TOP DOGS, PUPPY DOGS, AND TAX HOLIDAYS

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Abstract

Why do host-country governments offer tax holidays to foreign multinational firms that establish local subsidiaries? This paper shows that a tax holiday has the effect of preventing the foreign firm from monopolizing the local market. This pro-competitive effect stems paradoxically because a tax holiday makes the multinational firm temporarily a "tougher" competitor and induces local firms to delay entry into the market. Removing the threat of imminent rivalry assures the multinational firm of greater profitability and prompts 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: Tax holiday, commitment, entry deterrence, puppy-dog ploy, foreign direct investment, multinational corporation, temporary protection vs permanent protection, international trade,

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1. Introduction

In January 1999, Indonesia enacted the law granting tax holidays of up to twelve years to investors in 22 "pioneer" industries. Similar investment incentives are frequently offered today by developed and developing nations to attract foreign investments. A typical investment incentive package includes tax holidays, tariff reduction, subsidized labor training costs, and loans (Bond 1981, Bond and Guisinger 1985, Yuill and Allen, 1981, and Reuber et al. 1973). For example, in Thailand foreign investors are accorded 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 these investment incentives is that they are offered only for a limited period. Why they are given this way instead of as uniform and permanent rate reduction of equal value to investors is a puzzle that has attracted attention from economists. We conduct a positive analysis to explain this puzzle in the light of the theory of entry deterrence. Do temporary tax reduction have qualitatively different policy implications from a permanent tax reduction?

Host-country governments often encourage foreign investments as a means for promoting technology transfer to local industries. However, diffusion of technology may not occur as expected because foreign multinational firms can take preemptive measures to suppress local competition. We show that in such circumstances the tax holiday can foil the foreign firm's anti-competitive strategy and promote entry by the local competitor. Interestingly enough, the tax holiday benefits both the foreign firm and the domestic entrant.

We demonstrate this effect of the tax holiday in the model that extends the standard model of entry-deterrence (Dixit 1979, 1980, Ware 1984) to an infinite-horizon setting. The model proceeds in 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. When it enters, the two firms compete as duopolists. One advantage of the present model 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 making an entry-deterring investment when establishing the subsidiary in the host country. As explicated by Gelman and Salop (1983), the foreign firm under the threat of entry would prefer accommodating small-scale entry to deterrence as long as deterrence is costly. However, in contrast to the entrant featured in the Gelman-Salop analysis, the local firm in this paper lacks the means for committing to small-scale entry. In the absence of commitment the foreign firm's optimal strategy is to deter entry.

It is in such circumstances that 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 and induces the local firm to postpone entry. The prospect of delayed entry softens competition, prompting the foreign firm to abandon the costly entry-deterring 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, the tax break accorded on a permanent basis makes the foreign firm tougher at all times, and offers no reason for the local firm to delay entry. Unable to become a puppy, the local firm stands no chance of entry.

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 offers large tax breaks in the first period because it can make up the first-period losses amply with its second-period tax revenues. This yields the 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 large tax breaks 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 on the part of the host-country government, and yields in an equilibrium the tax profile in which the 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, many countries with no apparent credibility problems 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 multinational firms. The present model shows why those countries may still want to offer tax holidays instead of permanent tax breaks, and therefore complements the previous works explaining the prevalence of tax holidays and other temporary investment incentives.

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 shows 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 from zero. Two firms, the foreign multinational firm and the local firm, compete in the domestic market. The domestic market demand and the firms' cost functions are stationary over time. The timing of the game is as follows.

At time zero the foreign firm establishes a subsidiary in the host country by choosing a level K of investment. The one-time cost of investment is denoted by C(K), with $C'(K) > 0$ and $C''(K) \geq 0$ (where primes indicate differentiation). The local firm observes the level of investment by the foreign firm and decides whether and when to enter. When it enters, the local firm sinks own investment k, which costs c(k), with c'(k) > 0 and c"(k) ≥ 0. The two firms then compete at each subsequent moment by choosing a second strategic variable (outputs or prices). 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, etc., as extensively surveyed by Tirole (1988) and Shapiro (1989).

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.

In analyzing a subgame starting with entry by the local firm, we focus on the Markov-perfect equilibrium. This solution concept limits the strategy spaces to the payoff-relevant variables and therefore rules out essentially all types of implicit collusion that arise in repeated games. In our setting, that amounts to saying that the two firms choose prices or outputs simultaneously to maximize respective profits at each moment following entry by the local firm. Since, given the stationary environment of the model, the firm's momentary or 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.[1]

In those flow profit functions, S stands for the rate of tax reduction or subsidy offered to the foreign firm by the host-country government. That is, S > 0 implies preferential tax treatment

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[1] See footnote 5 for an example.

offered to the foreign firm whereas S = 0 means that the two firms pay taxes at the same standard rates. (We use the terms 'tax reduction' and 'subsidy' interchangeably.)

The subsidy rate S appears as an argument in the local firm's profit function as well because the subsidy is assumed to affect the equilibrium of the simultaneous-move game played at each moment in the post-entry subgame. Assumption 1 indicates more precisely the effect of a subsidy on each firm's equilibrium flow profit (subscripts denote partial differentiation).

Assumption 1: (A) $\pi_S(K, k, S) < 0, \Pi_S(K, k, S) > 0,$

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

The first two inequalities in Assumption 1 indicate that subsidies shift profits from the local firm to the foreign firm. This profit-shifting property of subsidies is familiar from the strategic trade policy literature pioneered by Brander and Spencer (1985), and holds in the Cournot and the (differentiated-goods) Bertrand models (Eaton and Grossman 1986). The next two inequalities say that a subsidy makes investment more effective for the foreign firm and less efficient for the local firm. The final inequality says that the subsidy is more effective to the foreign firm when the entrant's production is less efficient. These properties are satisfied by many standard duopoly models, and is often assumed in the literature investigating similar issues (for example, see McAfee and Schwartz 1994).

The profit functions also satisfy the following standard properties:

Assumption 2 $\pi_k(K, k, S) > 0, \pi_K(K, k, S) < 0,$

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

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

Having described the post-entry subgame, 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 accorded the foreign firm permanently from time zero on. Supposing that the local firm enters at time $t \geq 0$, its total profit can be written as:

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

where r is the instantaneous interest rate.[2] The local firm's optimal or best-response level of investment satisfies the first-order condition

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

and is denoted by $\hat{k}(K, S)$. This best-response investment depends on K and S but is independent of the date of entry. The local firm's maximum current-value profit is denoted by:

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

Since $v_K(K, S) = \pi_K < 0$, the local firm's strategy can be stated as follows: if the foreign firm's investment 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 so that $v(K, S) \leq 0$, it stays out at all times.[3]

Given the local firm's best-response strategy, the final step is to characterize the foreign firm's investment strategy. The foreign firm, acting as the Stackelberg leader in the investment stage of the game, is concerned with the choice between entry accommodation and deterrence. Consider accommodation first. Since the local firm enters at time zero by investing $\hat{k}(K, S)$, the foreign firm's flow profit is constant over time at $\Pi[K, \hat{k}(K, S), S]$. Its total profit therefore is:

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[2] If it chooses the entry date $t \to 0_+$, we say that the local firm enters at time zero.

[3] We employ the tie-breaking rule that the local firm stays out if the discounted sum of profits is zero.

[4] $\beta'(\Delta) = \{c'(\tilde{k}) - \pi_k(\tilde{k},K,S)/r\}\partial\tilde{k}/\partial\Delta > 0$ since the first term is negative by (7) and $\partial\tilde{k}/\partial\Delta < 0$ by (8). Thus, β is monotone-increasing for $t < T$, and hence if there is a unique value of Δ at which $\beta(\Delta) = 0$, it is unique. That implies that the optimal date of entry is also unique.

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

where we let $\hat{k} = \hat{k}(K, S)$ to ease notation. If we let $K^a(S)$ denote the level of investment that maximizes (2) (superscript 'a' stands for accommodation), the foreign firm's maximum profit from accommodation is given by:

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

Consider next the case in which the local firm is forced to stay out. The foreign firm earns the flow monopoly profit $\Pi(K, 0, S) \equiv M(K,S)$ in that case, so its total profit equals:

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

Let $K^m(S)$ denote the investment that maximizes (3). It is quite possible that by investing $K^m(S)$ the foreign firm can make entry unprofitable; 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 $v[K^m(S), S] > 0$ for relevant values of S so the foreign firm must invest more than $K^m(S)$ to deter entry. If we let $\bar{K}(S)$ denote the minimum level of investment that deters entry, that is, let $\bar{K}(S)$ be given by $v(K, S) = 0$, the foreign firm's total profit from deterrence is written as $M[\bar{K}(S), S]/r - C[\bar{K}(S)]$.

Let $\Omega(S)$ denote the difference in the foreign firm's total profit between entry deterrence and accommodation, that is:

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

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 the same 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 the benchmark satisfies the following condition:

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 graph representing the monopoly profit M(K, 0)/r - C(K) lies everywhere above that representing the duopoly profit $\Pi(K, \hat{k}, 0)/r - C(K)$. Panel B depicts the local firm's maximum current-value profit v(K, 0). Observe that $v[K^m(0)] > 0$ or $\bar{K}(0) > K^m(0)$, implying that deterrence is costly to the foreign firm.

3. Permanent Tax Reduction

Given that the foreign firm has an incentive to deter entry in the absence of tax breaks (Condition 1), in this section we examine whether offering a permanent tax break or subsidy can assist the domestic in gaining entry. The answer is in the negative under reasonable assumptions.

First, a small permanent subsidy has no effect on promoting entry. This is evident from Figure 1. To be effective, a subsidy must increase the foreign firm's maximum total profit at least to the level the foreign firm obtains from deterrence with zero subsidies (i.e., to the height of the dotted line in Panel A of Figure 1). Thus, if S* is given by:

$$\{M[\bar{K}(0), 0]/r - C[\bar{K}(0)]\} - V^a(S^*) \equiv 0,$$

any subsidy $S \leq S^*$ fails to facilitate entry.

On the other hand, too large a subsidy can lead to blockaded entry. This follows because $\bar{K}(S)$, the minimum investment necessary for deterrence, is decreasing in S, while $K^m(S) \equiv \text{argmax}\,\{M(K, S)/r - C(K)\}$ is increasing in S so that at high enough subsidy rates $K^m(S)$ can exceed $\bar{K}(S)$. In fact, if S** is defined by $K^m(S^{**}) = \bar{K}(S^{**})$, any subsidy rate exceeding S** causes entry to be blockaded. Figure 2 illustrates the case in which S = S**.

If entry is possible, therefore the subsidy rate must be in the interval (S*, S**). However, since S* and S** are not directly related, it is possible that $S^* \geq S^{**}$, in which case no permanent subsidies can induce entry to be accommodated.

Therefore, assuming that (S*, S**) is indeed an interval we check the possibility that a subsidy $S \in (S^*, S^{**})$ can promote entry. Expanding $\Omega(S)$ around S* yields

$$\Omega(S) = \Omega(S^*) + (S - S^*)\Omega'(S^o)$$

for some $S^o \in (S^*, S)$. Entry is accommodated only if $\Omega(S) < 0$. Since $\Omega(S^*)$ and $S - S^*$ are both positive, the necessary condition for accommodation is that $\Omega'(S^o)$ be negative. To evaluate the last condition we differentiate (4) to obtain

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

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 $\bar{K}_S(S) = - v_S/v_K < 0$ since both v_S and v_K are negative. Therefore, for $\Omega'(S)$ to be negative the second term in (5) must be 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 still be negative. A sufficient condition for ruling out that possibility is

<u>Assumption 3.</u> Given K, a permanent subsidy raises the monopoly profit by a greater amount than it does the duopoly profit, that is,

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

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. This result is presented as

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

The intuition behind Proposition 1 is easily understood. The permanent subsidy lowers the cost of deterrence by requiring a smaller level of investment to deter entry, and raises the total profit from deterrence more than it does the profit from accommodation under Assumption 3. Therefore, if the foreign firm deters entry in the absence of subsidies, it continues to do so under the permanent subsidy.

4. Tax Holidays.

It was shown in the preceding section that the permanent subsidy is unlikely to induce entry by the local firm under mild conditions. In this section we show that the tax holiday or the temporary subsidy to the foreign firm can facilitate entry, and explain why.

Suppose that the subsidy is accorded the foreign firm between time zero through time T; that is, S is positive through time T and zero afterwards. Begin the analysis by reconsidering the local firm's strategy under the tax holiday. First, focus on the case in which the local firm enters at time $t \geq T$. In this case, because the tax holiday has expired at T, the local firm's profit is simply equal to

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

Since (1') is identical to (1) with S = 0, the local firm's optimal strategy is to enter at time T with the investment $\hat{k}(K, 0)$, provided that $v(K, 0) > 0$ or equivalently $K < \bar{K}(0)$, and to stay out otherwise.

Consider next the case that entry occurs at time $t < T$. The local firm earns the flow profit $\pi(K, k, S)$ between t and T and $\pi(K, k, 0)$ afterwards so its total profit is given by:

$$(7) \qquad \int_t^T e^{-r\tau}\pi(K, k, S)d\tau + \int_T^\infty e^{-r\tau}\pi(K, k, 0)d\tau - e^{-rt}c(k)$$

$$= (e^{-rt} - e^{-rT})\pi(K, k, S)/r + e^{-rT}\pi(K, k, 0)/r - e^{-rt}c(k).$$

Let $\Delta \equiv T - t > 0$, the remaining duration of the tax holiday. Given the date of entry t, the local firm's optimal level of investment satisfies the first-order condition:

$$(8) \qquad (1 - e^{-r\Delta})\pi_k(K, k, S)/r + e^{-r\Delta}\pi_k(K, k, 0)/r - c'(k) = 0,$$

and is denoted by $\tilde{k} = \tilde{k}(\Delta; K, S)$. This indicates that the local firm's optimum investment depends on K, S and Δ, but not directly on the actual date of entry t.

The local firm's optimal investment has an interesting property; it decreases with Δ or the remaining period of the tax holiday. Put in another way, *the earlier the local firm enters (before time T), the smaller the optimal investment.* To see this simply apply the implicit-function theorem to (8) to obtain

$$d\tilde{k}/d\Delta = e^{-r\Delta}[\pi_k(K, k, 0) - \pi_k(K, k, S)]/[soc(\Delta)],$$

and observe that

$$soc(\Delta) \equiv (1 - e^{-r\Delta})\pi_{kk}(K, k, S) + e^{-r\Delta}\pi_{kk}(K, k, 0) - rc''(k)$$

is negative by the second-order condition while the numerator is positive by Assumption 1, so

$$(9) \qquad d\tilde{k}/d\Delta < 0$$

as we claimed.

The above result has a simple explanation. Since the local firm earns a lower flow profit under the tax holiday, entry is less profitable during the tax holiday than after it has expired. Hence, the earlier the local firm enters, the lower is the return from investment, thereby justifying the negative relationship in (9).

We next characterize the optimal date t of entry by the local firm ($t < T$). To do that we substitute the optimal investment $\tilde{k} = \tilde{k}(\Delta; K, S)$ into (7) and rewrite the local firm's profits as:

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

We differentiate this with respect to t, multiply through by e^{rt} and apply the first-order condition (8) to obtain the following expression:

(10) $\beta(\Delta) \equiv rc(\tilde{k}) - \pi(K, \tilde{k}, S)$.

The right-hand side is the difference between the saved interest (rc) and the forgone flow profit (π) when the local firm postpones entry for an instant. Hence, $\beta(\Delta)$ measures the benefit to the local firm at time t (< T) of delaying entry for a moment.

With (10), we can state the local firm's entry strategy as follows. If β is positive for all t < T, the local firm enters at T (recall that the local firm never delays entry past T, if it enters at all). If β is negative for all t < T, it enter at time zero. If there is Δ such that $\beta(\Delta) = 0$, Δ is unique, and the optimal date of entry is given by $t = T - \Delta$.[4] Uniqueness of Δ also implies that dt/dT = 1; that is, *extending a tax holiday by one day delays entry by one day*.

We summarize the results of this section so far in

Proposition 2. If entry is accommodated, under the tax holiday the local firm enters later and/or invests less than when there is no tax holiday.

We are now in a position to examine whether the foreign firm wants to accommodate entry under the tax holiday. By deterring entry the foreign firm earns the monopoly profit M(K, S) through time T and M(K, 0) afterwards, or the total profit:

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

How does that compare with the profit from deterrence under the tax holiday? Recall that with no subsidy the foreign firm must invest at least $\bar{K}(0)$ to deter entry. Under the tax holiday, any investment $K < \bar{K}(0)$ will induce entry by time T, when the tax holiday ends. Therefore, the foreign firm must still invest $\bar{K}(0)$ to deter entry under the tax holiday. The foreign firm's profit from entry deterrence is therefore given by

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

We compare this profit with the profit the foreign firm makes from accommodation. The next lemma facilitates 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 time T.

Lemma 1 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 the amount K*, which is 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 Π(K*, 0) afterwards so the total profit:

$$A(T) \equiv \int_0^T e^{-r\tau} M(K^*, S) d\tau + \int_T^\infty e^{-r\tau} \Pi(K^*, 0) d\tau - C(K^*)$$

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

Given K*, accommodation yields a greater profit to the foreign firm if

(11) $$\Psi(T) \equiv D(T) - A(T)$$

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

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

is negative. Since K* is sufficiently close to $\bar{K}(0)$, Condition 1 implies that

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

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

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

provided that entry is not blockaded at S. Furthermore, differentiating, we obtain

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

With K* sufficiently close to but strictly less than $\bar{K}(0)$, the difference $M[\bar{K}(0); S] - M(K^*, S)$ can be arbitrarily small whereas the other terms $\Pi(K^*, 0) - M[\bar{K}(0), 0]$ is clearly negative. Hence, $\Psi'(T)$ is negative, meaning that $\Psi(T)$ is decreasing in T.

Hence, given continuity of $\Psi(T)$, there exists $\tilde{T}$ such that $\Psi(\tilde{T}) = 0$ and for any $T > \tilde{T}$ we have $\Psi(T) < 0$, meaning that the foreign firm accommodates. Of course, K* need not be the foreign firm's optimal investment. If the foreign firm chooses K** instead, it must be because K** yields a greater profit than K*. Thus, the foreign firm also accommodates entry for $T > \tilde{T}$ when it invests optimally.

Proposition 3 has the following explanation. To the extent that entry deterrence is costly, the foreign firm prefers accommodation if the entrant can commit to being non-aggressive, which in the present context means entering at a later date and/or with a lower level of investment. However, in the absence of the tax holiday, the local firm cannot make such a commitment credibly because, once the foreign firm has sunk its investment, the local firm has an incentive to enter as soon as possible (at time zero) with the aggressive level of investment, $\hat{k}(K, 0)$. Anticipating this kind of response from the local entrant, the foreign firm has no desire to accommodate entry.

In such a case, offering the tax holiday to the foreign firm can change the local firm's optimal strategy by creating the uneven flow of profits over time. Since it expects to earn smaller flow profits during the tax holiday, the local firm tends to postpone entry until the tax holiday ends. Even if it attempts to enter before the tax holiday ends, the local firm invests less to reflect the lower expected returns from investment. Softening of the local competition raises the foreign firm's profit from accommodation. In addition, deterrence under the tax holiday requires as much investment as in the absence of the tax holiday (i.e., $\bar{K}(0)$), and so the cost of entry deterrence remains unchanged. Thus, the tax holiday makes accommodation more attractive an option than deterrence.[5]

In short, the tax holiday is a puppy-dog ploy that allows the local firm to commit to being non-aggressive and induce accommodation. It is interesting to note that both the firms are made better off under the tax holiday.

5. Concluding Remarks.

This paper showed that the host-country government can offer a tax holiday to help the local firm enter the local market that would otherwise be dominated by the foreign multinational firm. The tax holiday works because it makes the foreign firm temporarily a tougher competitor, and prompts the local firm to delay entry and/or invest less when entering the market. To the extent that deterrence is costly in the first place, the foreign firm has an incentive to accommodate small-scale entry. Thus, the tax holiday serves as a puppy-dog ploy for the host country by facilitating entry of local competitions and thereby preventing monopolization of the local market by the foreign firm. This pro-competitive effect is absent under permanent tax reduction. That is, because under permanent tax reduction the local firm's flow profit is constant over time, there is no reason for the local firm to postpone entry.

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[5] Suppose that two firms play Cournot games with the linear demand, $P = A - (x + X)$, once the local firm enters. Marginal costs of production are given by $C/K - S$ for the foreign firm and c/k for the local firm, where K and k denote the R&D investments that reduce marginal cost and S is the subsidy. Local firm's fixed cost of production is f. Costs of investment for the local firm is ϕk^2 and ΦK^2 for the foreign firm. Let $A = 300$, $c = 80$, $C = 30$, $\phi = 8$, $\Phi = 4$, $S = 2$, $r = 1$, and $f = 8{,}350$. Then, $\Omega(0) = 11{,}530 > 0$ and $\Omega(\infty) = 11845 > 0$: that is, without tax holidays or with permanent tax break the foreign firm deters entry. With a tax holiday, however, entry may be accommodated: $\Omega(3) = - 7.2434 < 0$.

Finally, we point out that, although we focused on the case in which the foreign firm over-invests to deter entry, the logic of the present analysis applies equally well to the case of under-investment for entry deterrence.[6]

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[6] For example, Ohno and Khaodhiar (1999) present a model in which the foreign firm deliberately adopts an inferior technology to discourage the local firm from copying it.

Appendix.

Proof of Lemma 1. Suppose that local firm enters at $t < T$ when the foreign firm invests $K^* < \bar{K}(0)$ where K^* is close to $\bar{K}(0)$. Then, the entrant's maximal profit is given by (6) or by its equivalent form:

$$(6') \qquad (e^{-rt} - e^{-rT})[\pi(K^*, \tilde{k}^*, S)/r - c(\tilde{k}^*)] + e^{-rT}[\pi(K^*, \tilde{k}^*, 0)/r - c(\tilde{k}^*)],$$

where $\tilde{k}^* = \tilde{k}(\Delta; K^*, S)$ maximizes the above expression. We have

$$\pi(K^*, \tilde{k}^*, S)/r - c(\tilde{k}^*) < \pi(K^*, \tilde{k}^*, 0)/r - c(\tilde{k}^*)$$
$$< \pi[K^*, \hat{k}(K^*, 0), 0]/r - c[\hat{k}(K^*, 0)] = v(K^*, 0).$$

where the first inequality follows from Assumption 1 while the second inequality holds because $\hat{k}(K^*, 0) = \text{argmax}\ \{\pi(K^*, k, 0)/r - c(k)\}$. 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 (6') is negative, or entering at $t < T$ is unprofitable for the local firm. Hence, the local firm enters at $t = T$. ❑

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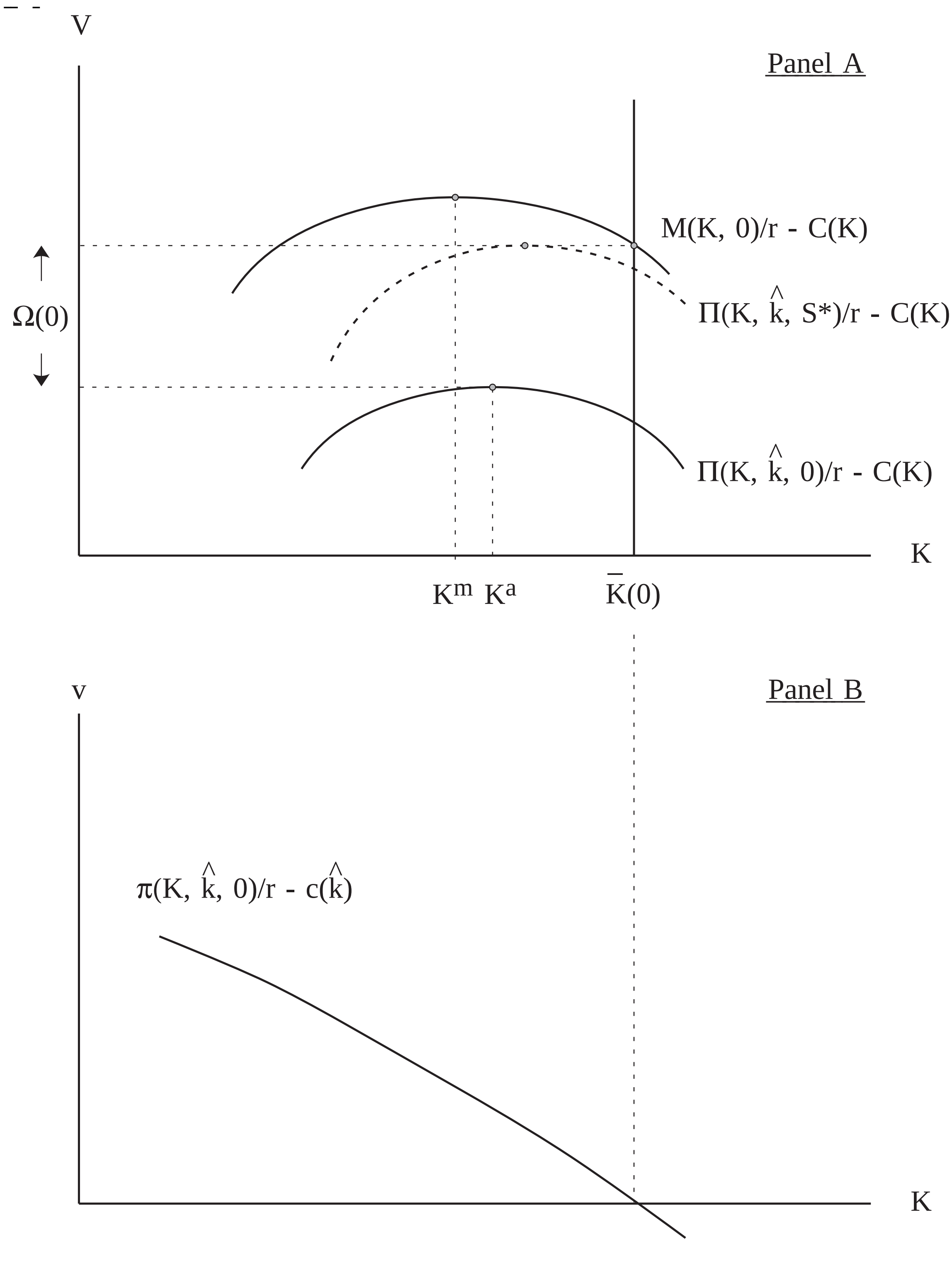
V
Panel A
M(K, 0)/r - C(K)
Π(K, k̂, S*)/r - C(K)
Ω(0)
Π(K, k̂, 0)/r - C(K)
K
K^m K^a
K̄(0)
v
Panel B
π(K, k̂, 0)/r - c(k̂)
K

Figure 1

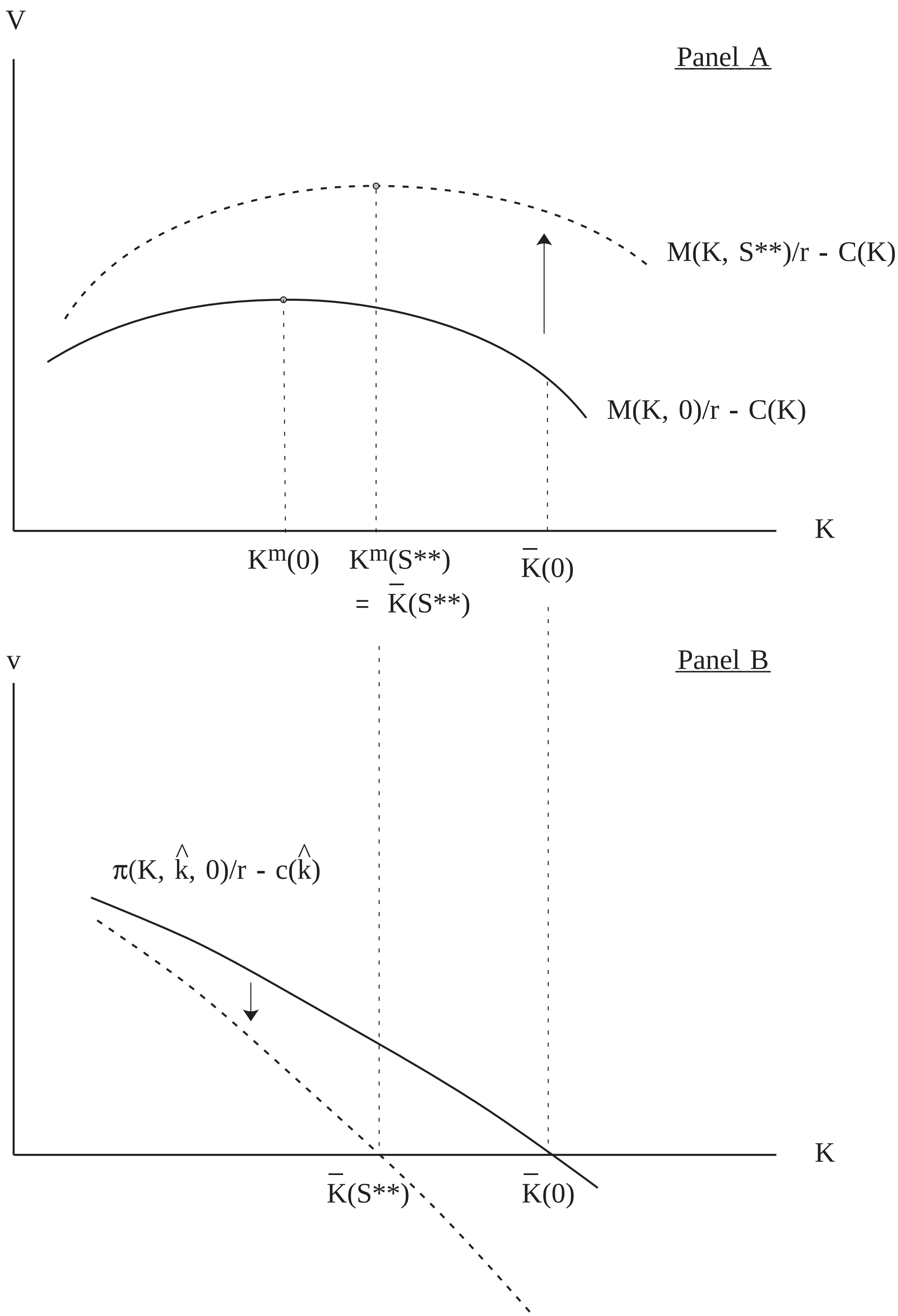

Figure 2