governments maximise social welfare. On the other hand, our model shares with Janeba-Peters and Marceau et al. the feature that a given mobile tax base (or a given firm's investment) ends up concentrated in a single country in equilibrium. By contrast, Keen (2001) and Janeba and Smart (2003) present models of discriminatory capital-tax-setting where a given tax base is only *partially* mobile internationally, and so ends up divided between countries in equilibrium.

offers and plant locations are determined. In Sect. 3, we solve for the bidding equilibrium in the baseline version of our model, where the pattern of geographic advantage for both firms is known with certainty. We introduce uncertainty in Sect. 4 and consider the implications for the subsidy competition equilibrium. In Sect. 5, we ask whether, in an uncertain investment environment, it is in the interest of the firm to reveal the full nature of its FDI and profitability. Finally, Sect. 6 concludes.

2 The model

2.1 Assumptions and notation

We build a two-firm, two-country model of international trade and fiscal (tax/subsidy) competition for inward FDI. The firms are indexed by $i \in \{1, 2\}$, while the countries are indexed by $j \in \{A, B\}$. We assume that the owners of both firms reside in the rest of the world (RoW), not in either of the potential host countries, and that each firm will establish at most one plant in either A or B , from which it will serve both of the host countries' product markets.⁷ We further assume that due to prohibitive trade costs, it is impossible to serve markets A and B from a plant located in RoW. Finally, for simplicity, we assume that there is no product market interaction between firms 1 and 2, and so each firm's pre-tax profit from producing in a particular location is independent of the other firm's location.⁸

Inward FDI generates social benefits for the host country. These might, for example, take the form of technological spillovers to domestic firms, the training of indigenous workers, the relief of involuntary unemployment, or the payment of wage premia.⁹ We are not specific about the precise source of these social benefits, and we denote the value that country j places on firm 1's plant by V_j . In order to limit the taxonomy of cases, we assume throughout our analysis that $V_B \geq V_A > 0$. We further assume that the countries have a common valuation of firm 2's FDI, W , that exceeds the value that either of them places on firm 1's FDI. These assumptions are summarised in Table 1. Our assumptions are designed to allow for differences in the social benefits of inward FDI across both countries and firms.¹⁰

We denote by Π_{ij} the pre-tax profits of firm i when it locates in country j . We define country A 's "geographic advantage" over country B in sector i as

⁷ Implicitly, we are assuming that plant fixed costs are sufficiently high to make two-plant entry unprofitable.

⁸ We have looked at the consequences of relaxing some of these assumptions in our previous work. For example, Ferrett and Wooton (2010a) examines the effects of product market interaction in a duopolistic fiscal competition game, and Ferrett and Wooton (2010b) allows for firm ownership within the host countries.

⁹ Ferrett and Wooton (2010a) focuses on the consumer surplus benefits of inward FDI, which arise whenever intra-regional trade costs result in local production leading to lower prices.

¹⁰ We thus assume that separability exists between the two sectors in two respects: firms 1 and 2 do not compete with each other on the product market; and the value to either host country of a given firm's plant is independent of the location of the other firm's plant.

Table 1 International valuations of FDI

	Firm 1		Firm 2
Country <i>A</i>	V_A	$\leq$	W
		$\leq$	$=$
Country <i>B</i>	V_B	$\leq$	W

$\Gamma_i \equiv \Pi_{iA} - \Pi_{iB}$, which can be positive or negative. This concept of geographic advantage will play a key role in our analysis. Suppose, for example, that there is a positive geographic advantage for firm i such that $\Gamma_i > 0$. This would give country A leverage in the competition to attract firm i in that before any tax/subsidy incentives are offered, firm i would make higher profits from locating in country A than in country B .

In order to limit the number of cases under consideration, we impose the following restrictions on the geographic advantage parameters, relative to the countries' valuations of the firms' FDI.

$$\Gamma_1 \in [0, V_B] \text{ and } \Gamma_2 \in [-W, W]. \quad (1)$$

According to (1), country A always possesses a geographic advantage in sector 1, whereas either country might possess a geographic advantage in sector 2. (1) also implies that the absolute level of geographic advantage for a given firm is not "too large" relative to the countries' valuations of that firm's FDI, in the specific sense that either country is always able to attract either firm's plant if it does not face fiscal competition for that plant from the other country.

We assume throughout our analysis that Γ_1 is known with certainty by all players from the start of the game. On the other hand, both governments may be uncertain about the value of Γ_2 , with consequent implications for their bidding strategies.

2.2 Sequence of moves

Within this setting, the fiscal competition for FDI takes the form of a three-stage game with the following sequence of moves. In stage one, the countries independently and simultaneously choose whether to target (or bid for) firm 1 or firm 2. This choice is irreversible, and it is impossible for a country to target both firms. If both countries choose to target the same firm in stage one, we say that that firm is the subject of "subsidy competition". In such a case, the other (untargeted) firm chooses its location solely on the basis of geographic advantage. Alternatively, if the countries choose to target different firms, then each firm will receive a single bid from one country.

In stage two, each country simultaneously announces its bid for the firm that it has chosen to target, where the bid is either positive (a subsidy) or negative (a lump-sum tax). Firms view these bids as location-specific fixed costs (to be incurred in stage three). It is important to note that our concept of a “bid” encompasses a broader range of incentives than simple cash transfers between the host government and the inward investor. Specifically, a bid can be any policy measure that both imposes a cost on the host country and increases the firm’s after-tax profits, should it locate in the country.¹¹ Thus, the provision of public infrastructure (or investment grants) and a skilled workforce (or training grants to achieve this) could both qualify as bids under our definition. Indeed, the very fact that the scope to offer simple cash subsidy payments might be restricted (e.g. under EU “state aid” rules) provides a motivation for our targeting constraints, because it implies that an FDI-incentive package must be specific to (i.e. justified in terms of the specific characteristics of) the investment project concerned. Essentially, specialised public servants must use firm-specific information (e.g. on technological and cost characteristics) to find more creative ways to encourage an inward FDI project than the simple offer to the MNE concerned of a cash payment. In turn, the historic willingness of the public sector to hire such specialised workers determines the country’s current “targeting capacity”.¹²

Finally, in stage three, each firm chooses where to locate its plant, by comparing prospective after-tax profits, and produces and sells its output. We solve the game backwards to isolate its subgame-perfect Nash equilibria in pure strategies.

We study two distinct games, distinguished by the assumption we make about the countries’ knowledge of Γ_2 . In our baseline case in Sect. 3, Γ_2 is common knowledge. This means that the pattern of geographic advantage in both sectors is known with certainty by the countries when making their targeting choices in stage 1 of the game. In Sect. 4, we consider instead the situation in which there is uncertainty over the pattern of geographic advantage, as the precise value of Γ_2 is unknown by the countries.

2.3 Equilibrium fiscal incentives and plant locations under certainty

We begin our analysis by deriving the outcomes of stages two and three of our game in the baseline case (where both Γ_1 and Γ_2 are known to all players with certainty), taking as given the countries’ targeting choices in stage one. We shall exploit the assumptions in (1), which limit the size of geographic advantage and ensure that

¹¹ In our model, a lump-sum tax could be interpreted either as a reduction in concessions relative to some implicit, economy-wide benchmark or as a tightening of discretionary enforcement within a complex tax code.

¹² Restrictions on simple cash subsidy payments also provide a justification for the fact that we do not allow a host country to post the same (uniform) bid for inward FDI from both firms. Indeed, in the absence of monetary transfers, the concept of a “uniform bid” potentially becomes problematic. For example, the appropriate project-specific bid to incentivise investment by firm 1 might take the form of the provision of a new highway, while that for firm 2 might be a publicly provided training course. Thus, a given (uniform) non-monetary investment incentive might be valued very differently by the two firms.

if only one country targets a firm, then it is guaranteed to attract the FDI. In other words, any geographic disadvantage a country may face is less than the maximum subsidy that it is prepared to offer the MNE.

There are essentially three cases to consider, which vary according to how many countries target a given firm. In the “*laissez-faire*” scenario, a firm is targeted by neither of the countries. In this case, if firm 1 receives no bids, then it will follow geographic advantage and locate in country A as $\Gamma_1 > 0$, resulting in country A getting a payoff of V_A , while country B gets nothing. If, on the other hand, firm 2 receives no bids, then the firm will follow its geographic advantage to country A if $\Gamma_2 > 0$ and to country B if $\Gamma_2 < 0$. The host will gain its valuation of the FDI, W , while the other country gets nothing.

The second case involves subsidy competition, where both countries target the same firm.¹³ In our model, subsidy competition is a private-value, first-price, sealed-bid auction with a twist. The presence of geographic advantage typically means that the firm is *not* indifferent between locations when the countries’ bids are equal. Thus, country A wins the subsidy competition for firm 1 if and only if $\Theta \equiv V_A + \Gamma_1 - V_B \geq 0$, where A makes a winning bid of (just above) $V_B - \Gamma_1$, while B unsuccessfully bids its full valuation of the firm, V_B . This highlights the fact that the possession of a geographic advantage gives country A an advantage in the competition such that it can bid less than B and still attract firm 1. Therefore, under subsidy competition, country A ’s payoff when it wins the competition for firm 1 is Θ , while country B ’s payoff should it win the FDI is $-\Theta$. The losing country misses out on the FDI but does not have to pay any subsidy, so has a net payoff of zero from that sector.

A very similar story holds when both countries target firm 2. The difference for this sector is that our parameter choices allow either country to have the geographic advantage while both value the FDI equally. Each country is prepared to bid its valuation, but only the losing country does so in equilibrium. The winner of the FDI is the country with the geographic advantage in sector 2, and its payoff is its level of geographic advantage.¹⁴

The final possibility is for each firm to be targeted by a single country. When only country B targets firm 1, it will attract the FDI if its bid offsets country A ’s geographic advantage, such that $V_B \geq \Gamma_1$. Thus, B must pay a subsidy of (just above) Γ_1 and will get a payoff from sector 1 of $V_B - \Gamma_1$. When only country A targets firm 1, it is able to appropriate its geographic advantage by imposing a tax of Γ_1 on firm 1. Country A ’s payoff from sector 1 is therefore $V_A + \Gamma_1$. The bidding for firm 2 is similar, except that either country may enjoy the geographic advantage in that sector;

¹³ This case always accompanies the *laissez-faire* case. If neither country targets a particular firm, then the other firm must be the subject of subsidy competition.

¹⁴ The outcomes of the subsidy competition for firm 2 can be straightforwardly derived by considering the competition for firm 1 when $V_A = V_B$. Our analysis of the equilibrium under subsidy competition follows Bjorvatn and Eckel (2006), and Ferrett and Wooton (2010b). Readers are referred to those papers for further details. Moreover, Furusawa et al. (2015) show that under complete information and when the target firm is wholly owned outside the host region, an English (ascending) auction yields the same equilibrium outcome as our first-price, sealed-bid auction.

Table 2 Equilibrium locations and taxes/subsidies under certainty

	Country <i>B</i> targets	
	Firm 1	Firm 2
Country <i>A</i> targets		
Firm 1	A wins firm 1 if $\Theta > 0$ B wins firm 1 if $\Theta < 0$ (1, 1) Firm 2 follows geographic advantage Γ_2	A wins firm 1 with tax of Γ_1 and benefits by $V_A + \Gamma_1$ (1, 2) B wins firm 2 with subsidy/tax of Γ_2 and benefits by $W - \Gamma_2$
Firm 2	A wins firm 2 with tax/subsidy of Γ_2 and benefits by $W + \Gamma_2$ (2, 1) B wins firm 1 with subsidy of Γ_1 and benefits by $V_B - \Gamma_1$	A wins firm 2 if $\Gamma_2 > 0$ B wins firm 2 if $\Gamma_2 < 0$ (2, 2) Firm 1 follows geographic advantage to A

but, again, firm 2 is won by the (sole) country that bids for it, either with a tax that appropriates its geographic advantage or with a subsidy that compensates for its geographic disadvantage.

We summarise the results of this subsection in Table 2. Each cell shows the firms' locations in response to the governments' choices of targets. Thus, the cell identified in bold as “(*i*, *j*)” gives the destinations of the FDI of firms 1 and 2, based on the criteria discussed above, when *A* bids for firm *i* and *B* bids for firm *j*.

3 Bidding under certainty

We turn now to consider the host countries' equilibrium targeting choices in our baseline model where there is no uncertainty over geographic advantage in either sector. The objective of governments is to maximise the combined benefits from FDI and the tax revenues from investing firms (where the latter will be negative when a firm is paid a subsidy). The payoff matrix is shown in Table 3.

In Table 3, we use the term Λ_i to capture country *i*'s payoff from sector 2 when both countries target firm 1. We define $\Lambda_A \equiv W$ if $\Gamma_2 > 0$ and $\Lambda_A = 0$ otherwise, while $\Lambda_B \equiv W$ if $\Gamma_2 < 0$ and $\Lambda_B = 0$ otherwise. In (2, 2), when both countries target firm 2, firm 1 locates in country *A*, given *A*'s assumed geographic advantage in the sector.

3.1 Equilibria under certainty

The following result is both interesting in itself and will simplify our subsequent search for equilibria.

Proposition 1 *Subsidy competition, in the sense of both countries targeting the same firm, never arises in equilibrium when the pattern of geographic advantage in both industries is known with certainty at the start of the game.*

Table 3 Payoffs under certainty

B's payoff A's payoff	Country B targets	
	Firm 1	Firm 2
Country A targets		
Firm 1	$\max\{-\Theta, 0\} + \Lambda_B$ (1, 1) $\max\{\Theta, 0\} + \Lambda_A$	$W - \Gamma_2$ (1, 2) $V_A + \Gamma_1$
Firm 2	$V_B - \Gamma_1$ (2, 1) $W + \Gamma_2$	$\max\{-\Gamma_2, 0\}$ (2, 2) $V_A + \max\{\Gamma_2, 0\}$

Proof We show that the losing country would do better by avoiding a subsidy competition for firm 1 and choosing to target firm 2 instead.¹⁵ Suppose that country A targets firm 1 and that $\Theta > 0$, so A will win a subsidy competition for 1. Concerning country B's targeting choice, there are two cases to consider. (Regardless of its targeting choice, country B will make nothing from sector 1.) If $\Gamma_2 > 0$, then B would gain $W - \Gamma_2 > 0$ from targeting and winning firm 2, compared to receiving nothing from sector 2 if it targeted firm 1. Alternatively, when $\Gamma_2 < 0$, while B is still unsuccessful in targeting firm 1, it will gain W because it wins firm 2. However, it would get the greater benefit of $W - \Gamma_2$ from targeting, winning, and taxing firm 2. Thus, country B's welfare is always higher from targeting firm 2. A similar argument will hold for the case where $\Theta < 0$ and country B would win the subsidy war for firm 1. In such circumstances, country A would be better off by targeting and attracting firm 2. $\square$

The result in Proposition 1 is a consequence of our assumption that the countries know the pattern of geographic advantage before making their targeting choices. Because of this, both countries know the outcome of any given subsidy competition and the losing country realises that it would do better by targeting the other firm, and attracting it with a tax or a subsidy that is below its valuation.

The formal consequence of Proposition 1 is that the only possible pure-strategy equilibria are (1, 2) and (2, 1). We now consider the conditions for the existence of these two equilibria, focusing initially on (1, 2). Country A optimally targets firm 1 in response to a choice of firm 2 by country B if and only if:

$$\Gamma_1 \geq \max\{\Gamma_2, 0\}. \quad (2)$$

Essentially, country A chooses to target the sector with the larger geographic advantage and consequently higher tax revenue. Country B optimally targets firm 2 in response to A's choice of firm 1 if and only if

¹⁵ A similar argument can be used to show that the losing country would opt out of a subsidy competition for firm 2.

$$\begin{aligned}\Gamma_2 > 0 : W - \Gamma_2 &\geq \max\{-\Theta, 0\}, \\ \Gamma_2 < 0 : \Gamma_2 &\leq \min\{\Theta, 0\}.\end{aligned}\quad (3)$$

Therefore, for (1, 2) to be the equilibrium targeting choices and resulting firm locations, we require both (2) and (3) to hold. Next, we set out the conditions for (2, 1) to be an equilibrium. Country *A* optimally targets firm 2 in response to *B*'s choice of firm 1 if and only if:

$$\begin{aligned}\Gamma_2 > 0 : \Gamma_2 &\geq \max\{\Theta, 0\}, \\ \Gamma_2 < 0 : W + \Gamma_2 &\geq \max\{\Theta, 0\}.\end{aligned}\quad (4)$$

Country *B* optimally targets firm 1 in response to *A*'s choice of firm 2 if and only if

$$V_B - \Gamma_1 \geq \max\{-\Gamma_2, 0\}.\quad (5)$$

Figure 1 uses conditions (2)–(5) to plot the equilibrium targeting and location choices in (Γ_1, Γ_2) -space. Figure 1 maintains our assumption that $\Gamma_1 > 0$, while the geographic advantage in sector 2 can lie with either country. Broadly speaking, outcome (1, 2) tends to be an equilibrium as we move upwards and to the left in Fig. 1, while (2, 1) tends to be an equilibrium towards the lower right. Both of these outcomes are intuitive. In equilibrium, country *A* will target the sector where it enjoys the greater geographic advantage, whereas country *B* targets the sector where its geographic disadvantage is lower.

We can summarise the central result of this section as follows. Subsidy competition, where both countries target the same firm, never arises in equilibrium in the baseline version of our model: The country that would lose the competition would always do better by opting out of a head-to-head contest and targeting the other firm instead. Consequently, in equilibrium, the two countries target and win different firms, and the firms never co-locate.

Two clarificatory observations on the above result are in order. First, we should note that we are assuming that the governments use only *pure strategies* when making their targeting choices. With mixed strategies, there would be some probability that subsidy competition for a given firm arises in equilibrium. We exclude mixed strategies, both for simplicity and because they lack a natural interpretation in our context.¹⁶

Second, there are two regions in Fig. 1 where two equilibria co-exist. In equilibrium, the countries target different firms, but the allocation of firms to countries is indeterminate. In these regions, the countries face a coordination problem. In concluding that subsidy competition does not arise *in equilibrium* in these regions, we are essentially assuming that the countries succeed in coordinating on the same equilibrium such that each country's belief (regarding the other country's targeting choice) turns out to be correct. However, should such coordination fail, then subsidy competition might arise by mistake. For example, if both (1, 2) and (2, 1) are Nash

¹⁶ Note also the well-known fragility of a mixed-strategy Nash equilibrium. In such an equilibrium, a player is indifferent between her pure strategies, so lacks a strong incentive to mix.

Fig. 1 Equilibrium locations under certainty

equilibria and *both* countries believe that the other country will target firm 2, then the outcome of the game will be subsidy competition for firm 1. This outcome is not an equilibrium, because both countries acted on false beliefs, but arises when coordination fails.

Thus, it is natural to consider how coordination might be achieved when there are two targeting equilibria. There are several possibilities. First, if $V_A + V_B > W$, then from the perspective of the host countries, (1, 2) Pareto dominates (2, 1) throughout part of the region in the second quadrant of Fig. 1 where there are two equilibria. In this parameter space, it seems natural to expect (1, 2) to arise as the “focal” equilibrium.^{17, 18} Second, our game assumes that the countries make their targeting choices simultaneously. However, if the countries moved sequentially (which seems no less reasonable *prima facie*), then the outcome in the regions of Fig. 1 with two equilibria would be uniquely determined by the first-mover’s preference between (1, 2) and (2, 1). Finally, it is possible that the countries could achieve coordination through pre-play communication. For example, they might be able to coordinate on the equilibrium that maximises their joint surplus, although such a mechanism would really require the modelling of side payments.

3.2 Industrial profits under certainty

We have determined that in equilibrium, each country targets a single firm but that there are ranges of the $\{\Gamma_1, \Gamma_2\}$ space in which there are multiple equilibria where,

¹⁷ Country A prefers (1, 2) to (2, 1) if $\Gamma_1 > \Gamma_2 + W - V_A$. It is straightforward to show that this holds in part of the two-equilibrium region in the second quadrant if $V_A + V_B > W$. On the other hand, country B prefers (1, 2) to (2, 1) whenever $\Gamma_1 > \Gamma_2$, because it both pays a lower subsidy and receives a higher benefit than in the equilibrium where it targets firm 1. It is intuitive that (1, 2) can be Pareto dominant in the second quadrant because it has each country targeting the sector where it enjoys a geographic advantage. This contrasts with the two-equilibrium region in the first quadrant, in which both countries would prefer to target firm 2 in the equilibrium, and thus our targeting game is a game of chicken where targeting firm 2 represents the “not swerve” strategy.

¹⁸ (1, 2) might also be focal for other reasons, such as if firm 1 were wholly owned in country A or if it had operated there in the past.

in general, the two nations will not be indifferent between these equilibria. We were, however, able to establish a particular parameterisation of the model in which there was a clear international ranking of the equilibria. We now consider the impact of international competition for FDI on the after-tax profitability of the firms' investments, in order to establish whether the firms' preferences with respect to investment locations might be comparably ranked.

In the first quadrant of Fig. 1, where country *A* has geographic advantage in both industries, the firm that is targeted by *A* gets higher pre-tax profits from locating there but these are taxed away in equilibrium, such that the firm earns the equivalent of its pre-tax profits had it located in country *B*. The firm that is targeted by country *B* in equilibrium gets lower pre-tax profits from locating there but is compensated by a subsidy such that its after-tax profits are the same as the pre-tax profits it would have earned from locating in country *A*. The tax and subsidy offers in equilibrium therefore mean that both firms would prefer to be targeted by country *B* and receive a subsidy, as opposed to facing a tax if they were targeted by country *A*.

When each country has a geographic advantage in one of the industries, as is the case in the second quadrant of Fig. 2, the firms share a preference with respect to the targeting outcome. Suppose that the equilibrium is (1, 2), such that each country targets the firm in the industry in which it has a geographic advantage. In such a case, both countries charge a tax on the firms in equilibrium. These taxes mean that despite having located in the more profitable country, each firm ends up with after-tax profits equivalent to it having located in the country with the geographic disadvantage. In contrast, when the targeting choice in equilibrium is (2, 1), each country gets the industry in which it has a geographic disadvantage and has to pay it a subsidy to attract the firm. From the perspective of the producers, the firms prefer this equilibrium outcome as they end up with after-tax profits equivalent to the pre-tax profits they would have earned from following geographic advantage.

In summary, given that taxes in equilibrium extract the rents of locating in countries with geographic advantage, firms will generally prefer to be compensated for making investment decisions contrary to the pattern of geographic advantage. This reflects a fundamental conclusion of this particular game of international competition for FDI, in that firms can never do better in the certainty equilibrium than earning the pre-tax profits from following geographic advantage.

Fig. 2 Equilibria under uncertainty

In the next section, we investigate the implications of introducing a degree of uncertainty about the pattern of geographic advantage.

4 Bidding under uncertainty

We now assume that Γ_2 is a random variable, whose exact value is known only to firm 2. The other players (in particular, the governments of countries *A* and *B*) know only that Γ_2 is uniformly distributed on $[-\Delta, \Delta]$. The precise realisation of Γ_2 is only revealed to the governments *after* all of their decisions have been made, if it is revealed at all. We assume that $\Delta < W$, which ensures that the uncertainty over Γ_2 is not “too large.” Specifically, it implies that if the Γ_2 realisation was known with certainty, then a country that is the sole nation to target firm 2 would always succeed in winning it. The expected payoffs to being the sole bidder for firm 2 are the same for both countries, given that they are assumed to get the same benefit W from the FDI and that the distribution of the geographic advantage is assumed to be symmetrical about zero.

We maintain our earlier assumption that the geographic advantage for firm 1 is known and has a value in the positive interval $\Gamma_1 \in [0, V_B]$. Consequently, if country *A* solely targets firm 1, it will make $V_A + \Gamma_1$ from the FDI, whereas country *B* will make $V_B - \Gamma_1$ if it were to be the sole bidder for firm 1. The outcome of both countries bidding for firm 1 is discussed in Sect. 3. On the basis of these assumptions, the remaining task is to establish how the countries’ uncertainty over the geographic advantage of firm 2 affects their bidding strategies and their expected payoffs for each pair of targeting choices.

We assume that governments are attempting to maximise expected welfare. Given that the governments are bidding under uncertainty, there is the possibility that mistakes may happen, in the sense that an equilibrium bid for firm 2 may be insufficient to attract its FDI. In that respect, the unlucky government has “wasted” its bid as it might otherwise have successfully targeted firm 1. A risk-averse government might therefore be more inclined to target the “sure thing” rather than a risky bid. We shall consider the implications of this below.¹⁹

4.1 Country *A* targets firm 1 and country *B* targets firm 2

We initially calculate the expected benefit based upon country *B* bidding for firm 2. Country *B* will attract the investment if and only if its subsidy offer S_B overcomes the realisation of country *A*’s geographic advantage Γ_2 . Country *B* will set S_B so as to maximise $E(\Omega_B)$, the expected gain from attracting firm 2’s FDI:

¹⁹ There is no “winner’s curse” in this game, in the sense that neither government will overbid for a firm, such that the subsidy paid is greater than the welfare benefit of the FDI. The issue is that the downside of a failed bid can be national welfare less than what the country could have ensured through targeting firm 1, the benefits of whose FDI are known.

$$E(\Omega_B) = \Pr \{S_B > \Gamma_2\} (W - S_B), \quad \text{where} \quad \Pr \{S_B > \Gamma_2\} = \begin{cases} 0 & \text{if } S_B < -\Delta, \\ (S_B + \Delta)/2\Delta & \text{if } S_B \in (-\Delta, \Delta), \\ 1 & \text{if } S_B > \Delta. \end{cases} \quad (6)$$

Country B will be unable to attract firm 2 if its subsidy is below the lower bound of A 's geographic advantage, while it is guaranteed to attract firm 2 if it offers a subsidy above the upper limit of A 's geographic advantage. Thus, country B never needs to make a subsidy offer in excess of Δ .

From (6), the optimal FDI subsidy can be derived. If $W > 3\Delta$, country B 's valuation of the FDI is sufficiently high that it would be prepared to offer a subsidy equal to Δ . This would guarantee that it would win firm 1 and bring benefits equal to $(W - \Delta)$. Should country B 's valuation of firm 2 be more modest, then it shall offer a lower bid of $S_B^* = (W - \Delta)/2$ and will win the FDI with probability $(W + \Delta)/4\Delta$ with country A attracting the FDI with probability $(3\Delta - W)/4\Delta$, while the countries' equilibrium expected payoffs will reflect the certainty of country A attracting firm 1, together with the expected gains from the countries' success (or otherwise) of attracting firm 2.

$$\begin{aligned} E(\Omega_A) &= (V_A + \Gamma_1) + \frac{(3\Delta - W)W}{4\Delta}, \\ E(\Omega_B) &= \frac{(W + \Delta)^2}{8\Delta}. \end{aligned} \quad (7)$$

For the remainder of the analysis, we shall assume that $W < 3\Delta$, which ensures that the equilibrium probabilities of winning firm 2 are in the interval $(0, 1)$.

4.2 Country A targets firm 2 and country B targets firm 1

This is analogous to the previous case, so it can be dealt with briefly. Country B wins firm 1 and makes $V_B - \Gamma_1$ from industry 1. Country A sets S_A to maximise:

$$E(\Omega_A) = \Pr \{S_A > -\Gamma_2\} (W - S_A), \quad \text{where} \quad \Pr \{S_A > -\Gamma_2\} = \begin{cases} 0 & \text{if } S_A < -\Delta, \\ \frac{S_A + \Delta}{2\Delta} & \text{if } S_A \in (-\Delta, \Delta), \\ 1 & \text{if } S_A > \Delta. \end{cases} \quad (8)$$

For valuations where $W < 3\Delta$, country A will offer an optimal subsidy $S_A^* = (W - \Delta)/2$ that has a probability of success equal to $(W + \Delta)/4\Delta$. The resulting expected payoffs reflect country B 's success in attracting firm 1 and the expected location of firm 2 in equilibrium:

$$\begin{aligned} E(\Omega_A) &= \frac{(W + \Delta)^2}{8\Delta}, \\ E(\Omega_B) &= (V_B - \Gamma_1) + \frac{(3\Delta - W)W}{4\Delta}. \end{aligned} \quad (9)$$

4.3 Both countries target firm 1

As neither country bids for firm 2, the probability that either country wins the FDI is $\frac{1}{2}$. Therefore, the countries' expected payoffs are:

$$\begin{aligned} E(\Omega_A) &= \max\{\Theta, 0\} + W/2, \\ E(\Omega_B) &= \max\{-\Theta, 0\} + W/2. \end{aligned} \quad (10)$$

We can now show that subsidy competition for firm 1 never arises in equilibrium. The reason is that the loser of such a subsidy competition would do better by deviating to target firm 2. Suppose, for example, that country *A* would lose the subsidy competition for firm 1. This means that the first element of $E(\Omega_A)$ in (10) is zero. Comparing (9) and (10), we can easily calculate that country *A* is better to avoid the FDI competition and to target firm 2 directly. It is similarly straightforward to show that country *B* will prefer to avoid the subsidy competition for firm 1 if it were guaranteed to lose. Thus, (1, 1) can never be a targeting equilibrium.

4.4 Both countries target firm 2

This case is qualitatively similar to the cases discussed above. The key difference is that in setting its bid for firm 2, a government now needs to consider both the pattern of geographic advantage and the other government's bid. Under (2, 2), firm 1 follows geographic advantage and locates in country *A*. Country *B* wins firm 2 if $S_B > S_A + \Gamma_2$ and it therefore sets S_B to maximise

$$\begin{aligned} E(\Omega_B) &= \Pr\{S_B > S_A + \Gamma_2\}(W - S_B), \\ \text{where } \Pr\{S_B > S_A + \Gamma_2\} &= \begin{cases} 0 & \text{if } S_B < S_A - \Delta, \\ \frac{S_B - S_A + \Delta}{2\Delta} & \text{if } S_B \in (S_A - \Delta, S_A + \Delta), \\ 1 & \text{if } S_B > S_A + \Delta. \end{cases} \end{aligned} \quad (11)$$

We maintain our parameter restriction that $W < 3\Delta$ which ensures that the equilibrium probabilities of winning firm 2 are in the interval (0, 1) and both countries offer equilibrium subsidies that are strictly less than their valuations. Then, country *B*'s reaction function is $S_B(S_A) = (S_A + W - \Delta)/2\Delta$ and, by symmetry, that of country *A* is $S_A(S_B) = (S_B + W - \Delta)/2\Delta$.²⁰ The equilibrium subsidies offered by the countries are $S_A^* = S_B^* = W - \Delta$, where the probability that each country attracts the FDI is one half. As the bids are identical, they do not distort the firm's location choice, which is therefore driven entirely by geographic advantage. The benefit to the lucky country that hosts the FDI is $\Delta/2$.

²⁰ As we might expect, these reaction functions reveal that the countries' subsidies for firm 2 are strategic complements.

4.5 Equilibria under uncertainty

Taking into account the nature of the uncertainty over firm 2's geographic advantage, the countries' expected payoffs are shown in Table 4, where we continue to assume that $\Gamma_1 \in (0, V_B)$ and Γ_2 is uniformly distributed over the interval $[-\Delta, \Delta]$.

Our first observation is that as noted above, the two countries will never simultaneously compete for firm 1, such that (1, 1) cannot be a Nash equilibrium. It is always better for the country that knows it will lose the subsidy competition for firm 1 to target firm 2 instead. To see this, consider value of the terms in the (1, 1) cell of Table 4. For the country losing the battle for firm 1, it can choose to target firm 2 instead, if that will result in a higher expected benefit. This is always the case as $(\Delta + W)^2/8\Delta - W/2 = (\Delta - W)^2/8\Delta > 0$. Consequently, the losing country from the subsidy competition for firm 1 is always better off targeting firm 2 than ineffectually competing for firm 1's FDI.

We now study the conditions under which both countries may compete to attract firm 2, such that (2, 2) is a Nash equilibrium. It is useful to define another term.

$$\Psi(\Delta) \equiv \frac{(W - \Delta)(W - 2\Delta)}{4\Delta}.$$

$\Psi(\Delta)$ measures the increase in a country's expected payoff from industry 2 when the country joins the subsidy competition for firm 2.

From the payoffs in Table 4, it is clear that country A's best response to country B's decision to target firm 2 is to target the same firm if and only if $\Gamma_1 < \Psi(\Delta)$. If country A's geographic advantage in sector 1 is very large, then country A will choose to avoid the competition for firm 2 and capture Γ_1 in tax instead. Similarly from Table 4, we can see that targeting firm 2 is country B's best response to country A targeting firm 2 if and only if $\Gamma_1 > V_B - \Psi(\Delta)$. As before, this is an intuitive result. A very large Γ_1 would require country B to pay firm 1 a sizeable subsidy in order to attract firm 1's FDI.

Linking these two inequalities yields $\Psi(\Delta) > \Gamma_1 > V_B - \Psi(\Delta)$ as a necessary and sufficient condition for (2, 2) to be a targeting equilibrium. We can plot these thresholds in Fig. 2, which shows the level of geographic advantage in sector 1 and the range of geographic advantage in sector 2 that are consistent with both countries competing to attract firm 2, the industry with the geographic advantage that is known only to the firm. The lower limit of $\Delta = W/3$ is chosen to ensure that neither country bids Δ and guarantees that it attracts firm 2's FDI. In this range $\Psi(\Delta)$ is declining in Δ . In general, a region where (2, 2) is the unique targeting equilibrium exists if $V_B < W/3$, which ensures that $\Psi(\Delta) > V_B - \Psi(\Delta)$ at $\Delta = W/3$. Intuitively, subsidy competition for firm 2 can only arise if the value that the countries place on firm 2's FDI is sufficiently large.²¹

²¹ Figure 2 was generated using the parameter values $V_B = 7$ and $W = 30$.

Table 4 Payoffs under uncertainty

B's payoff A's payoff	Country B targets	
	Firm 1	Firm 2
Country A targets		
Firm 1	$\max\{-\Theta, 0\} + W/2$ (1, 1) $\max\{\Theta, 0\} + W/2$	$(\Delta + W)^2/8\Delta$ (1, 2) $V_A + \Gamma_1 + (3\Delta - W)W/4\Delta$
Firm 2	$V_B - \Gamma_1 + (3\Delta - W)W/4\Delta$ (2, 1) $(\Delta + W)^2/8\Delta$	$\Delta/2$ (2, 2) $V_A + \Delta/2$

Above the (2, 2) region in Fig. 2, the targeting equilibrium is (1, 2).²² In this region, country A chooses to exit the subsidy competition for firm 2 and instead captures Γ_1 in tax by targeting firm 1 alone. Below the (2, 2) region, the targeting equilibrium is (2, 1). In this case, firm B opts to exit the subsidy competition for firm 2.²³

We now briefly consider the issue of risk aversion on the part of the competing governments. In targeting firm 2, a government runs the risk of failing to attract the firm's FDI while simultaneously missing out on making its best offer for firm 1's FDI. If a country were risk averse, it would discount the benefit of a risky action relative to one with a guaranteed payoff. Consequently, A would put more weight on the guaranteed benefit of attracting firm 1 and extracting its geographic advantage Γ_1 through taxation, effectively drawing down its (negatively sloped) threshold $\Psi(\Delta)$ in Fig. 2. To see this, consider the threshold value of Γ_1 on the axis, where $W=3\Delta$. In this case, the *expected* benefit to A of it jointly bidding for firm 2 is $\Psi(\Delta)=\Delta/2$, while the *guaranteed* benefit of being the sole bidder for firm 1 is Γ_1 . A risk-neutral government would be indifferent between these two bidding strategies, but a risk-averse government would prefer the sure thing, meaning that such a government's threshold would be below that of a risk-neutral government.

Similarly, against the risky alternative of winning the subsidy competition for firm 2, a risk-averse government B would be prepared to accept a higher geographic disadvantage and necessary subsidy to attract firm 1 and yet still bid for that firm's FDI, pushing up its (positively sloped) threshold, $V_B - \Psi(\Delta)$. Combining risk aversion on the part of both governments would therefore squeeze, but not necessarily eliminate, the parameter space in Fig. 2 in which both governments intentionally bid for firm 2, in the knowledge that one country will be unsuccessful.

²² In addition to $\Gamma_1 > \Psi(\Delta)$, we also require $\Gamma_1 > V_B - V_A - \Phi(\Delta)$ for (1, 2) to be the targeting equilibrium, where $\Phi(\Delta)=(\Delta - W)^2/8\Delta$. The latter condition ensures that B's best response to 1 is 2. However, to simplify our presentation and to allow us to focus on essentials, we note that it is straightforward to show that $\Gamma_1 > V_B - V_A - \Phi(\Delta)$ whenever $\Gamma_1 > V_B - \Psi(\Delta)$, and thus (1, 2) is always an equilibrium above $\Gamma_1 = \Psi(\Delta)$ and $\Gamma_1 = V_B - \Psi(\Delta)$.

²³ The condition for A to choose 2 in response to 1 is $\Gamma_1 < V_B - V_A + \Phi(\Delta)$, which holds for all $\Gamma_1 < \Psi(\Delta)$.

5 To reveal or not to reveal?

Suppose that in the beginning, firm 2's geographic advantage is unknown by the potential host nations. Are there any circumstances under which the firm would benefit from credibly announcing the value of Γ_2 ? In this section, we compare the pay-offs to firm 2 from the competition to attract its FDI under certainty and uncertainty. We can then determine whether it is worthwhile for the firm to reveal its geographic advantage prior to the governments making their choice as to which industry to target and the magnitude of the corresponding subsidies or taxes. We assume that the point of revelation is prior to stage one of the game, in advance of the governments' decisions as to which firms to target.²⁴

In the certainty case, we established above that the *best* a firm can do in the equilibrium is receive the equivalent of its pre-tax earnings from locating in the country with the geographic advantage for its industry. Indeed, the equilibrium bids are designed to make the firm just willing to locate in the country bidding for it. Consequently, a subsidy in equilibrium is just enough to offset the bidding country's geographic disadvantage. This will not be the case under uncertainty, as the countries do not know the precise level of subsidy sufficient to nudge the firm from one location to the other.

Under uncertainty, we have shown that any equilibrium bids made to attract firm 2 are always positive subsidies. It follows that the *worst* that firm 2 can ever do in the uncertainty equilibrium is receive the equivalent of its pre-tax earnings from locating in the country with the geographic advantage for its industry. Firm 2 will, in general, earn more than this worst-case minimum, either because the country with the geographic advantage chooses to target firm 2 and offers a positive subsidy or because the firm locates in the other country and receives a subsidy that more than offsets that country's geographic disadvantage. Thus, under uncertainty, firm 2 always captures post-tax earnings that are (weakly) greater than what it might have received under certainty. This demonstrates that firm 2 never has an incentive to reveal the true nature of its geographic advantage to its potential hosts.

6 Summary and conclusions

Our contribution is to incorporate governments' targeting choices into the analysis of fiscal competition for FDI under imperfect competition, an area of research that we believe to have been somewhat neglected in the literature. We argue that governments will choose which firms to target prior to their deciding upon the composition of incentive packages, including the tax/subsidy levels, that they will offer firms to invest. Under the assumption that governments are unable to target every potential inward investor with a tailored subsidy offer, we have shown that subsidy competition, where both countries target the same firm, never intentionally arises in

²⁴ An alternative would be for firm 2 to announce the value of Γ_2 prior to stage 2, in an attempt to influence the size of the inducement(s) that it would receive from its committed suitor(s).

equilibrium, if all players know the pattern of geographic advantage. The intuition for this central result is clear. The country that would lose the subsidy competition can always do better by opting out of a head-to-head contest and switch to targeting the other firm. Consequently, the equilibrium is characterised by the two countries targeting and winning different firms, such that the firms never co-locate.

We moved beyond our baseline model to allow for uncertainty in the pattern of geographic advantage. We assumed that the bidding governments only had a probability distribution of the geographic advantage in one of the two sectors, while the firm concerned knew the exact value. In this environment, where the MNEs are better informed than the governments about the relative profitability of rival plant locations, we showed that subsidy competition can arise in equilibrium. The intuitively appealing condition for subsidy competition is that both governments must value the FDI project of the firm concerned sufficiently that they are prepared to spend resources on bidding for the firm, despite running the risk that they may be unsuccessful.

We then explored the firms' preferences between the certainty and uncertainty scenarios. In the certainty equilibrium, where the firms locate in different countries and are both subject to tax/subsidy transfers, we showed that neither firm can earn after-tax profits that exceed the level of profits it would earn under *laissez-faire* (where geographic advantage alone determines plant locations). We made use of this result in our uncertainty game, where both governments offer strictly positive bids for FDI in the subsidy-competition equilibrium and the firm concerned thus earns higher profits than under *laissez faire*. The MNE that is the subject of subsidy competition under uncertainty will therefore have no incentive to reveal the precise pattern of geographic advantage in its sector to either government (even if it could credibly do so), since such revelation would return the game to its baseline, certainty case.

A potential avenue for future research would be to explore the welfare and policy implications of governmental targeting constraints. For example, might there be a conflict between the welfare of the host region (countries *A* and *B* combined) and efficiency (global welfare, which includes the firms' after-tax profits)? Under certainty over geographic advantage and in the absence of targeting constraints on government behaviour, our game would involve two independent (standard) subsidy competitions, with the resulting equilibrium outcome being efficient.²⁵ We therefore speculate that the existence of targeting constraints might benefit the host region at the expense of the world as a whole. Essentially, the targeting constraints act as a commitment device, limiting the spread of subsidy competition. Therefore, one potential policy implication is that national targeting constraints, such as those in our model, might reduce the need for restrictions on subsidy competition at the level of the host region. We leave these issues for future study.

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²⁵ On the efficiency of a fiscal competition for FDI, see, for example, Ferrett and Gravino (forthcoming, Proposition 4).

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