Foreign Monopoly and Tax Holidays

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Abstract
Host country governments often grant tax holidays to foreign firms locating in their territories. Although such preferential tax treatment appears to disadvantage local competitors who try to enter the new markets, tax holidays can actually facilitate entry by local firms. This pro-competitive effect stems from the fact that tax holidays are granted for a limited time. By making the foreign firm appear temporarily “tough”, tax holidays induce local firms to delay entry, which in turn prompts the foreign firm to accommodate entry rather than pursue costly entry-deterring strategies. Thus, tax holidays benefit both the foreign firms and local entrepreneurs.

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**Foreign Monopoly and Tax Holidays**

1. **Introduction**

Host country governments often grant investment incentives to foreign firms that locate in their territories. A typical investment incentive package includes tax holidays, lower tariffs on imported raw materials and components, subsidized labor training costs and financial loans.¹ Although it is understandable that such incentives may be needed for capital-scarce countries competing with each other to attract limited supplies of foreign capital, preferential tax treatment of foreign firms seems to disadvantage local firms by making it more difficult to enter the new markets. However, in this paper we show that tax holidays can actually facilitate entry by local firms and benefit both foreign and local firms.

This pro-competitive effect stems from the fact that tax holidays are granted only for a limited time.² We demonstrate this effect by extending the standard model of entry deterrence (e.g., Dixit 1979, 1980) to an infinite-horizon setting, in which the entry date is endogenous. The model has two firms and three stages. The foreign firm is the incumbent and the local firm the potential entrant. The foreign firm moves first by making investment in the host country. In the second stage of the game the local firm observes the investment and decides whether and when to enter the new market over the infinite time horizon. The third stage of the game begins

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¹ For example, Thailand grants tax holidays as well as exemption or reduction of import duties of up to ninety percent on imported raw materials and components. See Reuber et al. (1973) for detailed examination of other tax holiday programs.

² For example, the law enacted in 1999 in Indonesia grants tax incentives for up to twelve years.
only when the local firm enters and is characterized by duopolistic competition. Without entry the foreign firm remains a monopoly.

The analysis centers on the foreign firm’s decision whether to deter entry by the local firm. The foreign firm naturally dislikes competition but would accommodate small-scale or inoffensive entry rather than pursue costly entry-deterring strategies as explicated by Gelman and Salop (1983). The local firm also prefers delayed entry to no entry at all. The problem is, unlike the entrant featured in the Gelman-Salop analysis, the local firm in our model cannot commit to small-scale entry so that the foreign firm’s optimal strategy is initially to make sufficient investment to deter any competition from the local firm.

It is in such a circumstance that tax holidays granted to the foreign firm serve as a commitment device for the local firm. Tax holidays make the foreign firm temporarily “tough” and force the local firm to commit to delayed entry. In other words, tax holidays serve as a puppy-dog ploy (see Fudenberg and Tirole, 1984), which facilitates entry by the local firm into the new market that would otherwise be dominated by the foreign firm.

What is essential in our result is that tax holidays be transitory. If they were granted permanently instead, the foreign firm remains tough at all times, and hence the local firm has no incentive to delay entry. Thus, the local firm’s optimal strategy is to enter as soon as possible, but then the foreign firm’s optimal strategy is to deter entry.

The remainder of the paper is organized in 5 sections. The next section presents the basic model. Section 3 considers the impact of permanent tax reduction on entry. Section 4 presents our main result. Section 5 discusses the welfare impact of tax holidays. Section 6 concludes.
2. An infinite-horizon model of entry deterrence

This section presents the model of entry deterrence in an infinite-horizon continuous-time setting. The model has two players: a foreign firm and a potential local entrant. In the first stage the foreign firm invests $K[0, \infty)$ at cost $C(K)$, which is assumed convex; i.e., $C'(K) > 0$ and $C''(K) > 0$. In the second stage, the local firm observes $K$, and decides whether and when to enter over the infinite horizon $[0, \infty)$. The third stage begins only if the local firm enters. Upon entry the two firms compete by choosing outputs or prices each time. The products need not be homogeneous; if the firms engage in price competition however we assume that the products are differentiated and substitutes. Until entry occurs the foreign firm remains a monopoly. Finally, we assume the market demands and factor prices do not change over time.

The foreign firm’s investment, $K$, is assumed to be sunk ex post, and therefore represents a broad class of strategic variables having commitment value, such as technology, product quality, product design, location, clientele size, supplier networks, etc., as extensively surveyed by Tirole (1988) and Shapiro (1989). Commitment value may come from the fact that, once $K$ is chosen, it is prohibitively costly to change its level. That is the case if $K$ has a huge fixed-cost component; that is, $C(0)$ is huge. For concreteness, we regard $K$ as the choice of technology the foreign firm installs to operate its plant in the host country. A higher value of

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3 Primes denote differentiation.

4 Alternatively, $K$ may represent investment in capacity, which can, as in Dixit (1979, 1980), be quite inflexible. For example, in most metallurgy industries, expanding capacity beyond the existing level is economically impossible.
K signifies a more sophisticated technology, which is more expensive to install but which lowers production cost.

We are now ready to solve the model. As we seek the subgame-perfect equilibrium, we first solve the subgame that begins if the local firm enters; we then solve the local firm’s entry decision problem, and finally we determine the foreign firm’s optimal investment strategy. The solution concept we employ for the post-entry subgame is that of Markov-perfect equilibrium, which essentially rules out the possibility of implicit collusion between the firms. In our model, since the firm’s flow profits do not depend on time due to the stationary environment, the Markov-perfect equilibrium profits are identical to the one-shot game Nash equilibrium profits.

We thus write the foreign firm’s and the local firm’s equilibrium flow (duopoly) profit as \( \Pi(K, S) \) and \( \pi(K, S) \), respectively. In these profit functions, \( S \) stands for the rate of tax or tariff reduction at a time under consideration, and is referred to simply as the subsidy rate. \( S \) also appears in the local firm’s profit function because subsidies to the foreign firm reduce the local firm’s equilibrium profit.

In a similar manner we denote the foreign firm’s (maximum) monopoly flow profit by \( M(K, S) \). We assume the flow profit functions satisfy Assumption 1 (subscripts denote partial differentiation).

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Institutions and regulations in the host countries may also enhance the commitment value of investment in capacity. For example, in many developing countries foreign investment is restricted to so-called “special economic zones,” where, once the zones are completely used up by other firms, enlarging plant capacity may be impossible. [See, e.g., Miyagiwa (1986).]
Assumption 1:

(A) \( M_S(K, S) > \Pi_S(K, S) > 0, \; \pi_S(K, S) < 0, \)

(B) \( M_K(K, S) > \Pi_K(K, S) > 0, \; \pi_K(K, S) < 0, \)

(C) \( \Pi_{SK}(K, S) > 0. \)

Part A of the assumption says that an increase in \( S \) or \( K \) reduces the foreign firm’s production cost and shifts profit from the local firm to the foreign firm. It is easy to check that this profit-shifting property, familiar in the strategic trade policy literature pioneered by Brander and Spencer (1985), holds in the Cournot and the differentiated-goods Bertrand models. Part (A) and (B) also say that the profit effect of \( K \) and \( S \) is greater when the foreign firm is a monopolist than when it is a duopolist. The intuition is that a unit cost reduction is more profitable when output is larger. The same intuition underlies part (C) of the assumption; i.e., a subsidy increases output and thereby makes investment is more profitable. This assumption is often made in the literature investigating similar issues [see, e.g., Besley and Suzumura (1992) and McAfee and Schwartz (1994)].

As an example of profit functions satisfying these properties consider the standard Cournot duopoly with linear demand: \( p = a - x - X \), where \( x \) and \( X \) are the local firm’s and the foreign firm’s output, respectively. The Cournot-Nash equilibrium profit to the foreign and the local firm are

\[
\Pi(K, S) = [a - 2W(K) + 2S + w]^2 / 9
\]

\[
\pi(K, S) = [a - 2w + W(K) - S]^2 / 9.
\]
With $W'(K) < 0$, it is easy to show that these profits satisfy Assumption 1.

Having described the equilibrium of the post-entry subgames, we now turn to the second stage: the entry decision by the local firm. We assume

**Assumption 2**: There is a $K > 0$ such that $\pi(0, K) = 0$; that is to say that it is possible for the foreign firm to deter entry at some investment $K$ without subsidies.

For the remainder of this section we also assume that $S$ is fixed at all $t \in [0, \infty)$. Let $r$ be the (common) instantaneous rate of interest. If the local firm enters at time $t \geq 0$, its discounted total profit is:

\[
\int_t^\infty e^{-rz} \pi(K, S) \, dz = e^{-rt} \pi(K, S)/r.\tag{1}
\]

If $\pi(K, S)$ is positive, the local firm enters at $t = 0$ and if $\pi(K, S)$ is non-positive the local firm never enters.\(^5\) Let $\tilde{K}(S)$ denote the level of $K$ that solves $\pi(K, S) = 0$. Then, since $\pi(K, S)$ is decreasing in $K$, the local firm’s optimal strategies are:

(i) Enter at $t = 0$ if $\pi(K, S) > 0$ or $K < \tilde{K}(S)$;

(ii) Never enter if $\pi(K, S) \leq 0$ or $K \geq \tilde{K}(S)$.\(^6\)

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\(^5\) Adding fixed entry or setup cost does not change our analysis.

\(^6\) We employ the tie-breaking rule that the local firm stays out if the discounted sum of profits is zero.
We finally turn to the foreign firm’s investment strategy. If the foreign firm remains a monopoly, its profit net of investment cost is:

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

Assuming (2) is strict concave, there is a unique unconstrained optimum, denote by $K^m(S)$.

If $\pi[K^m(S), S] \leq 0$, the foreign firm can prevent entry by investing $K^m(S)$, the unconstrained optimal investment. This is the case of blockaded entry. More interesting is the case in which $\pi[K^m(S), S] > 0$ so that the foreign firm must invest more than the unconstrained optimum to deter entry. For the remainder of this analysis, we focus on this case.

In the latter case, to deter entry the foreign firm must invest at least $\tilde{K}(S) > K^m(S)$. However, since (2) is decreasing for $K > K^m(S)$, the foreign firm never invests more than $\tilde{K}(S)$ to deter entry. So, the maximum profit from deterred entry is given by $M[\tilde{K}(S), S]/r - C[\tilde{K}(S)]$.

On the other hand, any investment less than $\tilde{K}(S)$ induces the local firm to enter at $t = 0$. In that case, the profit is

$$
\int_0^\infty e^{-rz}\Pi[K, S]dz - C(K) = \Pi[K, S]/r - C(K).\footnote{We assume here that the local firm obtains all information, including the technology, necessary for entry immediately after the foreign firm makes investment K. Alternatively, we may assume that a fixed time passes}
$$
Let $K^a(S)$ denote the level of investment that maximizes (3) (superscript ‘a’ stands for accommodation) and let $V^a(S)$ be the associated maximum total profit from entry accommodation:

$$V^a(S) = \Pi[K^a(S), S]/r - C[K^a(S)].$$

Now, let $\square(S)$ be the difference in profit between entry deterrence and entry accommodation, that is:

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

Then the foreign firm deters entry if and only if $\square(S) \geq 0$. This completes the description of the model when the subsidy rate remains constant for all $t \in [0, 1)$.

Setting $S = 0$ in the model yields the benchmark case, in which the foreign firm receives no preferential tax treatment. We assume that without preferential tax treatment the foreign firm prefers to deter entry. This is stated in 

**Assumption 3**: $\square(0) > 0$; or in the absence of tax reduction ($S = 0$) the foreign firm prefers to deter entry rather than accommodate entry by the local firm

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8 This analysis is valid only if $K^a(S) < \bar{K}(S)$. However, this inequality is always satisfied because (i) it can be shown that a monopoly invests more than a duopolist or $K^a(S) < K^m(S)$, and (i) $K^m(S) < \bar{K}(S)$. Before the local firm acquires necessary knowledge for entry and that until then the foreign firm is monopoly. Such a change does not substantially affect our results.
Figure 1 illustrates the model. In panel A, the two solid concave curves represent the foreign firm’s total net profit as the function of $K$ at $S = 0$. The top curve corresponds to the monopoly profit, $M(K, 0)/r - C(K)$, while the bottom one depicts the duopoly profit, $\mathbb{P}(K, 0)/r - C(K)$. In accordance with Assumption 3, Panel A shows that the profit from deterring entry (point d) with investment $\tilde{K}(0)$ exceeds the maximum profit from accommodating entry (point a) with investment $K^a(0)$. Panel B, on the other hand, depicts the local firm’s flow profit $\bar{\Pi}(K, 0)$. Observe that $\tilde{K}(0) > K^m(0)$ and $\mathbb{P}[K^m(0)] > 0$, implying that entry deterrence is costly to the foreign firm.

< Insert Figure 1 around here >

3. Permanent Tax Reduction

Given that the foreign firm prefers to deter entry in the absence of preferential tax treatment (Assumption 3), this section shows that granting a permanent tax break fails to promote entry by the local firm. That is, we establish:

**Proposition 1:** Under Assumptions 1 - 3 the foreign firm continues to deter entry under a permanent tax reduction program.

*Proof.* We must show that $\bar{\Pi}(0) > 0$ implies $\bar{\Pi}(S) > 0$ for $S > 0$. To this aim, we differentiate (4) to obtain:

$$\bar{\Pi}'(S) = \{M_S[\tilde{K}(S), S] - \Pi_S[K^a(S), S]/r + \tilde{K}'(S)[M_K[\tilde{K}(S), S]/r - C'[\tilde{K}(S)]].$$
The first term on the right of (5) compares the effect of an increase in $S$ on the monopoly and the duopoly flow profit, given the levels of investment. It is positive because

$$M_S[\tilde{K}(S), S] - \Pi_S[K^a(S, S)] > M_S[\tilde{K}(S), S] - \Pi_S[\tilde{K}(S), S] > 0.$$ 

The first inequality holds because $\tilde{K}(S) > K^a(S)$ implies $\Pi_S[\tilde{K}(S), S] > \Pi_S[K^a(S, S)]$ by Assumption 1.C. The second inequality follows from Assumption 1.A.

The second term on the right of (5) compares the indirect effect of subsidies through induced changes in investment. Since the effect on the duopoly profit vanishes by the envelope theorem, the indirect effect is just a change in the profit when the foreign firm is a monopoly. Since $(M_K/r - C') < 0$ at $\tilde{K}(S) > K^m(S)$ (see figure 1) and $\tilde{K}'(S) = -\pi_S/\pi_K < 0$ by Assumption 1, this indirect effect is also positive.\(^9\) Since both terms on the right-hand side of (5) are positive, $\Box'(S) > 0$, and hence $\Box(S) > \Box(0) > 0$. This is what we wanted to show.

The intuition behind proposition 1 is straightforward. Under Assumption 1, at given $K$ permanent subsidization raises the profit to the foreign firm more when it is a monopolist than when it is a duopolist [the first term on the right-hand side of (5)]. In addition, permanent

\(^9\) The situation depicted in figure 1 holds for $S > 0$ if $S$ is not too large or as long as $\tilde{K}(S) > K^m(S)$. The latter inequality may be reversed if $S$ is too large. But reversals imply that the foreign firm blockades entry under permanent subsidization. Proposition 1 thus remains valid.
subsides make it easier to deter entry [the second term on the right-hand side of (5)]. Thus, the
foreign firm has more incentives to deter entry under permanent subsidization.

4. Tax Holidays

We now show that granting tax holidays to the foreign firm facilitates entry while
permanent subsidies do not. Consider a tax holiday program that begins at time zero and ends
at time $T > 0$. We first claim

**Lemma 1.** The local firm never enters at $t > T$ under the tax holiday program.

*Proof.* Entry at $t > T$ yields $[e^{-rT}\pi(K, 0)/r]$, which is less than the profit $[e^{-rT}\pi(K, 0)/r]$ from entry at $T$, provided of course that $\pi(K, 0)$ is positive.

Having ruled out the possibility of entry at $t > T$, we focus on entry at $t \in [0, T]$. Entering at $t \leq T$, the local firm receives the flow profit $\pi(K, S)$ between $t$ and $T$ and $\pi(K, 0)$ after the tax holiday program ends. Therefore, the total profits to the local firm are:

$$
(6) \quad (e^{-rt} - e^{-rT})\pi(K, S)/r + e^{-rT}\pi(K, 0)/r \quad (t \leq T).
$$

Since by Assumption 1 $\pi(K, 0) > \pi(K, S)$ for $S > 0$, (6) suggests the following optimal strategies for the local firm:

(a) if $\pi(K, S) > 0$, enter at $t = 0$

(b) if $\pi(K, 0) > 0 \geq \pi(K, S)$, enter at $t = T$

(c) if $0 \geq \pi(K, 0)$, do not enter.
Recalling that $\tilde{K}(S)$ solves the equation $\pi(K, S) = 0$ and that $\tilde{K}(0) > \tilde{K}(S)$ for $S > 0$, we restate the local firms optimal strategies as follows.

**Lemma 2**: (the optimal strategies for the local firm)

(A) If $K < \tilde{K}(S)$, enter at $t = 0$.

(B) If $\tilde{K}(0) \geq K \geq \tilde{K}(S)$, enter at $t = T$.

(C) If $K \geq \tilde{K}(0)$, do not enter.

We are now in a position to characterize the foreign firm’s optimal strategy under the tax holiday program. By Lemma 2, to deter entry the foreign firm must invest at least $\tilde{K}(0)$. Thus, the maximum profit from deterring entry is:

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

On the other hand, when the foreign firm invests $K \geq [\tilde{K}(S), \tilde{K}(0)]$, the local firm enters at $T$ by Lemma 2, so the foreign firm earns at most:

$$A_1(T) = \max_K \{(1 - e^{-rT})M[K; S]/r + e^{-rT}M[0]/r - C(K)\}. \quad (7)$$

Alternatively, if the foreign firm invests $K < \tilde{K}(S)$, entry occurs at $t = 0$ by Lemma 2, so the foreign firm earns at most:

$$A_2(T) = \sup_K \{(1 - e^{-rT})M[K; S]/r + e^{-rT}M[0]/r - C(K)\}. \quad (8)$$

The next lemma compares these profits.
**Lemma 3:** \( A_1(T) > A_2(T) \), or the foreign firm prefers to accommodate entry at \( t = T \) rather than at \( t = 0 \).

(The proof is in the appendix).

Thus, the foreign firm deters entry if and only if \( D(T) > A_1(T) \). We are ready to present our main result.

**Proposition 2:** Under Assumptions 1 - 3 there is \( \tilde{T} \) such that granting a tax holiday program with \( T > \tilde{T} \) induces the foreign firm to accommodate entry.

**Proof.** Let the foreign firm invest \( K^* \), arbitrarily close to but strictly less than \( \tilde{K}(0) \). Then, by Lemma 2 the local firm enters at time \( T \) so the foreign firm’s total profit is:

\[
A^*(T) = (1 - e^{-rT})M(K^*, S)/r + e^{-rT} \Pi(K^*, 0)/r - C(K^*).
\]

Define

\[
\mathcal{D}(T) = D(T) - A^*(T)
\]

\[
= \{(1 - e^{-rT})M(\tilde{K}(0); S)/r + e^{-rT}M(\tilde{K}(0), 0)/r - C(\tilde{K}(0))\} \\
- \{(1 - e^{-rT})M(K^*, S)/r + e^{-rT} \Pi(K^*, 0)/r - C(K^*)\}.
\]

Since \( K^* \) is sufficiently close to but less than \( \tilde{K}(0) \), Assumptions 1 and 3 imply that

\[
\mathcal{D}(0) = \{M(\tilde{K}(0); S)/r - C(\tilde{K}(0))\} - \{ \Pi(K^*, 0)/r - C(K^*) \} > 0;
\]
that is, if the tax holiday program lasts a very short time, the foreign firm prefers to deter entry rather than invest $K^*$ and accommodate entry. On the other hand, at $T = T^*$ we have

$$\square(\cdot) = \{M(\tilde{K}(0); S)/r - C[\tilde{K}(0)]\} - \{M(K^*, S)/r - C(K^*)\} < 0.$$ 

This inequality results from the fact that $K^* < \tilde{K}(0)$, together with the fact that the profit $M(K, S)/r - C(K)$ is decreasing in the neighborhood of $\tilde{K}(0)$. Then, continuity of $\square(T)$ implies that $\square(T) = 0$ at some $T$.

Furthermore, differentiating (9) and rearranging yields

$$\square'(T) = -e^{-rT}\{M(K^*, S) - M(\tilde{K}(0); S) + M(\tilde{K}(0), 0) - \Pi(K^*, 0)\} < 0.$$ 

This inequality follows because, with $K^*$ sufficiently close to $\tilde{K}(0)$, the difference between the first two terms in braces on the right of (1) is arbitrarily small, whereas the difference, between the next two terms is strictly positive. Thus, $\square(T)$ is monotone-decreasing. Hence, there exists unique $\tilde{T}$ such that for $T > \tilde{T}$ $\square(T) < 0$ or $A^*(T) > D(T)$. But by definition $A_1(T) \equiv A^*(T)$ for any $T > 0$, so $A^*(T) > D(T)$ implies $A_1(T) > D(T)$ for $T > \tilde{T}$. That is, the foreign firm accommodates entry if granted a tax holiday program longer than $\tilde{T}$. This completes the proof.

The intuition behind Proposition 2 is the following. Provided that entry deterrence is costly, allowing for small-scale (or delayed) entry is preferable to the foreign firm than deterring entry. For the local firm, too, delayed entry is better than no entry at all. While both firms would benefit from delayed entry, the local firm cannot, without tax holidays, make a
credible commitment to delay entry, because, once the foreign firm has invested below $\tilde{K}(0)$ on the promise that entry is delayed, the local firm has the incentive to renege on it and enter at $t = 0$. Anticipating such opportunism, the foreign firm’s optimal strategy is to deter entry.

In such a case, granting tax holidays to the foreign firm changes the entrant’s optimal entry strategy. Even if the foreign firm invests less than $\tilde{K}(0)$, the prospect of making negative profits during the tax holidays forces the local firm to delay entry till the end of the program. Tax holidays thus allow the local firm to credibly commit to delaying entry. As a consequence, both the foreign and the local firm benefit when tax holidays are granted to the former.

5. Welfare

In this paper our primary focus was on what tax holidays do, and not on whether it is an optimal policy to grant tax holidays. The welfare effect of the tax holiday program is in general ambiguous because of the two conflicting welfare effects it generates. On the one hand, entry generates profits and more consumer surpluses due to more competition, thereby raising host country welfare. On the other, as the foreign firm no longer finds it necessary to invest as much or install a better technology, prices may increases, thereby reducing consumer surpluses. In addition, subsidies have to be given to the foreign firm. The net welfare effect depends on which effect is dominant.

Thus, evaluation of the net welfare effect of tax holiday programs requires more detailed information about the market size and the types of the initial investment the foreign firm undertakes to deter entry. Although the general conclusions are difficult to be reached, there are two cases in which tax holidays are more likely to improve host country welfare. One
case arises when the foreign firm’s investment does not affect its cost of production but instead it raises the local firm’s entry costs. Then, the flow monopoly profit is independent of own investment, and hence consumer surpluses do not fall. Absent the negative effect of tax holidays noted above, tax holidays are more likely to improve host country welfare (the financial cost of subsidization still has to be taken into account).

Another case in which tax holidays can improve host country welfare occurs if the foreign firm’s initial investment determines the market size. For example, to deter entry the foreign firm may intentionally introduce a low-quality product to keep the demand sufficiently low. In such a case entry accommodation means the introduction of a better quality, which increases demand. Thus, the negative effect of tax holidays noted earlier is absent and so host country welfare is likely to increase under tax holiday programs.

6. Summary

Host country governments often grant tax holidays to foreign firms locating in their territories. We showed that tax holidays make the foreign firms appear temporarily “tough” and thereby deter immediate entry by local competitors. Such a puppy-dog ploy makes the foreign firm more willing to accommodate (delayed) entry instead of adopting costly entry-deterring strategies. Thus, tax holidays facilitate entry by the local firms and prove beneficial both to the foreign and the local firms.
Appendix

**Lemma 3:** $A_1(T) > A_2(T)$, or the foreign firm prefers to accommodate entry at $t = T$ rather than at $t = 0$.

**Proof.** Hold $T$. Let $T$. Rewrite (7) as a function of $S$:

$$(7') A_1(S; T) = \max_K \{(1 - e^{-rT})M(K; S)/r + e^{-rT}T(K, 0)/r - C(K)\}.$$

The expression in braces on the right is defined over $\tilde{K}(0) \geq K \geq \tilde{K}(S)$. Since $\tilde{K}(0) > K^m(0)$, the unique optimum, $A_1(S; T)$, occurs either in the interior of the constraint or at $\tilde{K}(S)$. For given $T$, we have:

$$(A1) \quad \partial A_1(S; T)/\partial S = (1 - e^{-rT})M(S(K; S)/r$$

$$+ \{(1 - e^{-rT})M(K; S)/r + e^{-rT}T(K, 0)/r - C'(K)\})\tilde{K}(S).$$

The first term on the right of (A1) is positive. If we have the interior optimum, the second term is zero by the first-order condition. If the optimum occurs at $\tilde{K}(S)$, the second term is positive, since it is the product of the two negative terms. Either way, $\partial A_1(S; T)/\partial S > 0$.

Next, rewrite (8) as:

$$(8') A_2(S; T) = \sup_K \{(1 - e^{-rT})T(K; S)/r + e^{-rT}T(K, 0)/r - C(K)\}.$$

This is defined for $K < \tilde{K}(S)$. Suppose that the supremum occurs at $K < \tilde{K}(S)$. Then by the envelope theorem

$$(A2) \quad \partial A_2(S; T)/\partial S = (1 - e^{-rT})T(S(K; S)/r > 0.$$
Comparing (A1) and (A2) and noting that $M_S(K; S) > \prod_S(K; S)$ by Assumption 1 and that the second term on the right-hand side of (A1) is non-negative, we obtain

(A3) \[ \frac{\partial A_1(S; T)}{\partial S} > \frac{\partial A_2(S; T)}{\partial S}. \]

Assumption 1 also implies

(A4) \[ A_1(0; T) > A_2(0; T). \]

From (A3) and (A4) it follows that $A_1(S; T) > A_2(S; T)$ for $S > 0$.

If (8’) has no interior maximum, the supremum is at $\check{K}(S)$. Then direct computation shows that

\[ A_2(S; T) \leq (1 - e^{-rT})\prod[\check{K}(S); S]/r + e^{-rT}\prod[\check{K}(S), 0]/r - C[\check{K}(S)] \leq A_1(S; T). \]

Thus, in either case we have that $A_1(S; T) > A_2(S; T)$ for $S > 0$. This is what we wanted to show.
References


The foreign firm deters entry without tax holidays