

Labor-Quality Signaling to Attract Foreign Investment

Hisashi Sawaki

1. Introduction

There are many ways for countries to attract foreign direct investment (FDI). It is extremely important to create a favorable business environment and to provide multinational firms with pecuniary incentives (e.g., tax breaks and grants). However, activities by investment promotion agencies (IPAs), which are established in almost all countries, are equally important at least in the short term. This is because, in many cases, potential foreign investors do not have enough information about the countries where they are considering investing, and IPAs can bridge this gap between investors and countries.

For instance, Ireland's Industrial Development Authority (IDA) declares on their website that their country is one of the best places to do business.¹ When the IDA started attracting FDI in the 1970s, Ireland was less developed than many Western European countries. The IDA had to use the strategy of inviting firms by compensating them for locating in such a “backward” country. After that, partly due to the improved labor quality as a result of heavy investment in education, Ireland underwent significant economic development. The IDA then felt a need for an advertising program to correct the misperceptions of investors and create a new image of Ireland as source of high-quality labor. The IDA engaged in promotion campaigns built on the increased skills of the Irish labor force (Wells and Wint, 2000).

Wells and Wint (2000, p. 4) define investment promotion as “activities that disseminate information about, or attempt to create an image of the investment site and provide investment services for the prospective investor.” The focus of this paper is on the first role: disseminating information. Through this function, IPAs can communicate

all the features that make their country attractive as FDI recipients.

FDI promotion can be a costly activity because it is not confined to creating a website. Even if jobs related only to information dissemination are considered, tasks include holding investment forums and seminars, sending direct mail, and engaging in delegate investment missions.

To analyze such IPA campaigns, we apply costly signaling models from game theory. Our analytical focus is on a rather short-term event, and we treat the business environment as given. It is assumed that the attractiveness of a country is not well-known to foreign investors and that the IPA for this country has an opportunity to signal the attractiveness through their advertising campaigns.

Inspired by the above anecdote about Ireland, the unknown parameter of attractiveness is taken to be labor quality in this study.² The purpose of this paper is to provide a theoretical rationale for IPA campaigns. Specifically, we are interested in determinants of the campaign intensity: how the intensity is related to the actual labor quality, and how changes in exogenous factors such as the market demands in this industry affect the intensity.

There are some empirical studies that explore the activities of IPAs. Among such studies, Morisset and Andrews-Johnson (2004) argue that FDI promotion is in general effective by showing that FDI attraction and the average expenditure of IPAs are positively associated. Harding and Javorcik (2011) report that investment promotion works in countries where information asymmetries are likely to be severe.

Theoretical papers have traditionally focused on the use of corporate taxes or subsidies as means of FDI attraction. For instance, there are several papers that analyze tax competition for internationally mobile firms in models of economic geography (e.g., Borck and Pflüger, 2006). In addition, several papers, including Bjorvatn and Eckel (2006), investigate subsidy competitions in a monopolistic setting, whereas Haufler and Wooton (2010) analyze tax competitions in an oligopolistic industry.

This paper also adds to the literature on signaling behavior in international trade. Collie and Hviid (1993, 1994, 1999) analyze how trade policies can be distorted when domestic governments intend to signal some information about their countries through the policies. Bond and Samuelson (1986) show that governments may use tax holidays to signal their countries' productivity levels and attract FDI. In contrast, there are some models in which firms rather than governments send signals about unknown parameters (e.g., Wright, 1998; Kolev and Prusa, 2002; Miyagiwa and Ohno, 2007;

Cassing and To, 2008; Katayama and Miyagiwa, 2009). To the best of the author's knowledge, this study and Sawaki (2015) are the first attempts to investigate IPA advertising campaigns using signaling models.

2. The model

We consider a model of FDI attraction under incomplete information. The oligopolistic setup in Haufler and Wooton (2010) is used as the basis of the model, because this setup is compatible with incomplete information.

Suppose that there are two countries, a and b , in either of which a fixed number of multinational firms are ready to make investments. After the investment stage, these firms are supposed to compete in homogenous-good markets. It is assumed that each firm's marginal cost of production reflects the labor quality of the country in which the firm has chosen its investment site. Thus, the labor quality in each country is important information for firms when making decisions about FDI. Suppose, however, that the true labor quality of country a is not known to any firm at the beginning of the game. The IPA for country a knows the true quality and has the opportunity to engage in advertising campaigns to signal this. We assume one-sidedness of incomplete information, in part for tractability and in part because we want to see how an IPA engages in such campaigns when confronted with a country with established reputations. Therefore, the true labor quality of country b is common knowledge. The main players in this model are the IPA of country a and the multinational firms.

The total population in this area is normalized to unity. For tractability, the populations in the two countries are assumed to be identical: each country has $1/2$ consumers. A simple partial-equilibrium model of a good, labeled x , is considered. Each consumer in the two countries has the identical inverse demand $p_i = a - x$, where x_i is the per-capita consumption in country $i \in \{a, b\}$ and p_i is the price of this good.³ The aggregate demand in each country is

$$X_i = (1/2)(a - p_i), \quad i \in \{a, b\}. \quad (1)$$

On the supply side, there are a total of k multinational firms, where $k \geq 2$ is an integer, based in the third country and ready to invest in country a or country b .

Each firm incurs identical fixed costs when making an investment. It is assumed that these costs are sufficiently large that each firm constructs a production facility in

only one of the two countries. As in Haufler and Wooton (2010), these costs are omitted in the equations below for simplicity.

From its own facility, each firm serves the markets of both countries a and b . x_{ij} denotes the sales in market i (i.e., the market in country i) by a country- j firm (i.e., a firm that has constructed its facility in country j), $i, j \in \{a, b\}$. The aggregate supply in markets a and b are, respectively,

$$X_a = k_a x_{aa} + k_b x_{ab} ; X_b = k_a x_{ba} + k_b x_{bb} , \quad (2)$$

where k_i is the number of country- i firms ($k_a + k_b = k$), which is determined endogenously in the model. The firms engage in Cournot competition in the two segmented markets. Profits for each firm are defined as follows:

$$\begin{aligned} \pi_a &= (p_a - \omega) x_{aa} + (p_b - \omega - \tau) x_{ba} , \\ \pi_b &= (p_a - \tau) x_{ab} + p_b x_{bb} , \end{aligned} \quad (3)$$

where π_i represents the profit for a country- i firm. $\tau (> 0)$ is an export cost, which is exogenous here as in Haufler and Wooton (2010). ω is the marginal cost of production for a country- a firm. The following assumption is made.

- Assumption 1. (i) ω is inversely associated with the labor quality in country a .
(ii) The marginal cost for a country- b firm is normalized to zero.

Part (i) above is consistent with Haufler and Wooton (2010). This is because, in their model, the marginal cost of production is the product of the wage rate and the labor-input coefficient; the former is constant while the latter is the reciprocal of the labor productivity in the host country. The normalization in part (ii) reduces the burden of calculation and is possible because both the demand and cost functions are linear in this model (see Appendix 1). Strictly, ω is interpreted as the difference between marginal costs in countries a and b . Incomplete information is introduced in this parameter below.

Using (1) and (2), the profits in (3) can be rewritten as

$$\pi_a = \pi_{aa} + \pi_{ba} , \quad (4)$$

where $\pi_{aa} \equiv [\alpha - 2(k_a x_{aa} + k_b x_{ab}) - \omega] x_{aa}$, $\pi_{ba} \equiv [\alpha - 2(k_a x_{ba} + k_b x_{bb}) - \omega - \tau] x_{ba}$;

$$\pi_b = \pi_{ab} + \pi_{bb}, \quad (5)$$

where $\pi_{ab} \equiv [\alpha - 2(k_a x_{aa} + k_b x_{ab}) - \tau] x_{ab}$, $\pi_{bb} \equiv [\alpha - 2(k_a x_{ba} + k_b x_{bb})] x_{bb}$.

Technical discussions of the rationale behind Assumption 1 and equations (3) – (5) are given in Appendix 1.

It is assumed that $\omega \in [\omega_{\min}, \omega_{\max}]$ is a random variable picked by Nature, and its true value is initially private information only known to the IPA of country a . No firm knows the true value before the investment stage. Because this model focuses on separating equilibrium (as seen below), the distribution of ω need not be specified, although it is supposed to have positive density everywhere in the interval $[\omega_{\min}, \omega_{\max}]$ and to be common knowledge. $\omega > 0$ is taken to mean that the labor quality of country a is inferior to that of b , and vice-versa. As a first step in investigating FDI promotion, we focus for the most part on the situation in which the labor qualities in countries a and b are *not* markedly different:

Assumption 2. (i) $\omega_{\min} < 0 < \omega_{\max}$. (ii) $\omega_{\max} - \omega_{\min}$ is *not large*.

This assumption increases tractability: if ω_{\max} and/or ω_{\min} deviate far from zero, then it becomes difficult to determine the signs of some functions and thus to derive general conclusions, although simulations are still possible, as seen below.

The IPA of country a signals the value ω to firms via promotion campaigns. Wells and Wint (2000, p. 164) argue that, due to the public-good nature of investment promotion, IPAs are naturally government-funded. Therefore, in this paper we assume that the IPA has the same objective as the government and maximizes the following:

$$G = (1/4)(x_a)^2 - e. \quad (6)$$

The first term in the RHS is the consumer surplus in country a , calculated using $n(1/2)(x_a)^2$, where $n = 1/2$ is the population of country a . e is the expenditure on FDI promotion, based on which the firms update their beliefs about ω and make their investment and production decisions. As seen in (6), other than the concern about the expenditure, the objective of the IPA is to maximize the consumer surplus by

enhancing competition. This setup is consistent with the objective of governments in the main model in Haufler and Wooton (2010).

The timing is as follows. In Stage 0, Nature picks $\omega \in [\omega_{\min}, \omega_{\max}]$. This is observed by the IPA of country a , but not by the multinational firms. In Stage 1, the IPA chooses e , which is observed by the firms. Conditional on this observation, the firms form their posterior beliefs $\hat{\omega}$ about ω . In Stage 2, the firms independently make decisions on their investment sites. k_a firms construct production facilities in country a while $k_b (= k - k_a)$ firms construct facilities in country b . The former firms (i.e., the country- a firms) learn the true value of ω while the latter firms (i.e., the country- b firms) maintain their beliefs of $\hat{\omega}$ and do not learn the true value of ω . In Stage 3, the firms compete as Cournot oligopolists in the segmented markets.

This is a signaling model in which the IPA is the Sender and the firms are the Receivers. Note, however, that in Stage 3 the country- a firms and country- b firms have different amounts of information. The country- a firms come to know the true value of ω because they can directly observe it in their production facilities; the country- b firms do not have this opportunity and maintain their beliefs of $\hat{\omega}$. It is assumed that these beliefs of the country- b firms are not updated after the investment stage even on off-the-equilibrium paths. That is, even if unexpected numbers k_a and k_b are observed (“unexpected” in the sense “not consistent with the observed e ”), this event is taken to have occurred as a result of mistakes by some firms and the belief is not updated. This assumption is natural because no firm knew the true value of ω at the investment stage.⁴

The solution concept used in this model is the perfect Bayesian equilibrium, which roughly demands two conditions: (i) all players (i.e., the IPA and the firms) maximize their own payoffs given the other players’ strategies and the beliefs; (ii) the beliefs are consistent with the IPA’s incentives.

The current model focuses on separating equilibrium in which the IPA spends an amount $e(\omega)$ in advertising, where $e(\omega)$ is a one-to-one function. In such an equilibrium, the firms associate each level of observed e with a different ω , and thus the posterior belief matches the true marginal cost: $\hat{\omega} = \omega$. In short, this implies that it is impossible for the IPA to misguide the ex-post perceptions of firms about the labor quality. The analysis starts at Stage 3 and proceeds backward.

3. The production stage

In Stage 3, the numbers of firms k_a and k_b are treated exogenously. Because the two markets are segmented and the cost functions are linear, the analyses of the markets can be conducted independently.

First, we consider the Cournot competition in market a . Each country- a firm maximizes π_{aa} in (4) with respect to x_{aa} while knowing the true ω . The first-order condition yields the following:⁵

$$(1/2)(\alpha - \omega) = (k_a + 1)x_{aa} + k_b x_{ab}. \quad (7)$$

The country- b firms do not know ω and thus have to make an inference about a country- a firm's choice x_{aa} . Each country- b firm takes the expectation of π_{ab} in (5) conditional on the observed e ,

$$E(\pi_{ab} | e) = \{\alpha - 2[k_a E(x_{aa} | e) + k_b x_{ab}] - \tau\} x_{ab},$$

and maximizes this with respect to x_{ab} . The first-order condition leads to:

$$(1/2)(\alpha - \tau) = k_a E(x_{aa} | e) + (k_b + 1)x_{ab}. \quad (8)$$

The country- b firms infer x_{aa} by taking the expectation of (7):⁶

$$(1/2)(\alpha - \hat{\omega}) = (k_a + 1)E(x_{aa} | e) + k_b x_{ab}, \quad (9)$$

where $\hat{\omega} \equiv E(\omega | e)$ is the posterior belief conditional on e .

It is convenient to derive the relationship between $E(x_{aa} | e)$ and x_{ab} by subtracting (9) from (8):

$$E(x_{aa} | e) = -(1/2)\hat{\omega} + (1/2)\tau + x_{ab}. \quad (10)$$

This equation implies that when $\hat{\omega} = 0$ (i.e., when the labor qualities in a and b are perceived to be equivalent), the expected local sales by a country- a firm should be larger than the exports by a country- b firm owing to the advantage of not incurring

export costs. Equations (7), (8), and (10) yield the Bayesian Nash equilibrium outputs in Stage 3:

$$x_{aa}^* = \frac{(k_a + 1)\alpha - (k + 1)\omega - k_a k_b \hat{\omega} + (k_a + 1)k_b \tau}{2(k + 1)(k_a + 1)},$$

$$x_{ab}^* = \frac{\alpha + k_a \hat{\omega} - (k_a + 1)\tau}{2(k + 1)}. \quad (11)$$

Then, the per-capita consumption in country a becomes:

$$x_a^* = 2(k_a x_{aa}^* + k_b x_{ab}^*) = \frac{k(k_a + 1)\alpha - k_a(k + 1)\omega + k_a k_b \hat{\omega} - (k_a + 1)k_b \tau}{(k + 1)(k_a + 1)}. \quad (12)$$

From (11), it follows that a decline in $\hat{\omega}$ decreases x_{ab}^* but increases x_{aa}^* . That is, if country- b firms believe that the labor quality in country a is high (i.e., if $\hat{\omega}$ is low), then they step back and reduce their outputs. However, country- a firms increase their outputs in response to these actions by country- b firms. Because the former effect on x_{ab}^* dominates the latter on x_{aa}^* , a decline in $\hat{\omega}$ decreases the overall outputs in country a (to be consumed by an individual), as seen in (12), and thus raises the equilibrium price $p_a^* = \alpha - x_a^*$. This result is summarized as follows:

Lemma 1 *A decline in $\hat{\omega}$ has an output-reducing effect in country a :*

$$\frac{\partial x_a^*}{\partial \hat{\omega}} = \frac{k_a k_b}{(k + 1)(k_a + 1)} > 0.$$

In this respect, IPA campaigns inducing a low $\hat{\omega}$ can harm the welfare of country a . Of course, this result is obtained without consideration of the investment stage and thus with the tentative assumption that k_a and k_b are constant.

Substituting (11) into the first terms on the RHS in (4) and (5) yields the profits for each firm from sales in market a , as functions of the belief $\hat{\omega}$ and the true type ω :⁷

$$\pi_{aa}^*(\hat{\omega}, \omega) = \frac{1}{2} \left[\frac{(k_a + 1)\alpha - (k + 1)\omega - k_a k_b \hat{\omega} + (k_a + 1)k_b \tau}{(k + 1)(k_a + 1)} \right]^2, \quad (13)$$

$$\pi_{ab}^*(\hat{\omega}, \omega) = \frac{1}{2} \left[\frac{(k_a + 1)\alpha + k_a(k + 1)\omega - k_a k_b \hat{\omega} - (k_a + 1)^2 \tau}{(k + 1)(k_a + 1)} \right] \times \left[\frac{\alpha + k_a \hat{\omega} - (k_a + 1)\tau}{k + 1} \right]$$

The analysis of market b can be conducted analogously. The sales by each firm are

$$x_{ba}^* = \frac{(k_a + 1)\alpha - (k + 1)\omega - k_a k_b \hat{\omega} - (k_a + 1)(k_b + 1)\tau}{2(k + 1)(k_a + 1)},$$

$$x_{bb}^* = \frac{\alpha + k_a \hat{\omega} + k_a \tau}{2(k + 1)}. \quad (14)$$

Using (4), (5), and (14), we can derive the profits each firm earns in market b :

$$\pi_{ba}^*(\hat{\omega}, \omega) = \frac{1}{2} \left[\frac{(k_a + 1)\alpha - (k + 1)\omega - k_a k_b \hat{\omega} - (k_a + 1)(k_b + 1)\tau}{(k + 1)(k_a + 1)} \right]^2, \quad (15)$$

$$\pi_{bb}^*(\hat{\omega}, \omega) = \frac{1}{2} \left[\frac{(k_a + 1)\alpha + k_a(k + 1)\omega - k_a k_b \hat{\omega} + k_a(k_a + 1)\tau}{(k + 1)(k_a + 1)} \right] \times \left[\frac{\alpha + k_a \hat{\omega} + k_a \tau}{k + 1} \right].$$

To focus on interior solutions, we require some constraints on the parameters. As mentioned above, in separating equilibrium the posterior belief coincides with the true marginal cost. From this fact and Assumption 2, it follows that $\hat{\omega} = \omega = 0$ is contained in the interval of our investigation. If $\hat{\omega} = \omega = 0$, then the number of firms located in each of the two countries is equal ($k_a = k_b = k/2$) as seen in the next section. Therefore, to ensure that x_{ab}^* in (11) and x_{ba}^* in (14) are positive when $\hat{\omega} = \omega = 0$, the following assumption is made:

Assumption 3. $\alpha - [(k/2) + 1]\tau > 0$.

This is guaranteed if the demand intercept is sufficiently large.⁸

4. The investment stage

In Stage 2, the k firms independently make decisions on investment sites. Because no firm knows the true value of ω at this point, each firm has to make inferences about its profits conditional on the observed e . If a firm constructs a facility in country a , then its expected profit is $E(\pi_a^*|e) = E[\pi_{aa}^*(\hat{\omega}, \omega) + \pi_{ba}^*(\hat{\omega}, \omega)|e]$, where the functional forms of $\pi_{aa}^*(\hat{\omega}, \omega)$ and $\pi_{ba}^*(\hat{\omega}, \omega)$ are given in (13) and (15), respectively. In the above expression, the expectations are taken over ω ; the argument $\hat{\omega}$ is the belief formed by the country- b firms in Stage 3, which appeared in the last section and is assumed to be constant here.

Because $\pi_{aa}^*(\hat{\omega}, \omega)$ is a quadratic rather than linear function of ω , $E[\pi_{aa}^*(\hat{\omega}, \omega)|e]$ is not in general equivalent to $\pi_{aa}^*(\hat{\omega}, \omega)$ (Jensen's Inequality). However, because this model focuses on separating equilibrium and thus the belief $\hat{\omega}$ is formed with null support (i.e., the belief is an exact number with zero variance), $E[\pi_{aa}^*(\hat{\omega}, \omega)|e] = \pi_{aa}^*(\hat{\omega}, \hat{\omega})$ holds. Similar arguments apply for $E[\pi_{ba}^*(\hat{\omega}, \omega)|e]$. Therefore, if a firm chooses country a as its FDI location, then its expected profit is:

$$E(\pi_a^*|e) = \frac{1}{2} \left[\frac{\alpha - (k_b + 1)\hat{\omega} + k_b\tau}{k+1} \right]^2 + \frac{1}{2} \left[\frac{\alpha - (k_b + 1)\hat{\omega} - (k_b + 1)\tau}{k+1} \right]^2 .$$

The expected profit for a firm that chooses country b is

$$E(\pi_b^*|e) = \frac{1}{2} \left[\frac{\alpha + k_a\hat{\omega} - (k_a + 1)\tau}{k+1} \right]^2 + \frac{1}{2} \left[\frac{\alpha + k_a\hat{\omega} + k_a\tau}{k+1} \right]^2 .$$

Equating the above expected profits leads to the numbers of firms in the locational equilibrium:

$$k_a^*(\hat{\omega}) = \frac{k}{2} + \frac{(\tau + \hat{\omega} - 2\alpha)\hat{\omega}}{2[(\hat{\omega})^2 + \tau^2]} ; \quad k_b^*(\hat{\omega}) = k - k_a^*(\hat{\omega}) . \quad (16)$$

Note that $k_a^*(0) = k_b^*(0) = k/2$. That is, if the labor quality in country a is expected to be equivalent to that in country b , then the numbers of the firms located in a and b are equal. In addition, the following lemma holds. The proof is given in Appendix 2.

Lemma 2 *A decline in $\hat{\omega}$ has a locational effect in favor of country a :*

$$\frac{\partial k_a^*(\hat{\omega})}{\partial \hat{\omega}} < 0.$$

Lemma 2 implies that if the IPA can successfully persuade foreign investors that country a has a highly qualified labor force, then it can invite many investors.

To ensure interior solutions, $0 < k_a^* < k$ is assumed, which is satisfied for $\hat{\omega} \approx 0$ under Assumption 2. Following Haufler and Wooton (2010), k_a^* and k_b^* are treated as continuous variables rather than integers.⁹ In addition, all the outputs in (11) and (14), with k_i replaced by k_i^* in (16), are assumed to be positive.

5. The campaign stage

In Stage 1, the IPA of country a engages in promotional campaigns. In doing so, it chooses e to maximize the objective in (6), with knowledge of the true type ω and the belief of $\hat{\omega}$, and subject to the constraints in (12) and (16). Specifically, the objective is $G(e, \hat{\omega}, \omega) = CS(\hat{\omega}, \omega) - e$, where CS denotes the consumer surplus:

$$CS(\hat{\omega}, \omega) = \frac{1}{4}(x_a^*)^2 = \frac{1}{4} \left[\frac{k(k_a^* + 1)\alpha - k_a^*(k + 1)\omega + k_a^*k_b^*\hat{\omega} - (k_a^* + 1)k_b^*\tau}{(k + 1)(k_a^* + 1)} \right]^2. \quad (17)$$

The functional forms of k_a^* and k_b^* are as in (16).

Under complete information (i.e., the firms know the true value ω), e would be zero because the campaign expenditures would play no role. However, under incomplete information as assumed in this paper, expenditure can affect firms' beliefs and actions. This model is interested in how this expenditure depends on the true labor quality. To investigate this, the next lemma, which shows the incentives an IPA faces, is important. The proof is in Appendix 3.

Lemma 3 *The IPA has an incentive to overstate the labor quality of its country (i.e., an incentive to induce a low value for $\hat{\omega}$): $\frac{\partial CS(\omega, \omega)}{\partial \hat{\omega}} < 0$.*

The negative sign in the above derivative is explained as follows. Recalling the definition of CS and the fact that $k_b^* = k - k_a^*$, the derivative can be decomposed as

$$\frac{\partial \mathcal{CS}(\omega, \omega)}{\partial \hat{\omega}} = \frac{1}{2} x_a^* \cdot \left[\frac{\partial x_a^*}{\partial \hat{\omega}} + \frac{\partial x_a^*}{\partial k_a^*} \frac{\partial k_a^*}{\partial \hat{\omega}} \right] \quad \hat{\omega} = \omega, \quad (18)$$

whose exact functional form is given in (A.2) in Appendix 3. For tractability, we evaluate the RHS of (18) at $\hat{\omega} \approx 0$ under Assumption 2.

The expression in the square brackets is focused on: (i) $\partial x_a^* / \partial \hat{\omega}$ is positive as shown in Lemma 1 (the output effect of $\hat{\omega}$); (ii) it can be shown that $\partial x_a^* / \partial k_a^*$ is positive as long as $\omega \approx 0$. That is, the more firms that enter country a , the greater the supply for consumers in country a . Multiplied by it, the value of $\partial k_a^* / \partial \hat{\omega}$ is negative, as seen in Lemma 2 (the locational effect of $\hat{\omega}$).

Because the locational effect dominates the output effect in the setup of the model, the IPA has an incentive to overstate its labor quality (i.e., to understate $\hat{\omega}$), as is shown rigorously in Appendix 3. In short, if the IPA of country a persuades investors that the country has a qualified labor force, then while this may decrease the supply of goods from country b in the future, it induces many investors to enter the country now and thus increases the consumer surplus.

In separating equilibrium, however, the above incentive for the IPA is correctly anticipated by the firms, and thus the IPA cannot deceive them so $\hat{\omega} = \omega$. The equilibrium requires the following two conditions. First, $e(\omega_{\max})=0$ (the initial-value condition) is necessary. This is because when the resulting inflows of FDI and the outputs are at the possible lowest levels, the IPA has no reason to engage in advertising. Second, the marginal cost for the IPA of slightly exaggerating the labor quality has to match the marginal benefits of such exaggeration (the first-order condition). Equating these yields the following differential equation:¹⁰

$$e'(\omega) = \frac{\partial \mathcal{CS}(\omega, \omega)}{\partial \hat{\omega}}, \quad (19)$$

where the functional form of the RHS is given in (A.2) in Appendix 3. Equation (19) can be solved for $e(\omega)$ by integrating the RHS with respect to ω , which is a conceptually straightforward but tedious task. Without this task, however, Proposition 1 can be obtained.

Proposition 1 $e(\omega)$ is a decreasing function with $e(\omega_{\max})= 0$.

Proof: Lemma 3 and the initial-value condition simply prove it.

That is, the RHS of (19) represents the slope of $e(\omega)$, which is negative as seen in Lemma 3. Proposition 1 implies that the greater labor quality (i.e., the lower the value of ω) that a country has, the more intense the advertising campaigns engaged in by the IPA are. This result is natural, because countries will tend to emphasize their advantages to the foreign investors. The above result also reflects the scenario in Ireland, where the IDA started its full-fledged campaigns to advertise labor quality after the quality was improved.

In addition, the above result implies that more intense campaigns are associated with attracting more FDI. This is because in our model, the true value of ω is revealed ex-post to the firms, and thus lower levels of ω attract more firms to country a . This implication is consistent with the findings in Morisset and Andrews-Johnson (2004), cited in the Introduction.

Instead of showing the explicit solution for $e(\omega)$, which is very lengthy, we present some simulation results when the parameters are given specific values. The solid curve in Figure 1 represents $e(\omega)$ when $\alpha = 10$, $k = 10$, $\tau = 1$, $\omega_{\min} = -0.2$, and $\omega_{\max} = 0.2$. The proofs of Lemma 3, and thus of Proposition 1, use the fact that this curve is downward-sloping at point A as in Figure 1.

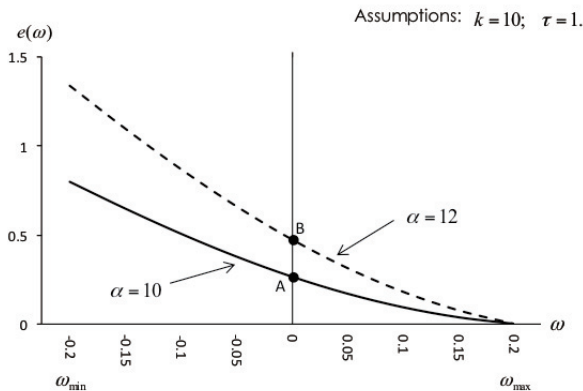


Figure 1. Advertising Expenditures

We next consider the impact of a change in an exogenous variable on the expenditure curve:

Corollary 1 *An increase in the market demand α shifts the $e(\omega)$ curve upward except at the point $(\omega_{\max}, 0)$.*

Proof. The absolute value of $\partial CS(0,0)/\partial \hat{\omega}$, whose functional form is given in (A.3) in Appendix 3, is increasing in α . This fact and the initial-value condition prove the corollary.

The dashed line in Figure 1 shows the $e(\omega)$ curve when α is raised to 12. The above proof uses the fact that the slope at point B is steeper than that at point A. Recall that $\partial CS/\partial \hat{\omega}$, which represents the slope, can be decomposed as in (18). On the RHS, x_a^* indicates how important this industry is to the IPA, while the expression in the square brackets indicates the marginal disutility the IPA incurs when its campaign efforts fall short of the expected level. Because a rise in α increases the absolute values of both parts, as seen in (A.3) in Appendix 3, this magnifies the campaign intensity. The impacts of changes in other variables (τ and k) are rather ambiguous.

In this study, we limit our attention to $\omega \approx 0$ under Assumption 2. Our purpose is to derive general results by focusing on tractable parameter intervals rather than to emphasize that the main results in Proposition 1 can change when ω deviates far from zero. Indeed, although many simulations were conducted, no case in which the slope of $e(\omega)$ became positive was found while still ensuring interior solutions. In other words, in simulations where ω was moved far from zero, some of the interior-solution conditions became binding before the sign of the slope changed.

6. Concluding remarks

In this paper, we analyzed a country's FDI promotion campaigns through signaling its labor quality. It has been shown that, for a tractable range of parameters, greater labor quality leads to more intense campaigns. This implies that the intensity of campaign efforts and attracting FDI are positively associated. In addition, a rise in demand in this industry magnifies the campaign efforts.

In our model, the true labor quality is ex-post revealed to the foreign investors. Therefore, whether information is complete or incomplete, neither the number of firms

attracted to a country nor the profits for these firms are affected. The only difference brought about by incomplete information is found in the welfare for the promoting country: incomplete information lowers the welfare due to the cost of advertising expenditures. Nonetheless, these costs are indispensable to prevent foreign investors from underestimating the labor quality of the country.

An extension of this model is found in Sawaki (2015), in which the market size, rather than the labor quality, of a promoting country is supposed to be unknown to foreign investors. The market sizes in the two countries are allowed to be different (α in country a ; β in country b) and the value of α is assumed to be incomplete information. It is shown that the greater the value of α , the more intense are the campaigns in by the IPA of country a . This result resembles that in the current paper, in the sense that countries tend to emphasize their points of excellence. The analysis in this extended version is simpler than that in the current paper, one of the reasons being that a change in $\hat{\alpha}$ (i.e., the beliefs about the market size) has output and locational effects in the same direction in contrast to the effects in the current paper (Lemmas 1 and 2).

The analysis in the current study has several limitations. One of them is that the main focus has been on the case in which the two countries are rather similar with $\omega \approx 0$. Others are that we assumed that the incomplete information is one-sided and the demand and cost structures are linear. A more general analysis that overcomes these limitations might be a useful subject for future research.

Acknowledgement

This work was supported by JSPS KAKENHI Grant Number 18K01571.

Appendix 1 Rationale behind Assumption 1 as well as (3)-(5)

Following Haufler and Wooton (2010), the profits for firms are originally defined as follows:

$$\begin{aligned}\pi_a &= (p'_a - \omega'_a)x_{aa} + (p'_b - \omega'_a - \tau)x_{ba}, \\ \pi_b &= (p'_a - \omega'_b - \tau)x_{ab} + (p'_b - \omega'_b)x_{bb}.\end{aligned}\tag{A.1}$$

In the above expressions, ω'_i is the marginal cost of production for a country- i

firm. In Haufler and Wooton (2010), $\omega'_i \equiv \gamma_i \cdot w$, where γ_i is a labor-input coefficient and thus a reciprocal for the labor productivity in country i , while w is a wage rate, which is equal in the two countries owing to the free-trade condition of the numeraire good. The analysis of the numeraire good is completely omitted in the current paper.

The functional forms in (A.1) are identical to those in (4) in Haufler and Wooton (2010), except that in their paper $\gamma_a = \gamma_b$ and thus $\omega'_a = \omega'_b$. In contrast, our model allows for a difference in labor productivities in countries a and b . In addition, suppose that the intercept of demand is α' rather than α :

$$p'_a = \alpha' - 2(k_a x_{aa} + k_b x_{ab}), \quad p'_b = \alpha' - 2(k_a x_{ba} + k_b x_{bb}).$$

Based on the above setup, we conduct the following transformation of variables to normalize the marginal cost in country b to zero:

$$\alpha \equiv \alpha' - \omega'_b, \quad \omega \equiv \omega'_a - \omega'_b.$$

The profits in (A.1) can then be transformed into those in (3), as well as (4) and (5). This normalization is possible because the demand and cost functions are linear, and reduces the number of variables, thus simplifying the calculations.

In addition, the above transformation implies that $\omega = (\gamma_a - \gamma_b)w$. Therefore, ω indicates how inferior the labor productivity of country a is compared with that of b , leading to part (i) of Assumption 1. In this paper, γ_b is common knowledge while γ_a is incomplete information, resulting in ω being incomplete information.

Appendix 2 Proof of Lemma 2

We take a derivative of $k_a^*(\hat{\omega})$ in (16):

$$\frac{\partial k_a^*(\hat{\omega})}{\partial \hat{\omega}} = \frac{[(\hat{\omega})^2 + \tau^2](\tau + 2\hat{\omega} - 2\alpha) - 2(\tau + \hat{\omega} - 2\alpha)(\hat{\omega})^2}{2[(\hat{\omega})^2 + \tau^2]^2}.$$

The case $\hat{\omega} \approx 0$ is focused on under Assumption 2.

We have $\frac{\partial k_a^*(0)}{\partial \hat{\omega}} = \frac{-(2\alpha - \tau)}{2\tau^2}$, which is negative under Assumption 3. From continuity of the function,¹¹ the above derivative is negative for $\hat{\omega} \approx 0$.

Appendix 3 Proof of Lemma 3

The derivative of $CS(\hat{\omega}, \omega)$ with respect to $\hat{\omega}$ is evaluated at $\hat{\omega} = \omega$ because our concern is the IPA's incentive to manipulate the belief starting from the true state. Thus, k_a^* and k_b^* in (A.2) below are functions of ω rather than $\hat{\omega}$, whose forms are given in (16):

$$\frac{\partial CS(\omega, \omega)}{\partial \hat{\omega}} = \frac{1}{2} \left[\frac{k(\alpha - \tau) + k_a^*(\tau - \omega)}{k+1} \right] \left[\frac{k_a^* k_b^*}{(k+1)(k_a^* + 1)} + \frac{\tau - \omega}{k+1} \cdot \frac{(\omega^2 + \tau^2)(\tau + 2\omega - 2\alpha) - 2(\tau + \omega - 2\alpha)\omega^2}{2(\omega^2 + \tau^2)^2} \right]. \quad (\text{A.2})$$

Assumption 2 is made because it is difficult to determine the sign of the RHS for all intervals of the parameters that ensure interior solutions. Thus, we evaluate (A.2) at $\omega = 0$. Noting that in this case $k_a^* = k_b^* = k/2$,

$$\frac{\partial CS(0, 0)}{\partial \hat{\omega}} = \frac{-k \cdot [\alpha - (\tau/2)]}{4\tau[1 + (k/2)](1+k)^2} \left[(k+1) \left(\alpha - \frac{k}{2} \tau - \tau \right) + (\alpha + k\tau) \right]. \quad (\text{A.3})$$

This is negative under Assumption 3. By continuity of the function, $\partial CS / \partial \hat{\omega} < 0$ for $\omega \approx 0$.

References

- Austen-Smith, David and Jeffrey S. Banks, "Cheap Talk and Burned Money," *Journal of Economic Theory* 91 (2000):1–16.
- Bjorvatn, Kjetil and Carsten Eckel, "Policy Competition for Foreign Direct Investment between Asymmetric Countries," *European Economic Review* 50 (2006):1891-1907.
- Bond, Eric W. and Larry Samuelson, "Tax Holidays as Signals," *American Economic Review* 76(4) (1986):820-26.
- Borck, Rainald and Michael Pflüger, "Agglomeration and Tax Competition," *European Economic Review* 50 (2006):647-668.
- Cassing, James and Ted To, "Antidumping, Signaling and Cheap Talk," *Journal of International Economics* 75 (2008): 373–82.

- Collie, David and Morten Hviid, "Export Subsidies as Signals of Competitiveness," *Scandinavian Journal of Economics* 95 (1993): 327–39.
- Collie, David and Morten Hviid, "Tariffs for a Foreign Monopolist under Incomplete Information," *Journal of International Economics* 37 (1994): 249–64.
- Collie, David and Morten Hviid, "Tariffs as Signals of Uncompetitiveness," *Review of International Economics* 7 (1999): 571–9.
- Fudenberg, Drew and Jean Tirole, *Game Theory*, Cambridge, MA: MIT press (1991).
- Haufler, Andreas and Ian Wooton, "Competition for Firms in an Oligopolistic Industry: The Impact of Economic Integration," *Journal of International Economics* 80 (2010):239-48.
- Harding, Torfinn and Beata S. Javorcik, "Roll Out the Red Carpet and They will Come: Investment Promotion and FDI Inflows," *Economic Journal* 121 (2011):1445-76.
- Katayama, Seiichi and Kaz Miyagiwa, "FDI as a Signal of Quality," *Economics Letters* 103 (2009):127–30.
- Kolev, Dorbin R. and Thomas J. Prusa, "Dumping and Double Crossing: The (In)effectiveness of Cost-Based Trade Policy Under Incomplete Information," *International Economic Review* 43 (2002): 895–918.
- Miyagiwa, Kaz and Yuka Ohno, "Dumping as a Signal of Innovation," *Journal of International Economics* 71 (2007): 221–40.
- Morisset, Jacques and Kelly Andrews-Johnson, *The Effectiveness of Promotion Agencies at Attracting Foreign Direct Investment*, FIAS Occasional Paper 16, Washington DC: Foreign Investment Advisory Service (2004).
- Sawaki, Hisashi, "Advertising a Country to Attract Foreign Investors," *Okayama University Discussion Paper Series I-90* (2015).
- Wells, Louis and Alvin Wint, *Marketing a Country: Promotion as a Tool for Attracting Foreign Investment*, FIAS Occasional Paper 13, Washington DC: Foreign Investment Advisory Service (2000).
- Wright, Donald J., "Strategic Trade Policy and Signalling with Unobservable Costs." *Review of International Economics* 6 (1998): 105–19.

Notes

- 1 <http://www.idaireland.com/>
- 2 A case in which the unknown parameter is the market size of a country is analyzed in Sawaki (2015).
- 3 In Haufler and Wooton (2010), countries a and b have n and $1 - n$ consumers, respectively, and each consumer has an inverse demand of the form $p_i = a - \beta x_i$. In the current paper, n is set to 1/2. In addition, the unit of the good is normalized so that $\beta = 1$ to lessen the burden of calculations.
- 4 This is known as a "no-signaling-what-you-do-not-know" condition, typically assumed in signaling games

(see Fudenberg and Tirole, 1991, p. 332). Without this condition, it is possible that the set of equilibria may expand.

- 5 Because this is a maximization problem for a single firm, it should be noted that $k_a x_{aa}$ in π_{aa} be decomposed into $x_{aa} + (k_a - 1)x_{aa}$ and the derivative taken with respect to the first term.
- 6 Similar calculations, albeit in a different setup, are found for instance in Collie and Hviid (1993, p. 330).
- 7 If information were complete, the profits would become those in (13) with $\hat{\omega}$ replaced by ω . Noting footnote 3 and Assumption 1, and setting $\hat{\omega} = \omega = 0$, it is straightforward to verify that these profits are equivalent to the first terms of (9) in Haufler and Wooton (2010) with $\omega = 0$, $\beta = 1$, and $n = 1/2$.
- 8 Assumption 3 is a necessary, not sufficient, condition for ensuring interior solutions. If $\hat{\omega} = \omega \neq 0$, then tighter conditions are required to ensure $x_{ab}^* > 0$, $x_{ba}^* > 0$. In addition, k_a and k_b , which are to be determined below, must be positive.
- 9 For two interpretations for this treatment, see footnote 11 in Haufler and Wooton (2010, p. 242).
- 10 This type of differential equation is found in many signaling models (e.g., Austen-Smith and Banks, 2000, p. 10).
- 11 The key is that the denominator of $\partial k_a^*(\hat{\omega}) / \partial \hat{\omega}$ neither reaches zero nor switches its sign for any value of $\hat{\omega}$.