

Competition for foreign direct investment when countries are not sure of site values

Koray Kiyamaz*
McKinsey & Company
Istanbul Turkey
and
Department of Economics
Tulane University
New Orleans USA

Leon Taylor
Dillard University
New Orleans, Louisiana USA

May 19, 1999

*For valuable comments, we thank William H. Oakland, İnsan Tunali, seminar participants at the 1994 meetings of the Southwestern Economics Association, and the reviewer for this journal. Send correspondence to Leon Taylor, 11 Fontainebleau Drive, Apartment G, New Orleans, La. 70125; tel. (504) 865-7731; LeonTaylor@hotmail.com.

Abstract

The fiscal tug-of-war between two countries to play host to a foreign-owned firm is like a Nash game. Suppose that the countries are not sure how much the firm values the sites that they offer to it. Also suppose that the countries fashion their expectation of site value by assigning the same likelihood to each value that they deem possible. Then, if they are quite unsure about site values, they will offer small subsidies to the firm. If they are pretty sure about site values, they will offer large subsidies. Here is the intuition behind the results: When a country is unsure about the value of its site, it is also unsure that a stingy offer will drive the firm to its rival. So it may take the chance and make a stingy offer rather than a generous one.

JEL classification code: F21

Key words: tax competition, foreign direct investment

1 Introduction

Governments often vie for a footloose firm by offering tax cuts or subsidies. Analyses of such a contest usually assume that its participants know full well its circumstances.¹ In reality, its participants usually know little. For instance, government officials must guess at how much a firm values a site when they have no competitive bids to refer to. That is usually the case when government recruits industry, since the lack of local land buyers is what spurs the government to seek buyers elsewhere.

The government's guess about the value of a site will affect its offer of incentives to a potential buyer. But if the government knows little about the value of its own site, then it is likely to know little about the value of a site elsewhere that the firm could occupy. The government's guess about that other site will also affect its offer of incentives. How these guesses will affect its offer is a subtle question, particularly when it must counter the offer of another government that guesses.

The question is critical to the early stage of a site search, when the firm decides where to go. In this stage, the firm discloses stark details of its project to a few governments and solicits their preliminary bids. (Hood and Young (1985) found that this strategy was typical in the searches of automotive firms for foreign sites.) Among the governments, the firm will later pick one with which to negotiate in earnest. Until then, governments game more with one another than with the firm, which carefully conceals its poker hand.

This paper analyzes that early stage of a site search. The key characteristic of the stage is that the firm keeps the governments in the dark about the values that it attaches to their industrial sites. The paper considers how the resulting uncertainty of governments affects their offers of incentives to the firm.

One can obtain sharp answers to this question, because one can reasonably presume that the governments are sure about a few things. In particular, one can presume that each government is sure of how the other would counter its offer; for it is likely that the governments have gamed before, perhaps in the conduct of foreign relations. We need not presume, however, that either government is sure of how the firm would react to their offers.

In general, our analysis applies to economic competition between governments at the local, state or national level. In particular, it will motivate the mathematics by addressing contests between countries for foreign direct investment, or FDI.

We favor the international application for its timeliness. Through the 1970s and until the late 1980s, analysts posited that the foreign firm and the host treated one another warily, like monopolies. Vernon's 1971 model of bilateral monopoly dominated the literature, and the shift of bargaining power from oil

¹Analyses of fiscal competition include Zodrow and Mieszkowski (1986), Wilson (1986, 1991), Oates and Schwab (1988), Wildasin (1988, 1991), Bucovetsky (1991) and Bucovetsky and Wilson (1991).

extractors to oil producers dominated the news.² In recent years, however, Third World hosts have vied for foreign firms by offering subsidies to them as well as by lifting restrictions on them.

Over time, models of competition that can apply to countries vying for foreign direct investment have come to stress the aggressive tactics of the potential hosts in pursuing firms: the construction of infrastructure to entice them; the willingness to reopen negotiations with them or even to bid in an auction for them. Doyle and van Wijnbergen (1994) analyze a firm that procures tax holidays by bargaining with one government at a time. Bond and Samuelson (1986) take a similar tack, and Andersson (1991) examines how sequential bargaining affects the distribution of gains from foreign direct investment between host and firm. Black and Hoyt (1989) model a firm that negotiates with several governments at the same time, then chooses its location once and for all. In a new tradition, King and Welling (1992) examine a firm that can relocate. In each of two periods, the firm conducts an auction between two regions bidding for its plant. King, McAfee and Welling (1993) extend the model so that governments can build infrastructure first and then bid in an auction for a firm.³

Several of these models allow for uncertainty. For example, Black and Hoyt examine uncertainty about how much the firm can produce in one site rather than another; and King and Welling consider uncertainty over the sunk cost of building the plant. Our contribution to this literature, however, is to focus on the uncertainty of potential *hosts* about the relative value of their plant sites.

That a few countries now compete for a footloose firm is the main point of departure for our analysis of uncertainty. In particular, we branch from the work that treats, as paramount, the uncertainty that affects bargaining between the firm and its chosen host. We branch from this work because - unless it is enriched by more theory - some of its main implications may no longer describe so well the world that we know.

For instance, Vernon (1971) considers a poor country that discovers a deposit of raw material. The country does not know how to exploit the deposit, so it sells exploitation rights to a foreign-owned firm. And it does so cheaply, since it must compensate the firm for taking a risk. The host invites in the firm partly to learn how it exploits the raw material. Once the host learns, it will claim for itself the profits from future exploits. Vernonesque theory thus implied that, over time, as poor countries learned more of the technology of the foreign firms on their soil, they would take over more of them.

By the late 1980s, however, the wave of nationalizations in the Third World had ebbed, even though there were still plenty of firms to seize, as Andersson found in 1991. Where, for all its power, might Vernonesque theory have gone

²For a more recent example of a bilateral monopoly model, see Doyle and van Wijnbergen (1994). Eaton and Gersovitz (1983) examine the impact of country risk on the firm's decision to invest.

³In a different vein, Conrad and Seitz (1994) model two countries that build infrastructure to support the endeavors of their firms for shares in home and foreign markets.

astray?

We suspect that a missing piece of the puzzle is that hosts now compete for a firm when they are unsure of its location costs. Seizing a firm today can hurt the chances of a potential host in the competition for more firms tomorrow, if the host does not know how much to offer the firm to offset its expected costs of seizure.

Generally, the host cannot be sure of how much to offer the firm to locate in its borders, largely because it cannot precisely estimate the political, social and cultural costs that the firm would face in foreign production. Such costs do not fit comfortably beneath the measuring rod of money.

While such intangible costs may vary with the firm's level of physical capital, they do not typically vary with its scale of production. And so the analysis will treat political, social and cultural costs as intangible fixed costs.

Firms appear to shun nations that are politically or socially instable. Stevens as well as Schneider and Frey have provided statistical evidence of the point, and Pfeffermann has drawn upon World Bank experience.

Since such fixed costs as political instability matter to the firm, they also matter to the host. In particular, the *firm's* estimate of intangible fixed costs matters to the host. Yet it has trouble inferring this cost estimate, in large part because it lacks the firm's industrial experience. For instance, the firm knows more than prospective hosts about the value that plant and equipment would add to its operations. The firm can thus estimate the cost to it of a seizure of capital more precisely than prospective hosts can.

We investigate how two countries compete for a firm when they are unsure of its fixed costs of location. Given this uncertainty, each country determines the size of the subsidy that it would offer the firm to occupy its site. This determination is strategic, since the country considers the subsidy that its rival would offer the firm. Although the countries share the same beliefs about the values of their sites, the sites themselves differ. To describe the sites as differentiated products offered by countries, we draw upon industrial organization models, especially that of Perloff and Salop.

Section 2 begins by analyzing competitive offers of subsidies by countries that are sure of site values. This case yields a benchmark by which to judge the effects of uncertainty on incentives – the case that we consider next. The aim of the analysis is to guide an empirical study, and Section 3 considers empirical implications that one may test.

2 Subsidy competition

2.1 The model

Consider a firm that will choose a profit-maximizing site for operations in either Country 1 or Country 2. Profits depend on output and input prices, market size,

social and physical infrastructure, political environment, taxes and subsidies. The firm can observe these variables, and it knows its own cost function.

The size of the market for which the firm would produce from a site in Country i is m_i . The difference between the market price of the firm's product and its average variable cost would be P_i . The firm's fixed costs in Country i would be θ_i .

T_i is the lump-sum subsidy – or the value of a package of incentives – offered to the firm by Country i . A negative T_i would represent a lump-sum tax. The firm's profit in Country i would be

$$P_i m_i + T_i - \theta_i, \quad i = 1, 2. \quad (1)$$

The firm will pick Country 1 if

$$P_1 m_1 + T_1 - \theta_1 > P_2 m_2 + T_2 - \theta_2. \quad (2)$$

Suppose that the firm locates in Country i . Then its impact on the national economy – without adjusting for the subsidy – will be R_i . Government i will pick a subsidy rate to maximize its expectation of the firm's net economic impact on the country. This net impact would be $R_i - T_i$.

With that setup, this paper will focus on this question: How does the contest between the two countries for the firm respond to the differences that they perceive in the fixed costs and known benefits of production on their sites?

We assume that the firm would receive the same price, net of average variable cost, from producing in either country: $P_i = P$.

To focus on how uncertainty over site value affects the countries' offers to the firm, we assume that the firm has the same value to both countries. In particular, we assume that the firm would have the same gross impact on either economy: $R_i = R$, $i = 1, 2$.

2.2 The case of certainty

We begin with the case in which both governments are sure of site values. Suppose, indeed, that both governments and the firm know all parameter values. Consider the case in which the site in Country 1 would yield a greater profit to the firm than the site in Country 2 if neither nation offers an incentive:

$$P(m_1 - m_2) + (\theta_2 - \theta_1) > 0. \quad (3)$$

A contest between the two countries for the firm yields the Nash equilibrium

$$\hat{T}_1 = R - [P(m_1 - m_2) + (\theta_2 - \theta_1)] + \epsilon, \quad (4)$$

$$\hat{T}_2 = R. \quad (5)$$

where ϵ is arbitrarily small and positive.⁴

Although Country 2 offers its largest feasible subsidy, R , Country 1 will win the firm with a smaller subsidy. In the form of $R - \hat{T}_1$, Country 1 will extract most of its “location rent” – the additional profit (before taxes or subsidies) that the firm would earn by locating there rather than in Country 2:

$$R - \hat{T}_1 = P(m_1 - m_2) + (\theta_2 - \theta_1) - \epsilon. \quad (6)$$

Z , the ratio of the firm’s location rent to the country’s payoff R , expresses the bargaining power of Country 1 vis-à-vis the firm:

$$Z = \frac{P(m_1 - m_2) + (\theta_2 - \theta_1)}{R}, \quad 0 < Z < \infty. \quad (7)$$

Using (4),

$$\lim_{\epsilon \rightarrow 0} \frac{\hat{T}_1}{R} = 1 - Z. \quad (8)$$

Suppose that Z is less than 1. Then the firm holds the upper hand, and it can extract a subsidy from Country 1. One can also interpret, in straightforward fashion, the cases in which Z equals 1 or is greater than 1.

2.3 The case of uncertainty

2.3.1 Setup

We now turn to the impact of cost uncertainty on offers by the two countries to the firm. As each country shapes its offer, its critical task is to estimate the fixed cost to the firm of producing on its site, relative to the fixed cost to the firm of producing on the site of its rival. We will call this “relative site cost.” The uncertainty of each country arises from its difficulty in preferring one estimate of relative site cost above other estimates. When the country is quite unsure, then its feasible estimates of the cost will range widely in the sense of being drawn from a broad interval – say, \$10 million to \$100 million. To keep the analysis simple, we assume a uniform distribution.

We now turn to the mathematics of the model. We assume that the two countries can observe all parameters except what the firm’s fixed cost would be in Country 1, relative to what its fixed cost would be in Country 2. The countries both estimate this relative fixed cost as θ . This is a random variable

⁴In practical terms, ϵ in (4) would equal the smallest unit of the currency preferred by the firm.

By assuming that $\epsilon > 0$, we rule out the limiting case of $T_1^* = R - [P(m_1 - m_2) + (\theta_2 - \theta_1)]$, and $T_2^* = R$ as a Nash equilibrium. Given $T_2^* = R$, Country 1 could improve upon $T_1^* = R - [P(m_1 - m_2) + (\theta_2 - \theta_1)]$ by raising its subsidy slightly and winning the firm for certain.

that follows the density function $f_\theta(\theta)$.⁵ The firm's valuation of the relative fixed cost is θ^* .

We assume that both countries are risk neutral. This suits the common case in which the firm's impact would be too small to affect either national economy much.

Let Π_i be the perception of each country of the probability that the firm will pick Country i . Country i will pick T_i to maximize the expected net benefit of inducing the firm to locate in its borders:

$$(R - T_i)\Pi_i. \quad (9)$$

Since the firm will choose between Country 1 and Country 2,

$$\Pi_2 = 1 - \Pi_1. \quad (10)$$

The firm will pick Country 1 if the advantages in market and fiscal incentive there offset any disadvantage that the firm has in fixed cost there:

$$P(m_1 - m_2) + (T_1 - T_2) > \theta. \quad (11)$$

Using (11), we get

$$\Pi_1 = F_\theta[P(m_1 - m_2) + (T_1 - T_2)], \quad (12)$$

where F_θ is the cumulative distribution function that corresponds to the prior f_θ . Taking T_2 as given, Country 1 solves

$$\max_{T_1^*} (R - T_1^*)F_\theta[P(m_1 - m_2) + (T_1^* - T_2)]. \quad (13)$$

Taking T_1 as given, Country 2 solves

$$\max_{T_2^*} (R - T_2^*)[1 - F_\theta[P(m_1 - m_2) + (T_1 - T_2^*)]]. \quad (14)$$

Hosts know something about the bounds. Define $b \equiv \max \theta_1 - \min \theta_2$ and $a \equiv \min \theta_1 - \max \theta_2$. Political, economic, cultural and social factors affect a and b . For example, an increase in Country 2's level of infrastructure essential to the foreign firm will shift the distribution of θ to the right.

Specify

$$f_\theta(\theta) = \begin{cases} \frac{1}{b-a} & \text{if } a \leq \theta \leq b, \\ 0 & \text{otherwise.} \end{cases} \quad (15)$$

⁵The assumption that both countries hold the same prior belief about cost makes the problem easier to solve and the solution easier to interpret. In particular, the assumption helps us derive unique solutions that lead to predictions that one can test.

(Note that, by (15), $0 \leq F_\theta \leq 1$.) If the firm turns down the country's offer, then the country will have wasted no resources. Thus the expected return to each country of courting the firm can never be negative. This implies that⁶

$$2a - b \leq P(m_1 - m_2) \leq 2b - a. \quad (16)$$

Thus, Country 1 solves

$$\max_{T_1^*} (R - T_1^*) \left[\frac{P(m_1 - m_2) + (T_1^* - T_2) - a}{b - a} \right]. \quad (17)$$

At the same time, Country 2 solves

$$\max_{T_2^*} (R - T_2^*) \left[1 - \frac{P(m_1 - m_2) + (T_1 - T_2^*) - a}{b - a} \right]. \quad (18)$$

The first-order conditions are

$$\frac{1}{b - a} [R - P(m_1 - m_2) - 2T_1^* + T_2 + a] = 0, \quad (19)$$

$$\frac{1}{b - a} [R - P(m_1 - m_2) + T_1 - 2T_2^* - b] = 0. \quad (20)$$

The second-order condition is always satisfied:

$$\frac{-2}{b - a} < 0. \quad (21)$$

So the problem has exactly one solution or equilibrium. This precision is due largely to the assumption that the two countries have identical, and simple, prior beliefs about cost.

To find the solution, we first solve the first-order conditions for the functions that specify how each country adjusts its offer of incentives in reaction to a change in the incentives offered by its rival. These reaction functions are:

$$T_1^*(T_2) = \frac{R - P(m_1 - m_2) + a}{2} + \frac{T_2}{2}, \quad (22)$$

$$T_2^*(T_1) = \frac{R - P(m_1 - m_2) - b}{2} + \frac{T_1}{2}. \quad (23)$$

Each country matches half of a change in the subsidy offered by its rival. One can imagine a succession of reactions, with smaller and smaller adjustments, that converges on a pair of equilibrium offers. This Nash equilibrium [$\hat{T}_1 = T_1^*(\hat{T}_2)$ and $\hat{T}_2 = T_2^*(\hat{T}_1)$] is

⁶This condition ensures that — in a Nash equilibrium $(\hat{T}_1, \hat{T}_2) — a \leq P(m_1 - m_2) + (\hat{T}_1 - \hat{T}_2) \leq b$.

$$\hat{T}_1 = \frac{3R - P(m_1 - m_2) + (2a - b)}{3}, \quad (24)$$

$$\hat{T}_2 = \frac{3R + P(m_1 - m_2) + (a - 2b)}{3}. \quad (25)$$

At the equilibrium, the perception of the probability of winning for each country is

$$\Pi_1 = \frac{P(m_1 - m_2) - (2a - b)}{3(b - a)}, \quad (26)$$

$$\Pi_2 = \frac{-P(m_1 - m_2) + (2b - a)}{3(b - a)}. \quad (27)$$

Both countries will perceive that a rise in the value of a unit of the firm's product will favor the country that offers the larger market ($\partial\Pi_1/\partial P = (m_1 - m_2)/3(b - a)$).

The expected net return to Country i of courting the firm is $\mathcal{R}_i = (R - T_i)\Pi_i$. Evaluation at the Nash equilibrium yields

$$\mathcal{R}_1 = \frac{1}{b - a} \left(\frac{P(m_1 - m_2) - (2a - b)}{3} \right)^2, \quad (28)$$

$$\mathcal{R}_2 = \frac{1}{b - a} \left(\frac{-P(m_1 - m_2) - (2b - a)}{3} \right)^2. \quad (29)$$

Results. With the basic setup in hand, we will examine the effects of changes in cost estimates on the countries' incentives to the firm and on the net return that they expect from courting the firm. Then we will consider the effects of changes in two parameters known by both countries. The parameters are: The firm's economic impact on the host country; and the value of the market that the firm can reach from the site in the host country.

First, consider changes in the degree of uncertainty that the countries have regarding the fixed cost of producing on a site of one country rather than on a site of another. Changes in the degree of uncertainty show up in new values of the parameters a and b that change the length of the interval for cost estimates, θ . We will first consider general changes in the bounds and then turn to the question of uncertainty.

The impacts, on the incentives offered by Country 1, of changes in the cost bounds are

$$\frac{\partial \hat{T}_1}{\partial a} = \frac{2}{3}, \quad (30)$$

$$\frac{\partial \hat{T}_1}{\partial b} = -\frac{1}{3}. \quad (31)$$

An event may touch the fiscal policy of a country by affecting the country's expectation of cost or its uncertainty regarding cost. One must distinguish, then, between how the event would affect the country's best estimate of cost and how the event would affect the dispersion of estimates. The random variable that expresses cost estimates, θ , has the mean $E(\theta) = (a + b)/2$; we take this to be the country's best estimate of relative fixed cost. The variance of θ is $V(\theta) = (b - a)^2/12$.

For our purposes, a change in variance that preserves the mean seems the purest measure of a change in uncertainty. We next consider how pure changes in uncertainty affect offers of incentives.

Changes in variance that preserve the mean. To change the variance while holding the mean in place, we impose the condition that $da = -db$. We use this as we take differentials of the functions that give the equilibrium offers to the firm by the countries. Perhaps surprisingly, we find that a rise in pure uncertainty concerning business conditions in a country would induce it to offer a smaller subsidy to the firm.

$$\frac{d\hat{T}_1}{db} < 0, \tag{32}$$

$$\frac{d\hat{T}_1}{da} > 0. \tag{33}$$

As Country 1 becomes more certain of its relative fixed cost to the firm – while retaining its expectation of that cost – it offers a larger subsidy. As it becomes less certain, it decreases its offer.

Similar results hold for Country 2:

$$\frac{d\hat{T}_2}{db} < 0, \tag{34}$$

$$\frac{d\hat{T}_2}{da} > 0. \tag{35}$$

Suppose that both countries are sure of costs. Then both also know that any cut by either from the equilibrium offer will certainly induce the firm to go to the rival. Now suppose that both countries are unsure of costs. Then both are also unsure that any cut in the equilibrium offer will lose the firm, and so they compete less avidly.

Since competition eases, the net return that each country expects in courting the firm, \mathcal{R} , can increase with the degree of uncertainty. To see this, define

$$K \equiv \frac{P(m_1 - m_2) - (2a - b)}{3}. \tag{36}$$

Then the impact of a pure change in uncertainty on the expected net return to Country 1 in offering a subsidy to the firm can be expressed as⁷

$$\frac{d\mathcal{R}_1}{db} = \frac{2K}{(b-a)} \left(1 - \frac{K}{b-a}\right) \geq 0. \quad (37)$$

The differential is calculated by setting $db = -da$, so one can interpret db alone as a measure of the change in pure uncertainty. A pure increase in uncertainty does not lower the expected net return to Country 1 in offering a subsidy; and, where the expected net return is positive, the rise in uncertainty will increase it. In addition, the response of the expected net return to the increase in uncertainty is great when the firm makes a product of great value or when Country 1 can offer it a much larger market than its rival can.⁸

The impact of a pure change in uncertainty upon Country 1's probability of winning the firm is⁹

$$d\Pi_1 = \frac{a+b-2P(m_1-m_2)}{3(b-a)^2} db. \quad (38)$$

Suppose that uncertainty increases (i.e., $db > 0$). Does Country 1's probability of winning increase with uncertainty? That, for Country 1, depends on whether its expected disadvantage in fixed cost exceeds its market advantage:

$$\text{sgn}[d\Pi_1] = \text{sgn}\left[\frac{a+b}{2} - P(m_1-m_2)\right]. \quad (39)$$

The firm can gain by dispelling all uncertainty when it chooses between two such countries – which are identical in known characteristics – for a site from which to produce for a world market. Because the countries are identical, they expect the relative fixed cost to be zero. That is, they believe that $\theta \in (-b, b)$, so they compute $E(\theta) = 0$. The subsidy rates are

$$\hat{T}_1 = \hat{T}_2 = R - b. \quad (40)$$

An increase in uncertainty raises the estimate of maximum fixed cost in either country. This cuts the equilibrium subsidies and conceivably can lead to taxes.

We caution that the model does not explicitly consider the firm's strategic response; such a response would be inappropriate for the stage of the site search

⁷To sign the differential, recall the equilibrium condition that $2a-b \leq P(m_1-m_2) \leq 2b-a$. It follows that $0 \leq \frac{P(m_1-m_2)-(2a-b)}{3}$, or $0 \leq K$. It also follows that $P(m_1-m_2)-(2a-b) \leq 3(b-a)$, or $\frac{K}{b-a} \leq 1$. Where the expected returns to each country of courting the firm are positive, the inequalities are strict.

⁸For these results, differentiate \mathcal{R} with respect to P and to m_1-m_2 . These are arguments in the function K , which appears in \mathcal{R} .

⁹For this result, compute the differential of (27) with respect to changes in a and b . Set $db = -da$ and simplify.

that we focus on here. Nevertheless, we think that one can infer this: If, as a general policy in its site search, the firm commits itself in a convincing fashion to telling the truth, then its best course is to tell the whole truth – that is, to tell the countries precisely how it values their sites.¹⁰

Changes in the mean that preserve the variance To change the mean of the uniform distribution of θ , while preserving its variance, we must change the midpoint of the interval while holding the bounds constant. So we impose the condition that $da = db$. Using this condition in manipulating (24), we find that

$$\frac{d\hat{T}_1}{da} = \frac{d\hat{T}_1}{db} > 0. \quad (41)$$

An increase in Country 1's expectation of the firm's relative fixed cost there causes it to increase its subsidy. It also lowers Country 1's expectation of the return from courting the firm:

$$\frac{d\mathcal{R}_1}{da} = -\frac{2K}{3(b-a)} < 0. \quad (42)$$

Changes in known parameters From the impact of uncertainty, we now shift our focus to the impact of changes in parameters that both countries know for sure. This section assumes that the countries can draw upon some site information to set the bounds on their estimates of site costs.

The known parameter that may matter most to each potential host is the economic impact of the firm, R . Equations (24) and (25) yield the result that, in a competition for the firm, each country matches dollar-for-dollar an increase in economic impact:

$$\frac{\partial \hat{T}_i}{\partial R} = 1. \quad (43)$$

As the appendix shows, that result holds for a general distribution of θ .

A country responds more strongly to changes in the economic impact of the firm than to changes in the size of its market, relative to the market of its rival:

$$\frac{\partial \hat{T}_i}{\partial m_i} = -\frac{P}{3} < 0, \quad (44)$$

$$\frac{\partial \hat{T}_i}{\partial m_j} = \frac{P}{3} > 0. \quad (45)$$

Here are the derivations about expected return:

¹⁰A referee notes that the firm has no incentive to commit to the truth when its chicanery would go undiscovered, since its overstatement of costs would prevent either country from collecting a rent.

$$\frac{\partial \mathcal{R}_1}{\partial R} = 0, \quad (46)$$

$$\frac{\partial \mathcal{R}_1}{\partial m_1} = \frac{2P}{3(b-a)} \left(\frac{P(m_1 - m_2) - (2a - b)}{3} \right) > 0, \quad (47)$$

$$\frac{\partial \mathcal{R}_1}{\partial m_2} = -\frac{2P}{3(b-a)} \left(\frac{P(m_1 - m_2) - (2a - b)}{3} \right) < 0. \quad (48)$$

How would a shift in foreign direct investment from low- to high-value manufacturing affect the country's offer of a subsidy? How would the shift affect the expected return to courting the firm? It turns out that relative market size ($m_2 - m_1$) magnifies the impact of an increase in market value (P):

$$\frac{\partial \hat{T}_1}{\partial P} = \frac{m_2 - m_1}{3}, \quad (49)$$

$$\begin{aligned} \frac{\partial \mathcal{R}_1}{\partial P} = \frac{2(m_1 - m_2)}{3(b-a)} \left(\frac{P(m_1 - m_2) - (2a - b)}{3} \right) &> 0 \quad \text{if } m_1 > m_2, \\ &< 0 \quad \text{if } m_1 < m_2. \end{aligned} \quad (50)$$

If Country 1 offers a larger market than its rival, then a shift in foreign direct investment toward high-value manufacturing will cause the country to raise its subsidy and yet to expect a larger return.

3 Conclusions and reflections

This simple model of competition between two host countries for a foreign firm suggests that large subsidies are extraneous for the country with the larger market or the better infrastructure. That finding is broadly consistent with statistical work published by Root and Ahmed in 1978. They carried out a multiple discriminant analysis of three groups of developing countries. The groups differed from one another by the size of the inflow per capita of foreign direct investment in the late 1960s. Root and Ahmed concluded that differences in the level of infrastructure seemed to explain more of the group variance in investment than did differences in either the simplicity or liberality of tax incentives.

Of course, one must distinguish tax rates levied on a broad class of firms from incentives offered to particular firms. It is conceivable that broad tax rates affect the foreign firm's decision of where to locate more than do offers of incentives. The firm may conclude that – after it had moved to the host country – a low, broad tax rate would be more likely to persist than a large, targeted incentive. The reason is that the government might have more trouble raising

the broad tax rate (which affects many firms) than eliminating the targeted incentive (which affects just one firm).

Nevertheless, there is evidence that corporate tax rates play a relatively small role in the location decisions of foreign-owned firms. In econometric work published in 1992, Wheeler and Mody concluded that corporate tax rates had less impact than infrastructure, supply of specialized inputs, or market expansion on foreign capital expenditures by U.S.-owned firms in the 1980s.

In principle, a country can induce a firm to occupy one of its sites by offering it enough money. We find that whether the potential host offers to pay firms a lot or a little depends on its uncertainty about the firm's costs. We suppose that the hosts adopt, for simplicity, a uniform probability distribution to articulate their beliefs about cost. Then, given their expectation of cost, as the potential hosts become more unsure about cost, they will cut back their offers of inducements to the firm.

Our analysis implies that the firm can procure more subsidies by reducing the uncertainty of foreign governments about its costs. But governments might resist information from the firm, out of suspicion. They know that the firm can gain by persuasively understating its value of a site. Governments might interpret an attempt to reduce uncertainty as an attempt to misstate valuation. To persuade governments of the former intent, the firm might demonstrate its technology to them. It must play its cards with care, however. Some data from its demonstration might leak out to its rivals. In addition, Vernonesque theory suggests that once the host comprehends the firm's technology, it may feel free to seize the operation.

Even when the governments believe the firm honest, they may resist its data. They may realize that their uncertainty about its costs enables each to cut its subsidy offer without worrying that it will certainly drive the firm to its rival. If the countries could commit to either a scenario in which both were informed or to one in which neither was informed, then both countries would prefer to sit in the dark.

4 Appendix

We will study comparative statics for the general form of the cumulative distribution function for θ ,

$$F_\theta[P(m_1 - m_2) + (T_1 - T_2)] \tag{A.1}$$

where

$$\frac{\partial F}{\partial T_1} = -\frac{\partial F}{\partial T_2} = f[P(m_1 - m_2) + (T_1 - T_2)]. \tag{A.2}$$

We assume that f is differentiable. We use (A.1) in (14) and (15) of the text, which give the maximization problems of Country 1 and Country 2, respectively.

The first-order conditions are

$$\Phi_1 \equiv (R - T_1^*)f - F = 0 \quad (A.3)$$

and

$$\Phi_2 \equiv (R - T_2^*)f - 1 + F = 0. \quad (A.4)$$

We will use the implicit function theorem and rule to justify and characterize the optimal subsidy functions $T_i^*(R, P, m_1, m_2)$, $i = 1, 2$. To satisfy the theorem, the determinant of the Jacobian for (68) and (69) must not vanish. The determinant $|J|$ is

$$\begin{vmatrix} \frac{\partial \Phi_1}{\partial T_1^* \partial T_1^*} & \frac{\partial \Phi_1}{\partial T_1^* \partial T_2^*} \\ \frac{\partial \Phi_2}{\partial T_2^* \partial T_1^*} & \frac{\partial \Phi_2}{\partial T_2^* \partial T_2^*} \end{vmatrix}$$

or

$$\begin{vmatrix} (R - T_1^*)f' - 2f & -(R - T_1^*)f' + f \\ (R - T_2^*)f' + f & -(R - T_2^*)f' - 2f \end{vmatrix}$$

where f' is the derivative of f . The value of the determinant is

$$|J| = ff'(T_1^* - T_2^*) + 3f^2. \quad (A.5)$$

We will consider a Bayesian Nash equilibrium (T_1^*, T_2^*) only if $|J|$ is nonzero for it.

We apply the implicit function rule and Cramer's rule to obtain these comparative statics:

$$\frac{\partial T_1^*}{\partial m_1} = P \frac{f'(R - T_1^*) - f}{f'(T_1^* - T_2^*) + 3f} \quad (A.6)$$

$$\frac{\partial T_1^*}{\partial m_2} = P \frac{-f'(R - T_1^*) + f}{f'(T_1^* - T_2^*) + 3f} \quad (A.7)$$

$$\frac{\partial T_1^*}{\partial P} = (m_1 - m_2) \frac{f'(R - T_1^*) - f}{f'(T_1^* - T_2^*) + 3f} \quad (A.8)$$

$$\frac{\partial T_2^*}{\partial m_1} = P \frac{-f'(R - T_2^*) + f}{f'(T_1^* - T_2^*) + 3f} \quad (A.9)$$

$$\frac{\partial T_2^*}{\partial m_2} = -P \frac{-f'(R - T_2^*) + f}{f'(T_1^* - T_2^*) + 3f} \quad (A.10)$$

$$\frac{\partial T_2^*}{\partial P} = (m_1 - m_2) \frac{f'(R - T_2^*) + f}{f'(T_1^* - T_2^*) + 3f} \quad (A.11)$$

$$\frac{\partial T_i^*}{\partial R} = 1, \quad i = 1, 2. \quad (A.12)$$

To ensure that (A.3) and (A.4) produce unique maxima of (14) and (15) in the text, we seek to satisfy the second-order conditions

$$(R - T_1^*) \frac{\partial f}{\partial T_1^*} - 2f < 0, \quad (\text{A.13})$$

$$(R - T_2^*) \frac{\partial f}{\partial T_2^*} - 2f < 0. \quad (\text{A.14})$$

If $f > 0$, then $|J| > 0$.¹¹ If $f' = 0$, then the result follows immediately. If f' is not zero, then rewrite (A.5) as $f[f''(T_1 - R) + f'(R - T_2) + 3f]$ and use the second-order conditions as well as a necessary condition of optimization for Country i , $R \geq T_i$, where $i = 1, 2$.

Since $|J| > 0$, the signs of (A.6) through (A.11) depend on the off-diagonal elements of the Jacobian. Setting $f' = 0$ over the domain of θ produces the comparative statics in the text. It also ensures that $dT_i/dT_j > 0$, for $i, j = 1, 2$. That result may not hold if f' is not equal to 0.

References

- [1] Andersson, T. 1991. *Multinational investment in developing countries: A study of taxation and nationalization*. London: Routledge.
- [2] Associated Press. 1996. Vanuatu police kidnap president, demand wages. *Pacific Daily News* October 13, page 4.
- [3] Bergsten, C. F., T. Horst and T. H. Moran. 1978. *American multinationals and American interests*. Washington, D.C.: The Brookings Institution.
- [4] Black, D. and W. Hoyt. 1989. Bidding for firms. *American Economic Review* 79: 1249-1256.
- [5] Bond, E.W. and L. Samuelson. 1986. Tax holidays as signals. *American Economic Review* 76: 820-6.
- [6] Bucovetsky, S. 1991. Asymmetric tax competition. *Journal of Urban Economics* 30: 167-181.
- [7] Bucovetsky, S. and Wilson, J.D. 1991. Tax competition with two tax instruments. *Regional Science and Urban Economics* 21: 333-350.
- [8] Conrad, K. and H. Seitz. 1994. Strategic competition with infrastructure services. *Working paper*, University of Mannheim, Germany.

¹¹We thank a referee for showing that a rewriting of (A.5) produces the result.

- [9] Doyle, C. and S. van Wijnbergen. 1994. Taxation of foreign multinationals: A sequential bargaining approach to tax holidays. *International Tax and Public Finance* 1: 211-226.
- [10] Eaton, J. and M. Gersovitz. 1983. Country risk: Economic analysis. In R.J. Herring, ed., *Managing international risk*. Cambridge: Cambridge University Press.
- [11] Goodman, L. W. 1987. *Small nations, giant firms*. New York: Holmes and Meier.
- [12] Gowers, Andrew. 1993. Murmurings of anxiety. *Financial Times*, March 29, III-1.
- [13] Guisinger, S. E., and associates. 1985. *Investment incentives and performance requirements*. New York: Praeger Publishers.
- [14] Hood, N. and S. Young. 1985. The automotive industry. In S. E. Guisinger and associates, *Investment incentives and performance requirements*. New York: Praeger Publishers.
- [15] King, I., P. McAfee and L. Welling. 1993. Industrial blackmail: Dynamic tax competition and public investment. *Canadian Journal of Economics* 26: 590-608.
- [16] King, I. and L. Welling. 1992. Commitment, efficiency, and footloose firms. *Economica* 59: 63-73.
- [17] Oates, W., and R. Schwab. 1988. Economic competition among jurisdictions: efficiency enhancing or distortion inducing? *Journal of Public Economics* 35: 333-354.
- [18] Organization for Economic Cooperation and Development. 1989. *International direct investment and the new economic environment*. Paris: OECD.
- [19] Oxelheim, L. 1993. Foreign direct investment and the liberalization of capital movements. In L. Oxelheim, ed., *The global race for foreign direct investment: Prospects for the future*. Berlin: Springer-Verlag.
- [20] Perloff, J.M. and Salop, S.C. 1985. Equilibrium with product differentiation. *Review of Economic Studies* 52: 107-120.
- [21] Pfefferman, G. 1992. Facilitating foreign investment. *Finance and Development*, March, 46-7.
- [22] Reuber, G.B. et al. 1973. *Private foreign investment in development*. Oxford: Clarendon Press.

- [23] Root, F.R. and A.A. Ahmed. 1978. The influence of policy instruments on manufacturing direct foreign investment in developing countries. *Journal of International Business Studies* 9: 81-93.
- [24] Schneider, F. and B. S. Frey. 1985. Economic and political determinants of foreign direct investment. *World Development* 13: 161-175.
- [25] Smith, D. and L. Wells. 1974. *Negotiating Third World mineral contracts*. Lexington, Mass.: Ballinger.
- [26] Stevens, G. 1969. U.S. direct manufacturing investment to Latin America: Some economic and political determinants. *Yale Economic Essays* 9: 137-99.
- [27] Stopford, J.M. and S. Strange, with J.S. Henley. 1991. *Rival states, rival firms*. Cambridge: Cambridge University Press.
- [28] United Nations Center on Transnational Corporations. 1992. *World investment report*. New York: United Nations.
- [29] Vernon, R. 1971. *Sovereignty at bay: The multinational spread of U.S. enterprises*. New York: Basic Books.
- [30] Whaley, Floyd. 1996. Post-collapse politics. *Pacific Daily News* 27: 255, October 13, page 1.
- [31] Wheeler, D. and A. Mody. 1992. International investment location decisions: The case of U.S. firms. *Journal of International Economics* 33: 57-76.
- [32] Wildasin, D.E. 1988. Nash equilibria in models of fiscal competition. *Journal of Public Economics* 35: 229-240.
- [33] Wildasin, D.E. 1991. Some rudimentary "duopoly" theory. *Regional Science and Urban Economics* 21: 393-421.
- [34] Wilson, J.D. 1986. A theory of interregional tax competition. *Journal of Urban Economics* 19: 296-315.
- [35] Wilson, J.D. 1991. Tax competition with interregional differences in factor endowments. *Regional Science and Urban Economics* 21: 423-451.
- [36] World Bank. 1991. *World Debt Tables 1991-92*. Washington, D.C.: World Bank.
- [37] Zodrow, G. and P. Mieszkowski. 1986. Pigou, Tiebout, property taxation and the underprovision of local public goods. *Journal of Urban Economics* 19: 356-70, 1986.