

# TOP DOGS, PUPPY DOGS, AND TAX HOLIDAYS

Kaz Miyagiwa and Yuka Ohno\*

## Abstract

Host-country governments often grant temporary tax incentives to lure foreign investment. This paper shows that such transitory preferential tax treatment has the effect of preventing the foreign firm from monopolizing the host-country market. The pro-competitive effect arises because a transitory tax break makes the foreign firm temporarily a “tougher” competitor and induces local firms to delay entry into the market. Removing the threat of immediate competition assures the foreign firm of greater profitability, prompting it to abandon the costly entry-deterring strategy. In contrast, a permanent and uniform tax reduction tends only to strengthen the foreign firm’s incentive to monopolize the host-country market.

**Keywords:** international trade, permanent vs temporary policy, entry deterrence, investment incentives, foreign investment, multinational corporation, tax holiday.

**JEL code:** F1, O3

Contact: Yuka Ohno, Department of Economics, MS-22, Rice University, Houston, TX 77005-1892: phone (713) 348-2354, fax (713) 348-5278, e-mail yuka@rice.edu.

# TOP DOGS, PUPPY DOGS, AND TAX HOLIDAYS

## 1. Introduction

In January 1999, Indonesia enacted the law granting tax incentives for up to twelve years to investors in 22 “pioneer” industries. Similar incentives are offered by developed and developing nations today to attract foreign investments. A typical investment incentive package includes tax holidays, tariff reduction, subsidized labor training costs, and loans (see Bond 1981, Bond and Guisinger 1985, Yuill and Allen, 1981, and Reuber et al., 1973). For example, in Thailand foreign investors receive tax holidays as well as exemption or reduction of import duties of up to ninety percent on imported raw materials and components.

One salient feature of those investment incentives is that they are transitory. This is a puzzle because both the host country government and the foreign recipient should be indifferent between transitory and permanent tax incentives of the equal present value. This paper argues however that there is a fundamental difference between the transitory and permanent tax policies.

Host-country governments often encourage foreign investments as a mean for promoting technology transfer to local industries. However, technology transfer may not occur as expected because foreign firms can take preemptive measures to deter entry by local competitions. We show that in such a circumstance giving a transitory tax break can foil the foreign firm’s anti-competitive strategy and promote entry by a local firm.

We demonstrate the pro-competitive effect of temporary tax incentives by extending the standard model of entry-deterrence (Dixit 1979, 1980, Ware 1984) to an infinite-horizon setting. The model has three steps. The foreign firm moves first by investing in the host country. The local firm observes the foreign firm’s investment and decides whether and when to enter. Upon entry the local firm competes with the foreign firm; until then the

foreign firm is a monopoly. One advantage of this extension is that the timing of entry by the local firm is no longer given as in the standard model but is an endogenous variable.

The analysis begins with the foreign firm deciding whether to deter entry by a local firm after establishing a subsidiary in the host-country market. As explicated by Gelman and Salop (1983), under the threat of entry the foreign firm would rather accommodate small-scale entry than pursue the costly strategy of entry deterrence. Unlike the entrant featured in the Gelman-Salop analysis, however, the local firm cannot commit to small-scale entry, and therefore entry deterrence remains as the foreign firm's best strategy.

It is in such a circumstance that a temporary tax break or a tax holiday can serve as a commitment device for the local entrant. Intuitively speaking, the tax holiday temporarily makes the foreign firm a tougher competitor, inducing the local firm to postpone entry until the tax holiday expires and the foreign firm loses the tax advantage. Delayed entry softens competition and prompts the foreign firm to abandon the costly entry-detering tactic.

In short, the tax holiday is a puppy-dog ploy (Fudenberg and Tirole 1984) that allows the local firm to enter the market dominated by the foreign firm. In contrast, a permanent tax break makes the foreign firm tougher at all times without offering any reason for the local firm to delay entry. Unable to become a puppy, the local firm stands no chance of entry. Thus, permanent and transitory tax incentives have totally different policy implications.

We now relate the present paper to the previous works. Bond and Samuelson (1986) portray the tax holiday as a signal sent by the better-informed government to the less-informed foreign investor within the standard two-period setting with two sender types. In a separating equilibrium, the high-return host country government can afford to offer a large tax break in the first period because in the second period it can collect large tax revenues from foreign investors to make up for first-period revenue losses. This yields a tax

profile in which the tax rate is low in the first period and high in the second. The low-return country cannot offer such a large tax break in the first period because of the meager tax revenues in the second period.

Doyle and van Wijnbergen (1994) offer an alternative explanation based on the theory of sequential bargaining. They note that once the foreign firm has sunk investment, the opportunistic host-country government can exploit the lock-in effect to raise taxes on the investment. The bargaining between the two parties reflects this opportunism, and yields a tax profile in which tax rates increase over time.

Both these models exploit the condition that the host-country government cannot commit to future tax rates, and therefore they apply primarily to those countries whose governments suffer from credibility problems for various reasons. However, there are many countries with no apparent credibility problems that also offer tax holidays. These countries could signal the high returns on investments with an offer of permanent tax breaks that could not be matched by the low-return countries. They could also commit to a uniform tax rate profile when negotiating with the foreign firms. The present model shows why those countries may still want to offer transitory instead of permanent tax breaks.

The following section presents the basic model of entry deterrence in an infinite-horizon setting, where the timing of entry is endogenous. Section 3 shows that permanent tax breaks cannot promote entry by the local firm. Section 4 explains how the tax holiday works to soften the foreign firm's incentive to deter entry. Section 5 concludes.

## **2. An Infinite-Horizon Model of Entry Deterrence**

This section extends the standard model of entry deterrence, developed by Dixit (1979, 1980) and extended by Ware (1984), to an infinite-horizon setting, where the entry date is endogenous. Time flows continuously:  $t \in [0, \infty)$ . Two firms, the foreign firm and

the local firm, compete in the domestic market. The foreign firm is an incumbent and the local firm is a potential entrant. The domestic market demand and the firms' cost functions are stationary over time. The timing of the game is as follows.

At time  $- \varepsilon$  ( $\varepsilon > 0$  and arbitrarily small), the foreign firm establishes a subsidiary in the host-country market by choosing a level of investment  $K$ . The one-time cost of investment is  $C(K)$ , with  $C'(K) > 0$  and  $C''(K) \geq 0$  (where primes indicate differentiation). The local firm observes  $K$  and acquires the necessary information to enter the market, such as production and management technologies and the strength of market demand. The local entrant completes information acquisition by  $t = 0$  and is prepared to enter the market. If it decides to enter at a time  $t \geq 0$ , it must sink own investment  $k$ , which costs  $c(k)$ , with  $c'(k) > 0$  and  $c''(k) \geq 0$ . Then the two firms compete by choosing a second strategic variable (outputs or prices) at each subsequent moment. Until entry occurs, the foreign firm is a monopoly.

In the present analysis investments are assumed sunk ex post, and therefore represent a broad class of strategic variables having commitment value, such as technology, product quality, firm location, clientele size, supplier networks, as extensively surveyed by Tirole (1988) and Shapiro (1989). The key assumption is that investment has a large enough fixed-cost component, that is,  $C(0)$  is sufficiently large that it is unprofitable for the foreign firm to invest incrementally over time.<sup>1</sup>

The present model can be solved backwards in three steps. We first solve the subgames that start when the local firm enters; we then solve the local firm's entry and investment strategy, and finally derive the foreign firm's investment decision.

---

<sup>1</sup> For example, once railroads or highways have been constructed, increasing the number of tracks or lanes later is extremely costly.

In analyzing a subgame starting with entry by the local firm, we focus on the Markov-perfect equilibrium. Since, given the stationary environment of the model, the firm's flow profits do not depend on time explicitly, the Markov-perfect equilibrium is a pair of prices or outputs that depend only on the levels of initial investments and the prevailing tax rates. Thus we write the foreign firm's and the local firm's equilibrium flow profit as  $\Pi(K, k, S)$  and  $\pi(K, k, S)$ , respectively. (Upper-case letters denote variables pertaining to the foreign firm; lower-case letters distinguish the local firm.)

In the flow profit functions,  $S$  stands for the rate of tax reduction or subsidy in effect at the time under consideration. That is,  $S > 0$  implies preferential tax treatment offered to the foreign firm while  $S = 0$  means that the two firms are taxed at the same rate. (We use the terms 'tax reduction' and 'subsidy' interchangeably.)

The subsidy rate  $S$  is an argument in the local firm's profit function because the subsidy lowers the foreign firm's production cost and therefore affects the post-entry subgame equilibrium. Assumption 1 summarizes the effect of a subsidy on equilibrium flow profits (subscripts denote partial differentiation).

**Assumption 1:**

$$(A) \quad \pi_S(K, k, S) < 0, \Pi_S(K, k, S) > 0,$$

$$(B) \quad \pi_{kS}(K, k, S) < 0, \Pi_{KS}(K, k, S) > 0, \Pi_{kS}(K, k, S) < 0.$$

Assumption 1A says that the subsidy shifts profits from the local firm to the foreign firm. This profit-shifting property is familiar from the strategic trade policy literature pioneered by Brander and Spencer (1985), and holds in the Cournot and the differentiated-goods Bertrand duopoly models (Eaton and Grossman 1986). The next two inequalities say that a subsidy makes investment more effective for the foreign firm and less so for the local firm. The final inequality says that the subsidy is more valuable to the foreign firm when the

entrant's production is less efficient so that the foreign firm has a larger market share. These properties are satisfied by many standard duopoly models and are often assumed in the literature investigating similar issues; see e.g., Besley and Suzumura (1992) and McAfee and Schwartz (1994).<sup>2</sup>

The profit functions also satisfy the following standard properties:

**Assumption 2:**

$$\pi_k(K, k, S) > 0, \pi_K(K, k, S) < 0,$$

$$\Pi_K(K, k, S) > 0, \Pi_k(K, k, S) < 0,$$

or investment raises each firm's own profitability while hurting the rival's.

Having described the post-entry subgames, we turn to the second step: analysis of the local firm's investment and entry strategy. For the remainder of this section we assume that the subsidy  $S$  is granted permanently. Then, by letting  $S = 0$  we obtain the benchmark case of no preferential tax treatment for the foreign firm.

If the local firm enters at a time  $t \geq 0$ , its total profit can be written as:

$$(1) \quad \int_t^{\infty} e^{-rz} \pi(K, k, S) dz - e^{-rt} c(k) = e^{-rt} [\pi(K, k, S)/r - c(k)],$$

where  $r$  is the instantaneous interest rate. The local firm's optimal level of investment solves the first-order condition

---

<sup>2</sup> For example, suppose that the two firms play a quantity-setting game under linear demand  $p = a - X$  (industry output), and that  $M(K)$  and  $m(k)$  are marginal costs of production that decrease in own investment. If the subsidy lowers the foreign firm's marginal cost by  $S$ , then,  $\Pi(K, k, S) = \{a - 2[M(K) - S] + m(k)\}^2/9$  and  $\pi(K, k, S) = \{a - 2m(k) + [M(K) - S]\}^2/9$ . These profit functions satisfy Assumptions 1 and 2.

$$\pi_k(K, k, S)/r - c'(k) = 0,$$

and is denoted by  $\hat{k}(K, S)$ . Notice that the optimal investment level depends on  $K$  and  $S$  but not on the date of entry. The local firm's maximum current-value profit is given by:

$$v(K, S) \equiv \pi[K, \hat{k}(K, S), S]/r - c[\hat{k}(K, S)].$$

Since  $v_K(K, S) = \pi_K < 0$ , we can state the local firm's strategy as follows: if the foreign firm's investment  $K$  is low enough so that  $v(K, S) > 0$ , the local firm invests  $\hat{k}(K, S)$  and enters at time zero; if  $K$  is high or  $v(K, S) \leq 0$ , it stays out at all times.<sup>3</sup>

Given the local firm's best-response strategy, we turn to characterizing the foreign firm's investment strategy. Acting as the Stackelberg leader in the investment game, the foreign firm must decide whether to accommodate or deter entry by the local firm. Consider the accommodation strategy first. Since it anticipates that the local firm enters at  $t = 0$  by investing  $\hat{k}(K, S)$ , the foreign firm's flow profit is constant over time at  $\Pi[K, \hat{k}(K, S), S]$ .

Therefore, the foreign firm chooses  $K$  to maximize its total profit:

$$(2) \quad \int_0^{\infty} e^{-rz} \Pi[K, \hat{k}(K, S), S] dz - C(K) = \Pi[K, \hat{k}(K, S), S]/r - C(K).$$

Let  $K^a(S)$  denote the level of investment that maximizes (2) (superscript 'a' stands for accommodation). Then, the foreign firm's maximum total profit from accommodation is:

$$V^a(S) \equiv \Pi\{K^a(S), \hat{k}[K^a(S), S], S\}/r - C[K^a(S)].$$

Consider next the case of entry deterrence. The foreign firm earns the flow monopoly profit  $\Pi(K, 0, S) \equiv M(K, S)$ , so its total profit will equal:

$$(3) \quad \int_0^{\infty} e^{-rz} M(K, S) dz - C(K) = M(K, S)/r - C(K).$$

---

<sup>3</sup> We employ the tie-breaking rule that the local firm stays out if the discounted sum of profits is zero.

Let  $K^m(S)$  be the level of investment that maximizes (3). Depending on the parameter values, it may be unprofitable for the local firm to enter when the foreign firm invests  $K^m(S)$ ; that is,  $v[K^m(S), S] \leq 0$ . This is the case of blockaded entry, and we have nothing much more to say.

More interesting is the case in which  $v[K^m(S), S] > 0$  so the foreign firm must invest more than  $K^m(S)$  to deter entry. Let  $\bar{K}(S)$  denote the minimum level of investment that deters entry; that is,  $\bar{K}(S)$  solves  $v(K, S) = 0$ .<sup>4</sup> Then, the foreign firm's total profit from deterring entry is written as  $M[\bar{K}(S), S]/r - C[\bar{K}(S)]$ .<sup>5</sup>

Now, let  $\Omega(S)$  be the difference in the foreign firm's total profit between deterrence and accommodation, that is:

$$(4) \quad \Omega(S) \equiv \{M[\bar{K}(S), S]/r - C[\bar{K}(S)]\} - V^a(S).$$

Then the foreign firm deters entry if and only if  $\Omega(S) > 0$ .

This completes the description of the model when the subsidy rate remains constant for all  $t \in [0, \infty)$ . Setting  $S = 0$  in the above model corresponds to the benchmark case in which the foreign firm receives no tax reduction. It is assumed that in the benchmark case the foreign firm prefers to deter entry. This is stated as:

**Condition 1:** In the absence of tax reduction ( $S = 0$ ) the foreign firm deters entry; that is,  $\Omega(0) > 0$ .

Condition 1 is illustrated in Figure 1. In Panel A, the two solid concave curves represent the foreign firm's total profits as a function of  $K$ . The graph corresponding to the

---

<sup>4</sup>  $\bar{K}(S)$  is decreasing in  $S$ .

<sup>5</sup> The foreign firm does not invest  $K > \bar{K}(S)$  to deter entry because (3) is decreasing in  $K$  at  $\bar{K}(S) > K^m(S)$ .

monopoly profit  $M(K, 0)/r - C(K)$  naturally lies everywhere above that representing the duopoly profit  $\Pi(K, \hat{k}, 0)/r - C(K)$ . As is stated in Condition 1, the foreign firm receives a greater profit from investing  $\bar{K}(0)$  and deterring entry (point d) than from investing  $K^a$  and accommodating entry (point a). Panel B depicts the local firm's maximum current-value profit  $v(K, 0)$ . Observe that  $v[K^m(0)] > 0$  and  $\bar{K}(0) > K^m(0)$  so that entry deterrence is costly to the foreign firm.

### 3. Permanent Tax Reduction

Given that the foreign firm has the incentive to deter entry in the absence of tax breaks (Condition 1), this section examines whether giving the foreign firm a permanent tax break can help the domestic firm enter the market. The answer is in the negative under reasonable assumptions.

Note first that a small permanent subsidy has no effect on promoting entry. This is evident from Figure 1. To be effective, a subsidy must be large enough to make accommodation as profitable as entry deterrence without the subsidy (i.e., a subsidy must raise profit from accommodation above the horizontal dotted line going through point d in Panel A). However, since it also raises the monopoly profit, high enough subsidy rates can lead to blockaded entry. This follows because  $K^m(S)$  or the entry-blockading investment is increasing in  $S$  while  $\bar{K}(S)$  or the minimum investment for deterrence is decreasing, so at  $S$  large enough  $K^m(S)$  can exceed  $\bar{K}(S)$ , resulting in blockaded entry.

Thus, there may not be permanent subsidy rates that can induce entry accommodation. Even if there are, to be effective a subsidy must make entry accommodation relatively more attractive to the foreign firm than entry deterrence; that is, we must have  $\Omega'(S) < 0$ .

To check that possibility, we differentiate (4) to obtain:

$$(5) \quad \Omega'(S) = \{M_K[\bar{K}(S), S]/r - C'[\bar{K}(S)]\}\bar{K}'(S) \\ + (1/r)\{M_S[\bar{K}(S), S] - \Pi_S[K^a(S), \hat{k}, S] - \Pi_K[K^a(S), \hat{k}, S]\hat{k}_S\}.$$

In (5), the first term on the right hand side is positive because it is the product of two negative terms;  $(M_K/r - C') < 0$  at  $\bar{K}(S) > K^m(S)$ , and  $\bar{K}'(S) = -v_S/v_K < 0$  since both  $v_S$  and  $v_K$  are negative. Within the second term, the difference  $M_S - \Pi_S$  is positive by Assumption 1 and the fact that  $\bar{K}(S) > K^a(S)$ , but  $\Pi_K \hat{k}_S$ , being the product of two negative terms, is also positive. Thus, the second term can be negative. However, that possibility is ruled out under

**Assumption 3:** Given  $K$ , a permanent subsidy raises the monopoly profit by a greater amount than it does the duopoly profit, that is,

$$(6) \quad M_S(K, S) - \Pi_S(K, \hat{k}, S) - \Pi_K(K, \hat{k}, S)\hat{k}_S > 0.$$

By Assumption 1B, the difference between the first two terms in (6) is positive; that is, a subsidy is more effective to the foreign firm when the entrant is less efficient (or non-existent). Assumption 3 says that the same result holds even if the entrant is allowed to adjust its investment optimally.

Setting  $K = K^a(S)$  in (6) and using the fact that  $M_S[K^a(S), S] < M_S[\bar{K}(S), S]$  by Assumption 1B ensures that the second term of the right-hand side of (5) is positive, and hence  $\Omega'(S)$  is positive. The result is presented as

**Proposition 1:** Under Assumptions 1 - 3 and Condition 1, the foreign firm deters entry by the local firm under a permanent and uniform tax reduction.

The intuition behind Proposition 1 is easily understood. Under Assumption 3, at given  $K$  the foreign firm stands to gain from a permanent subsidy more if it is a monopoly than if it

is a duopoly [the second term on the left-hand side of (5)]. Furthermore, now a more formidable competitor under a permanent subsidy, the foreign firm can deter entry by investing less so its profit increases even more [the first term on the left-hand side of (5)]. Thus, if it prefers deterring entry in the absence of a subsidy, the foreign firm has all the more incentive to do so under a permanent subsidy.

### 3. Tax Holidays.

Suppose now that the host-country government grants a temporary tax break to the foreign firm. Let  $S$  be positive during the time interval  $[0, T]$  and zero after  $T$ . We begin by considering the local firm's investment and entry strategies. Take  $K$  as given.

We first show that the local firm never enters at  $t > T$ . That is because the local firm's total profit from entry at  $t > T$  is given by

$$(1') \quad e^{-rt}[\pi(K, k, 0)/r - c(k)]. \quad (t > T)$$

This is the same as (1) with  $S = 0$  and is decreasing in  $t$ , provided that  $v(K, 0) > 0$ , or equivalently  $K < \bar{K}(0)$ . The local firm's optimal strategy when  $K < \bar{K}(0)$ , therefore is to enter as soon as possible or at  $t \leq T$ .

Thus, focus on the case in which entry occurs at a time  $t \leq T$ . In this case the local firm's flow profit is  $\pi(K, k, S)$  between  $t$  and  $T$  and  $\pi(K, k, 0)$  afterwards so its total profit is given by:

$$(7) \quad \int_t^T e^{-r\tau} \pi(K, k, S) d\tau + \int_T^{\infty} e^{-r\tau} \pi(K, k, 0) d\tau - e^{-rt} c(k) \\ = (e^{-rt} - e^{-rT})[\pi(K, k, S)/r - c(k)] + e^{-rT}[\pi(K, k, 0)/r - c(k)].$$

Since for any  $k$ ,  $\pi(K, k, 0)/r - c(k) > \pi(K, k, S)/r - c(k)$  by Assumption 1, (7) says that entry occurs if and only if  $\pi(K, k, 0)/r - c(k) > 0$ . Furthermore, the second term in (7) is independent of the date of entry,  $t$ . Therefore, for given  $K, k$ , and  $T$ , (7) reaches its maximum

at  $t = 0$  if  $\pi(K, k, S)/r - c(k) > 0$ , and at  $t = T$  if  $\pi(K, k, S)/r - c(k) < 0$ . Thus, the local firm has the following entry strategy:

- (i) if  $\pi(K, k, 0)/r - c(k) > \pi(K, k, S)/r - c(k) > 0$ , enter at  $t = 0$
- (ii) if  $\pi(K, k, 0)/r - c(k) > 0 \geq \pi(K, k, S)/r - c(k)$ , enter at  $t = T$
- (iii) if  $0 \geq \pi(K, k, 0)/r - c(k) > \pi(K, k, S)/r - c(k)$ , do not enter at any  $t \in [0, \infty)$

Entering at  $t = T$ , the local firm invests  $\hat{k}(K, 0) \equiv \operatorname{argmax} [\pi(K, k, 0)/r - c(k)]$ , while entering at  $t = 0$  it invests

$$\begin{aligned} \tilde{k}(K, S, T) \\ \equiv \operatorname{argmax} \{ (1 - e^{-rT})[\pi(K, k, S)/r - c(k)] + e^{-rT}[\pi(K, k, 0)/r - c(k)] \}. \end{aligned}$$

It is straightforward to show that

$$(8) \quad \partial \tilde{k}(K, S, T) / \partial S < 0, \text{ and } \partial \tilde{k}(K, S, T) / \partial T < 0.$$

That is, when entering at  $t = 0$ , the local firm invests less when the subsidy rate is higher, or the tax holiday is longer. It follows that the level of investment is smaller when there is entry at  $t = 0$  than at  $t = T$ , or  $\tilde{k}(K, S, T) < \hat{k}(K, 0)$ . This is because investment at  $t = 0$  is not as profitable as at  $t = T$  because of the lower flow profit under the tax holiday.

We summarize the result we obtained so far in

**Proposition 2:** If entry is accommodated under the tax holiday, the local firm enters either

- (i) at  $t = 0$  with the investment  $\tilde{k}(K, S, T)$  or
- (ii) at  $t = T$  with the investment  $\hat{k}(K, 0) > \tilde{k}(K, S, T)$ .

Proposition 2 shows how the tax holiday works as a puppy-dog ploy for the local firm. The tax holiday forces the local firm to enter at  $t = 0$  with a low and inoffensive level of investment or enables it credibly to delay entry till  $T$ . The remaining question then is whether the foreign firm will fall for such a ploy.

When the foreign firm invests less than  $\bar{K}(0)$  the local firm surely can enter at  $t = T$  when the tax holiday expires. Therefore, to deter entry the foreign firm must invest  $\bar{K}(0)$ , i.e. as much as it does in the absence of any subsidy. Thus, the foreign firm's total profit from entry deterrence is:

$$D(T) \equiv (1 - e^{-rT})M[\bar{K}(0); S]/r + e^{-rT}M[\bar{K}(0), 0]/r - C[\bar{K}(0)].$$

We compare this profit with that from entry accommodation. The next lemma facilitates the comparison.

**Lemma 1:** If the foreign firm invests at a level sufficiently close to (but strictly less than)  $\bar{K}(0)$ , the local firm enters at  $T$ .

Lemma 1 is based on a continuity argument. Any investment  $K$  less than  $\bar{K}(0)$  induces entry, but for  $K$  sufficiently close to  $\bar{K}$  entry occurs at  $T$ , not at  $t = 0$ . This seems intuitive enough so we relegate its proof to the appendix and proceed directly to our main result.

**Proposition 3:** Under Assumptions 1 and 2 and Condition 1, there is  $T = \tilde{T}$  such that, if the tax holiday is longer than  $\tilde{T}$ , the foreign firm accommodates entry.

*Proof:* Let the foreign firm invest  $K^*$ , an amount close enough to but strictly less than  $\bar{K}(0)$ . Then the local firm enters at time  $T$  by Lemma 1. Therefore, the foreign firm earns the flow profit  $M(K^*, S)$  during the tax holiday and  $\Pi(K^*, 0)$  afterwards, realizing total firm value:

$$A(T) \equiv (1 - e^{-rT})M(K^*, S)/r + e^{-rT}\Pi(K^*, 0)/r - C(K^*)$$

Given  $K^*$ , the foreign firm accommodates entry if

$$\begin{aligned} \Psi(T) &\equiv D(T) - A(T) \\ &= \{(1 - e^{-rT})M[\bar{K}(0); S]/r + e^{-rT}M[\bar{K}(0), 0]/r - C[\bar{K}(0)]\} \end{aligned}$$

$$- \{(1 - e^{-rT})M(K^*, S)/r + e^{-rT}\Pi(K^*, 0)/r - C(K^*)\}$$

is negative. Since  $K^*$  is sufficiently close to but less than  $\bar{K}(0)$ , by Condition 1

$$\Psi(0) = \{M[\bar{K}(0); 0]/r - C[\bar{K}(0)]\} - \{\Pi(K^*, 0)/r - C(K^*)\} > 0.$$

Since the monopoly profit  $M(K, S)/r - C(K)$  is decreasing in  $K$  around  $\bar{K}(0)$ ,  $K^* < \bar{K}(0)$  implies that

$$\Psi(\infty) = \{M[\bar{K}(0); S]/r - C[\bar{K}(0)]\} - \{M(K^*, S)/r - C(K^*)\} < 0.$$

Furthermore,

$$\Psi'(T) = -e^{-rT}\{M(K^*, S) - \Pi(K^*, 0) - M[\bar{K}(0); S] + M[\bar{K}(0), 0]\}.$$

With  $K^*$  sufficiently close to but strictly less than  $\bar{K}(0)$ ,  $M(K^*, S) - M[\bar{K}(0); S]$  is arbitrarily small while the remaining terms  $M[\bar{K}(0), 0] - \Pi(K^*, 0)$  is clearly positive. Hence,  $\Psi'(T)$  is negative.

Given continuity of  $\Psi(T)$ , therefore, there exists  $\tilde{T}$  such that  $\Psi(\tilde{T}) = 0$  and for any  $T > \tilde{T}$  we have  $\Psi(T) = D(T) - A(T) < 0$ , meaning that the foreign firm accommodates entry by the local firm. Of course,  $K^*$  need not be the foreign firm's optimal investment for given  $T$ . If the foreign firm chooses another level of investment, however it must do so because it can make even a greater profit from that. Thus, the foreign firm accommodates entry for  $T > \tilde{T}$  when it invests optimally.  $\square$

Proposition 3 has the following explanation. To the extent that entry deterrence is costly, the foreign firm prefers accommodation to entry deterrence to the extent that entry is not too aggressive, which in the present context means entry at a later date or with a lower level of investment. However, in the absence of the tax holiday, the local firm cannot make such a commitment credible because, once the foreign firm has sunk its investment, the local firm has the incentive to enter as soon as possible (at  $t = 0$ ) with the investment  $\hat{k}(K, 0)$ .

Anticipating this kind of aggressive response from the local entrant, the foreign firm has no desire to accommodate entry.

In such a case, granting the tax holiday changes the local entrant's optimal strategy. The expectation of lower flow profits during the tax holiday induces the local firm to postpone entry until the tax holiday expires or enter at  $t = 0$  with a low and inoffensive level of investment. Either way, the tax holiday allows the local firm to commit to the inoffensive strategy, thereby raising profits for the foreign firm and tempting it to accommodate entry. On the other hand, since deterrence requires as much investment as in the absence of subsidy [i.e.,  $\bar{K}(0)$ ], the cost of entry deterrence remains unchanged under the tax holiday. Thus, the tax holiday makes accommodation more profitable to the foreign firm than entry deterrence.

In short, the tax holiday is a puppy-dog ploy that tempts the foreign firm to accommodate entry by the local firm. Interestingly enough, both the foreign and the local firm are better off under the tax holiday.

#### **4. Concluding Remarks**

This paper developed a model of entry deterrence with an endogenous date of entry and utilized it to explain how the tax holiday can help the local firm enter the market that would otherwise be dominated by the foreign multinational firm. The tax holiday makes the foreign firm temporarily a tougher competitor and forces the local firm to delay entry or enter with less investment. To the extent that deterrence is costly, the foreign firm has the incentive to accommodate such small-scale entry even though it deters full-sale entry by the local firm. Thus, the tax holiday serves as a puppy-dog ploy for the local firm. The pro-competitive effect is absent under permanent tax reduction because the local firm has no incentive to delay entry or enter inoffensively under it.

The model of entry deterrence and its policy implications developed here have much application beyond the specific issue of international economics analyzed here. For example, Ohno (2001) utilizes the similar structure to show that there can be more competition with patents than without. There, finite-length patents obviate the need for the innovator to deter entry by forcing competitors to postpone entry, and end up promoting competition. Thus, patents work like the tax holiday here.

### Appendix

**Proof of Lemma 1:** Suppose that the foreign firm invests  $K^* < \bar{K}(0)$  where  $K^*$  is close to  $\bar{K}(0)$ . If it enters at  $t = 0$ , the local firm invests  $\tilde{k}^* \equiv \tilde{k}(K^*, S, T)$  and makes the profit

$$(A1) \quad (1 - e^{-rT})\pi(K^*, \tilde{k}^*, S)/r + e^{-rT}\pi(K^*, \tilde{k}^*, 0)/r - c(\tilde{k}^*).$$

This profit can be written as

$$\begin{aligned} & (1 - e^{-rT})[\pi(K^*, \tilde{k}^*, S)/r - c(\tilde{k}^*)] + e^{-rT}[\pi(K^*, \tilde{k}^*, 0)/r - c(\tilde{k}^*)] \\ & < \pi(K^*, \tilde{k}^*, 0)/r - c(\tilde{k}^*) \\ & < \pi[K^*, \hat{k}(K^*, 0), 0]/r - c[\hat{k}(K^*, 0)] \equiv v(K^*, 0). \end{aligned}$$

where the first inequality follows from Assumption 1 while the second holds because

$$\hat{k}(K^*, 0) \equiv \operatorname{argmax} \{ \pi(K^*, k, 0)/r - c(k) \}.$$

Now, let  $K^* \rightarrow \bar{K}(0)$  and observe that  $v(K^*, 0) \rightarrow v[\bar{K}(0), 0] = 0$  by the definition of  $\bar{K}(0)$ .

Therefore, for  $K^*$  sufficiently close to  $\bar{K}(0)$  the expression (A1) is negative, or entering at  $t = 0$  is unprofitable for the local firm. Hence, the local firm enters at  $t = T$ . □

### References

- Besley, Timothy and Kotaro Suzumura, 1992, Taxation and welfare in an oligopoly with strategic commitment, *International Economic Review* 33, 413-432.
- Bond, E.W., 1981, Tax holidays and industry behavior, *Review of Economics and Statistics* 63, 88-95
- Bond, E.W., and S. Guisinger, 1985, Investment incentives as tariff substitutes: a comprehensive measure of protection, *Review of Economics and Statistics* 67, 91-97.
- Bond, E.W., and L. Samuelson, 1986, Tax holidays as signals, *American Economic Review* 76, 820-826.
- Brander, J. A., and B. J. Spencer, 1985, Export subsidies and market share rivalry, *Journal of International Economics* 18, 83-100.
- Dixit, A., 1979, A model of duopoly suggesting a theory of entry barriers, *Bell Journal of Economics* 10, 20-32
- Dixit, A., 1980, The role of investment in entry deterrence, *Economic Journal* 90, 95-106.
- Doyle, C. and W. van Wijnbergen, 1994, Taxation of foreign multinationals: a sequential bargaining approach to tax holidays, *International Tax and Public Finance*, 1, no. 3 December, 211-225
- Eaton, J. and G. M. Grossman, 1986, Optimal trade and industrial policy under oligopoly, *Quarterly Journal of Economics* 101, 383-406.
- Fudenberg, D. and Jean Tirole, 1984, The fat-cat effect, the puppy-dog ploy, and the lean and hungry look, *American Economic Review* 74, 361-66.
- Gelman, J.R., and S. Salop, 1983, Judo economics: capacity limitation and coupon competition, *Bell Journal of Economics* 14, 315-325.

- McAfee, R. P., and M. Schwartz, 1994, Opportunism in multinational vertical contracting: nondiscrimination, exclusivity, and uniformity, *American Economic Review* 84, 210-230.
- Ohno, Y., 2001, Patent as a puppy-dog ploy, mimeo.
- Reuber, G. L., et. al., 1973, *Private Foreign Investment in Development*, (Clarendon Press, Oxford).
- Shapiro, C., 1989, Theory of oligopoly behavior; chapter 6, in R. Schmalensee and R. D. Willig, eds., *Handbook of Industrial Organization*, vol. 1 (North-Holland; Amsterdam).
- Tirole, J., 1988, *The Theory of Industrial Organization*, MIT Press, Cambridge.
- Ware, R., 1984, Sunk costs and strategic commitment: a proposed three-stage equilibrium, *Economic Journal* 94, 370-378.
- Yuill, Douglas and K. Allen, 1981, *European regional incentive programs 1981*, Glasgow: University of Strathlyde.

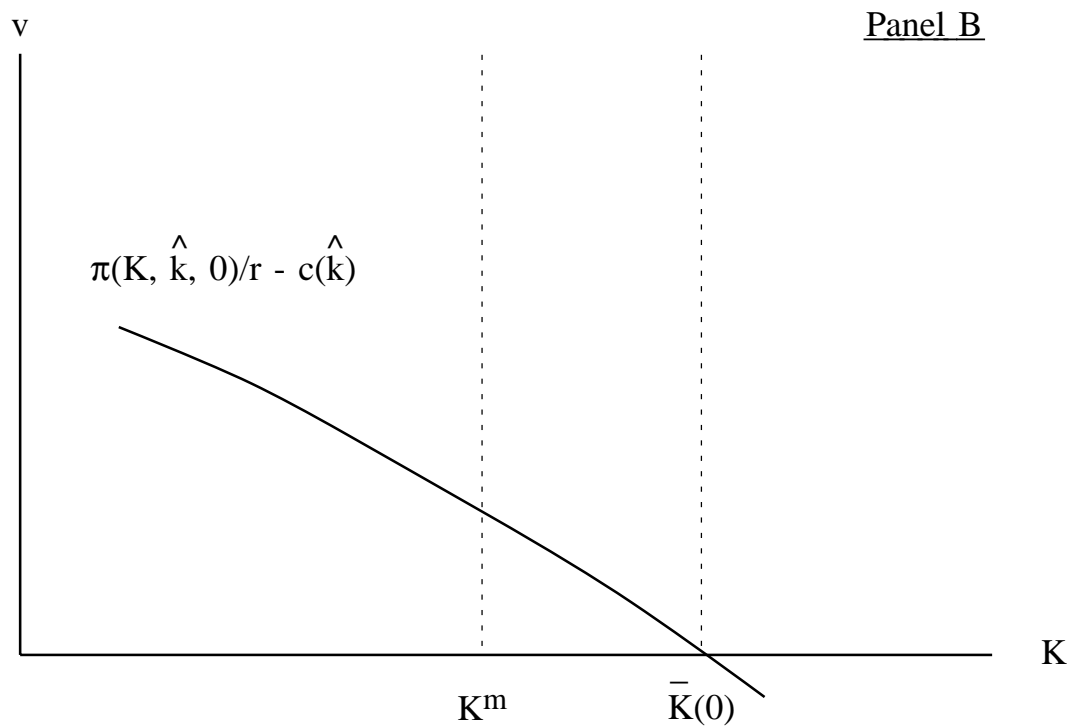
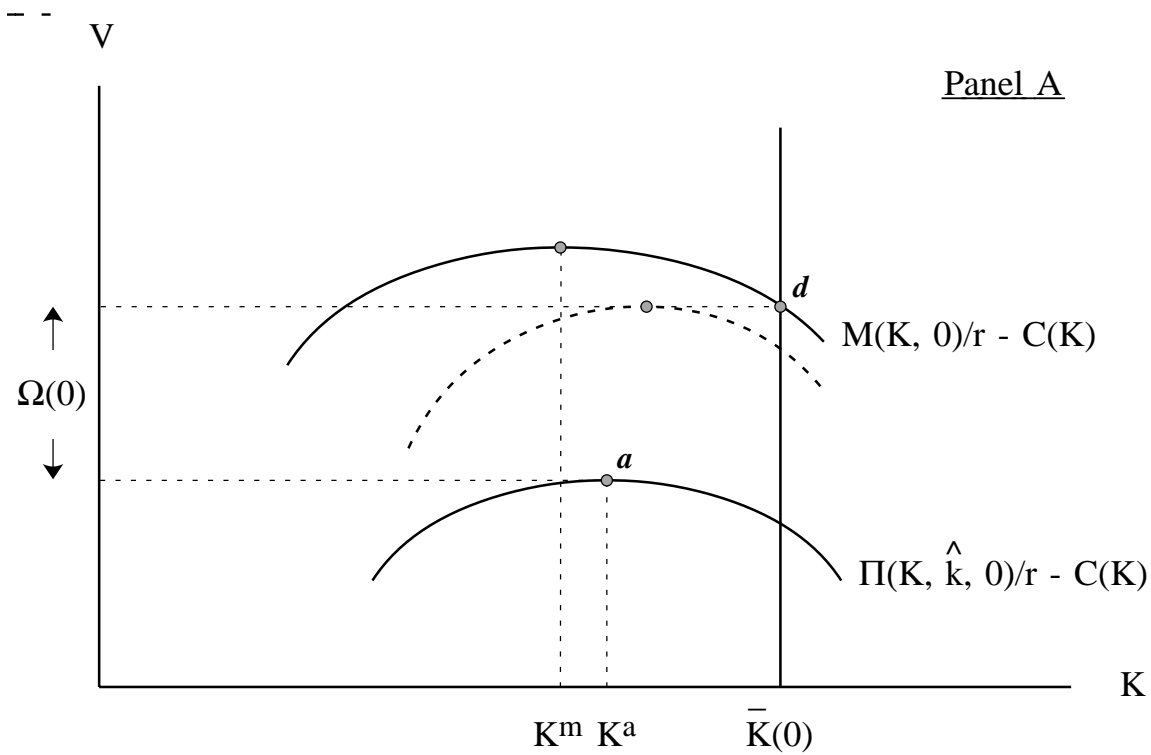


Figure 1