Trade, Welfare, and Economic Policies

Essays in Honor of Murray C. Kemp

Edited by
Horst Herberg and Ngo Van Long

Ann Arbor

THE UNIVERSITY OF MICHIGAN PRESS

Published in the United States of America by
The University of Michigan Press
Manufactured in the United States of America

1996 1995 1994 1993 4 3 2 1

Library of Congress Cataloging-in-Publication Data

Trade, welfare, and economic policies : essays in honor of Murray C. Kemp / edited by Horst Herberg and Ngo van Long.
p. cm. — (Studies in international trade policy)
Includes bibliographical references and index.
ISBN 0-472-10364-4 (alk. paper)
1. International trade. I. Kemp, Murray C. II. Herberg, Horst. III. Long, Ngo van. IV. Series.
HF1379.T74 1992
382—dc20 92-43038
CIP

A CIP catalogue record for this book is available from the British Library.

Taxation and the Birth of Foreign Subsidiaries

by Hans-Werner Sinn

published in:

H. Herberg and N.V. Long (Eds.):

"Trade, Welfare, and Economic Policies,

Essays in Honour of Murray C. Kemp",

University of Michigan Press: Ann Arbor 1993, pp. 325-352.

CHAPTER 19

Taxation and the Birth of Foreign Subsidiaries

Hans-Werner Sinn

It has long been known that foreign direct investment is an inherently dynamic phenomenon with characteristic growth phases of the subsidiary. Typically, the subsidiary is set up with only a small nucleus of equity capital transferred from the parent, undergoes a period of self-financed growth thereafter, and pays dividends to the parent when an ultimate stage of maturity has been reached. Such authors as Barlow and Wender (1955), Penrose (1956 and 1959), and Robbins and Stobaugh (1973) have carefully described this pattern and have developed what may be called the "nucleus hypothesis" of direct investment.

The role of taxes in the context of the nucleus hypothesis is fairly unknown. A rich body of literature on the influence of taxation on direct investment does exist and includes such important contributions as those of Hamada (1966), Horst (1977), Kemp (1962 and 1964), MacDougall (1960), Musgrave (1969), Richman (1963), and Sato and Bird (1975), or, to take more recent samples from the rapidly growing literature, Alworth (1986 and 1988), Jun (1989), Keen (1990), Leechor and Mintz (1990), Razin and Slemrod (1990), Sørensen (1989), and Sinn (1989). However, the relationship between taxation and the time pattern of a subsidiary's development has found little attention in that literature.

Why are subsidiaries required to grow out of a nucleus of equity capital rather than being established in a single step with all the equity they need? How do taxes interfere with this process? How will host and home country taxes, withholding taxes, double taxation agreements, and royalties affect the size of the nucleus, and how will they affect its growth? Does the subsidiary's "birth weight" determine its size at maturity? Will deferral really reduce the cost of equity finance? These are questions to which the existing literature on taxation and direct investment has provided rather incomplete answers, to say the least.

This paper tries to help fill the gap. I analyze the role of capital income taxation in a dynamic model of direct investment that is fully compatible with the nucleus hypothesis, even generating this hypothesis endogenously. The model is constructed from two main building blocks.

The first of these is the theory of the mature foreign subsidiary as developed by Hartman (1985) and Sinn (1984 and 1985). Among other things, this theory implies that taxes on cross-border profit distributions will not affect a subsidiary's cost of capital even in the case where equity is chosen as the marginal source of finance, and it suggests that international double taxation agreements that aim to reduce the burden of such taxes should primarily be seen as satisfying distributional rather than allocative objectives.[1] Sinn's evaluation of double taxation agreements was derived from a model that included a rich set of taxes, but was limited to mature, dividend paying subsidiaries and did not consider the tax influence on the growth toward maturity. Hartman's article was more explicit on the distinction between mature and immature firms, and included a brief discussion of the latter. However, as will be clarified in the seventh section, not all of its views fit well in the framework developed here.

The second building block is Sinn's article on the dynamic effects of dividend taxation (1991a). That article derived the full growth path of the subsidiary, from birth toward maturity, and it showed that taxes on profit repatriations imply the nucleus hypothesis. However, the tax on repatriations was the only tax considered.[2]

This paper combines the previous approaches by studying the firm's growth path under a richer set of taxes, including home taxes on the parent's interest income, home taxes on its capital gains, host taxes on the subsidiary's retentions, and home and host taxes on cross-border profit distributions. Its novelty consists in the derivation of a number of comparative static results concerning the influence of taxation on the immature subsidiary's investment decisions. These results answer some of the questions posed.

In the next section, I set up the formal model and explain the solution that is derived in the appendix. In the third through sixth sections, I offer the comparative static results, starting with the straightforward results and proceeding toward more sophisticated and unexpected ones. In the seventh section, I compare my results with a frequently used weighted average approach and the final section offers some conclusions.

While the paper is phrased in terms of direct investment, it should be emphasized that the model actually used is general enough to include the tax influence on the birth and development of a domestic corporation. The only difficulty with that interpretation is that a domestic corporation may be able to channel its profit distributions through share repurchases instead of dividends, a case that is of some importance in the United States (but less so in other countries).[3] Apart from that, however, the reinterpretation of the model is straightforward when the "parent" is replaced with a shareholder household and the "subsidiary" with a domestic corporation. For the sake of clarity and convenience, the terminology is limited to the case of direct investment.

Taxation and the Optimization Problem of the Parent

Applying Jun's (1989) idea of the "parent-veil", it is assumed that the parent chooses a policy of direct investment that maximizes the subsidiary's market value net of some initial equity transfer K_1. This policy is in the interest of the parent's shareholders because it maximizes their wealth and lowers their intertemporal budget constraints as far as possible.

Four separate tax rates are considered. The home country's rate of corporate tax, τ, which is applied to the parent's return from alternative investment projects available in the domestic capital market; the host country's rate of corporate tax, τ^*, which is applied to the subsidiary's reinvested earnings; the home country's rate of tax on capital gains, c, from an appreciation of the subsidiary's market value; and the overall tax rate on profit repatriations, r, which may consist of home and host country taxes.[4] All tax rates are bounded away from unity and may or may not be set equal to zero. In addition, there is a lump-sum tax or royalty generating the revenue, X, in each period.

Following the general principle of income accounting for corporations, the capital gains tax is modeled as a tax on accrued rather than realized capital gains. In practice, such a tax is far less important than in accounting theory. On the one hand, most tax laws do not require adjustment of the value of a subsidiary in the parent's tax balance sheet and limit taxation to the rare cases of realizations. On the other hand, principles of cautious bookkeeping (e.g., *Niederstwertprinzip* in Germany) often make it unnecessary for a company to revise the value of its marketable assets upward even if those do not formally qualify for an exemption from capital gains taxation. Both provisions are captured indirectly by the present approach in that a relatively low equivalent tax on accrued capital gains is assumed.

The rate of tax on repatriated earnings, r, is a *mixtum compositum* that captures home-country corporate taxes, host-country corporate taxes, host-country withholding taxes, and different rules for crediting and deductions.[5] When there is sufficient ownership of the parent (e.g., 10 percent or more in the United States, where the parent is majority owned by U.S. citizens), most countries use the credit-cum-deferral system. This system implies that the rate of tax on repatriated earnings is the higher of the home country's corporate tax rate and the sum of the host country's corporate and withholding tax rates. A number of countries apply the exemption instead of the credit system, sometimes also known under the name "international affiliation privilege". With the exemption system, the rate of tax on repatriations equals the sum of the host country's corporate and withholding taxes regardless of whether or not the home country's tax rate is higher than this sum. Another set of countries uses the credit system without deferral. This system is identical with the other two systems when the domestic corporate tax rate is low and parent companies are in an excess credit position. On the other hand, if the domestic corporate tax rate exceeds the average foreign tax rate on retained and repatriated earnings, then the domestic corporate tax rate is the relevant rate for both these kinds of earnings. Finally, in the case of insufficient ownership, most countries apply the deduction method. This method means that the repatriations net of the foreign corporate and withholding taxes are fully subject to the domestic corporate tax.

Detailed assumptions about which systems are being used are not necessary in this paper. However, it will be assumed that there is a preference for a deferral of profit repatriations in the sense that the overall tax burden on these repatriations exceeds that on profit retentions within the subsidiary:

$$r > 1 - (1 - \tau^*)(1 - c). \tag{1}$$

This condition is feasible under all four systems described and it is certainly satisfied for direct investment in tax havens. It is the typical assumption of the literature on direct investment.[6]

Given the tax system described, the subsidiary's market value is implicitly determined by the following arbitrage calculus, which requires the parent to be indifferent between keeping and selling the subsidiary at each instant of time, t.

$$R(1 - r) + (\dot{M} - T)(1 - c) = M\, i(1 - \tau). \tag{2}$$

Here, i is the (time invariant) rate of interest at which the parent can borrow and lend in the capital market, $R(t)$ is the flow of profit repatriations before foreign and domestic taxes, $M(t)$ the market value of the subsidiary, $\dot{M}(t)$ is its derivative with respect to time, and $T(t)$ a potential flow of equity transfers from the parent to the subsidiary. The left-hand side of equation (2) is the parent's implicit net-of-tax income from owning the subsidiary. The right-hand side is the opportunity cost of this ownership in terms of the net-of-tax interest income the parent could earn by selling the subsidiary and investing the proceeds in the capital market. Integration of equation (2) with respect to time gives an explicit expression for the subsidiary's market value at arbitrary points in time t.[7]

$$M(t) = \int_t^{\infty} \left[R(v)\,\frac{1 - r}{1 - c} - T(v) \right] \exp\left[-(v - t)\, i\,\frac{1 - \tau}{1 - c} \right] dv \tag{3}$$

The market value is defined up to an arbitrary integration constant; however, since this constant is irrelevant for the firm's optimization problem, it is set equal to zero. To satisfy the transversality condition of the firm's optimization problem, it must be assumed that

$$\lim_{v\to\infty}\{[R(v)(1 - r)/(1 - c)] - T(v)\} \exp\,[-(v - t)i(1 - \tau)/(1 - c)] = 0.$$

Let $f(K)$ denote the subsidiary's profit (or output) as a function of its stock of equity capital K.[8] The function is assumed to be positive, increasing, unbounded from above, and strictly concave. The latter reflects the assumption that there is a fixed, nonmarketable factor such as a natural resource or simply "entrepreneurship" in the background whose return accrues to the subsidiary. The flow of before-tax profit repatriations that the subsidiary generates is given by

$$R = f(K) - \dot{K} + T - X - \tau^*[f(K) - R - X], \tag{4}$$

where τ^* is the foreign rate of corporate tax on retained earnings, $\dot{K}$ is real net investment, and X is the lump-sum tax or royalty. It is assumed that the royalty is sufficiently small to allow for $\dot{K} > \epsilon$ in all stages of the subsidiary's development process, where ϵ is an arbitrarily small, strictly positive constant.

The subsidiary is founded at time t_1, where the investment opportunities characterized by $f(K)$ become available. Let K_1 be an initial stock transfer of equity that may or may not be amended by additional flow injections T at later points in time. Then the optimization problem can be written as

$$\max_{\{\dot{K},T,K_1\}} M(t_1) - K_1 \quad \text{s.t.} \quad K_1, T, R \geq 0. \tag{5}$$

The state variable of this problem is K and the controls are $\dot{K}$, T, and K_1. The constraints are essential to depict the fundamental tax asymmetry of the problem that consists in the fact that the government taxes the repatriations, but does not subsidize the equity transfers from the parent.[9] Share repurchases that could, in principle, be a justification for allowing T to be negative are forbidden.[10]

The formal solution of problem (5) by means of Pontryagin's maximum principle has been delegated to the Appendix. The nature of the solution is the same as that found in Sinn (1991a) for a variant of the model that has only a dividend tax.

Provided the investment projects described by the function $f(K)$ are profitable enough to make the foundation of the subsidiary worthwhile, the three phases of development described by the nucleus hypothesis are endogenously generated by the model. At the time of foundation, phase 1, the

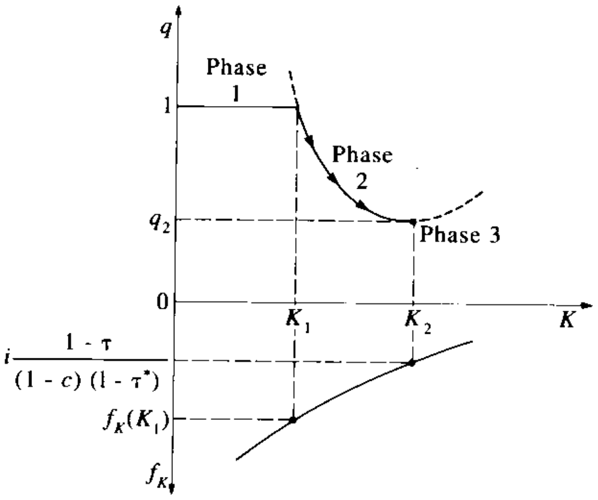

Fig. 1. The nucleus hypothesis

subsidiary receives a strictly positive lump-sum transfer $K_1 > 0$, the "nucleus". Then it enters a period of purely internal growth, phase 2, where no dividends are paid to the parent and no further transfers are received. Finally, it reaches a stage of maturity, phase 3, that is characterized by a capital stock K_2, $K_2 > K_1$, where it stays forever and repatriates its profits.

The solution is illustrated in figure 1, which shows a diagram with the subsidiary's equity K, the marginal value of this equity q, and the (marginal) pretax rate of return to capital $f_K(K)$ measured along the axes. The pretax rate of return to capital chosen at a particular stage of development equals the firm's cost of capital.

At the time of foundation, $q = 1$, since the parent transfers capital to the subsidiary up to the point where the increase of the subsidiary's market value resulting from an additional dollar of capital just equals one dollar:

$$q = 1 \quad \text{for } K = K_1. \tag{6}$$

After this, during the phase of internal growth, q declines monotonically, and K increases monotonically. The change of q satisfies the equation

$$(1 - c)[f_K(K)(1 - \tau^*) + \dot{q}/q] = (1 - \tau)i, \quad \text{for } K_1 \leq K \leq K_2, \tag{7}$$

and, because of equation (4) and $R = T = 0$, the change of K is given by

$$\dot{K} = [f(K) - X](1 - \tau^*), \quad \text{for } K_1 \leq K \leq K_2. \tag{8}$$

Equation (7) is the counterpart of the fundamental arbitrage condition (2). When $R = T = 0$, the latter implies that the subsidiary's market value appreciates at a rate that is sufficiently high to create net-of-tax capital gains that just match the net-of-tax interest income that a capital market investment would yield: $(\dot{M}/M)(1 - c) = i(1 - \tau)$. The former shows that the rate of appreciation of the subsidiary's market value equals the rate of return from direct investment net of the host country's corporate tax, $f_K \cdot (1 - \tau^*)$, minus the rate of decline in the *marginal* value of equity, $-\dot{q}/q$. Solving equation (7) for $\dot{q}$ and dividing the result by equation (8) generates an expression for the slope of the optimal path in (q, K) space that will be useful for subsequent comparative static analyses:

$$\frac{dq}{dK} = \frac{\dot{q}}{\dot{K}} = \frac{q\left[\frac{1-\tau}{(1-c)(1-\tau^*)}\, i - f_K(K)\right]}{f(K) - X}, \quad \text{for } K_1 \leq K \leq K_2. \tag{9}$$

The reason for the decline in q is that the marginal value of equity available in the subsidiary will be given by

$$q = \frac{1 - r}{(1 - c)(1 - \tau^*)} < 1, \quad \text{for } K = K_2, \tag{10}$$

once the subsidiary has matured and profits are being repatriated to the parent. This value of q is the one that models sharing the so-called new view generate. It falls short of unity because of the basic assumption that the tax system favors deferral. Let q_2 denote the mature subsidiary's value of q, as given by equation (10). The firm's cost of capital in the stage of maturity is given by the well-known equation

$$f_K(K) = i\,\frac{1 - \tau}{(1 - c)(1 - \tau^*)}, \quad \text{for } K = K_2, \tag{11}$$

which describes the firm's investment behavior when retained earnings are the marginal source of finance.[11]

Equations (9), (10), and (11), together with the starting condition $q = 1$ from equation (6), will be used in subsequent sections to derive comparative static results for the effects of tax reforms on direct investment. It is obvious from the three equations that some of the taxes have similar effects and others have opposite ones. This feature reflects the fact that the model is basically a portfolio-choice approach where the parent compares alternative investment strategies that all bear some sort of tax. The symmetries of the tax effects will help simplify the analysis.

Taxes on Repatriations and Worldwide Corporate Tax Reforms

The main purpose of international double taxation agreements has always been to reduce the tax burden on cross-border profit repatriations and to find a fair compromise between the home- and host-country interests in revenue collection. Economists, on the other hand, have pointed to the allocative implications of the double taxation agreements, emphasizing that severe distortions in the international allocation of capital could result from taxes on profit repatriations. Most experts agree that taxes on repatriations scare direct investment away and may, therefore, not be in the interest of the country collecting the tax revenue. However, as mentioned in the introduction, even among economists there have been voices that have played down the allocative problems, arguing that taxes on profit repatriations are fairly neutral and that the double taxation agreements should, indeed, be seen primarily under distributional aspects. The present model is able to reconcile these diverging views.

On the one hand, equation (11) shows that the rate of tax on repatriations, r, is irrelevant for the mature subsidiary's optimal capital stock K_2. As this subsidiary repatriates its earnings, a reduction in the repatriations is always available as a marginal source of finance. Even a high tax rate does not discriminate against investment, since the subsidiary's marginal investment outlay enjoys an immediate subsidy in terms of reduced taxes on repatriations that just compensates for the taxes on the future repatriations that this investment will generate.

On the other hand, equations (9) and (10) make clear that the subsidiary's starting stock of equity, K_1, will be smaller, and the initial cost of capital $f_K(K_1)$ higher, the higher the rate of tax on repatriations, r. Equation (9) describes a set of potential paths in (q, K) space that is independent of r, and equation (10) singles out one of these paths by determining the terminal value of q, q_2. Since q_2 declines with an increase in r, the starting stock of capital, determined by the intersection of the path with the $q = 1$ locus, must do so too. The result is illustrated in figure 2 by the shift from the upper to the lower path of q and the corresponding shifts from q_2 to q_2' and from K_1 to K_1'.

Obviously, unlike Sinn's contention (1984), double taxation agreements that reduce the overall tax burden on profit repatriations will, indeed, stimulate direct investment. Parents endow their subsidiaries with a higher "birth weight" than they otherwise would have done, and the phase of growth toward

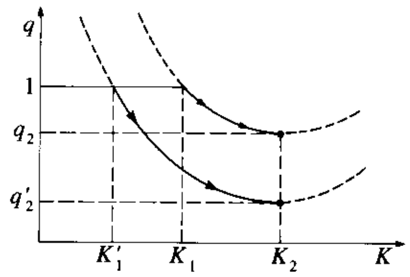

Fig. 2. Taxes on profit repatriations

maturity will be shorter. On the other hand, the final size of the subsidiary will, indeed, be independent of whether or not there are such double taxation agreements. In a mature subsidiary, only the proportions of surplus and original capital are affected by the overall tax burden on profit repatriations, not the size of the sum of these two kinds of equity capital itself.

A corollary of the result is that double taxation agreements come too late, when the tax burden on repatriations really hurts, for then the subsidiaries are mature and have reached their ultimate sizes. In order to be effective, the agreements must be known before the subsidiaries are founded, because only then will they be able to affect a subsidiary's size at birth and the speed at which it grows to maturity.

Another corollary is that the actual, measurable tax burden on the subsidiary's profits does not reveal much about its cost of capital f_K. When this burden is high, because the subsidiary is mature and repatriates its earnings, the cost of capital is low; and when the burden is low, because the subsidiary is immature and does not yet repatriate, the cost of capital is high. If anything, there is an inverse relationship between the measurable tax burden and the cost of capital at any given time.

While the discussion has centered around the role of taxes on profit repatriations, the portfolio nature of the problem solved by the parent implies that analogous allocative results can be derived by changing other taxes. Suppose, for example, that there are no capital gains taxes ($c = 0$) and that the host and home countries have the same corporate tax rates ($\tau^* = \tau$), while withholding taxes continue to keep q_2 below one. It is clear from equations (9) through (11) that in this case a worldwide cut in corporate taxes, accompanied by an increase in withholding taxes that just keeps the level of r constant, would have exactly the same effects as the isolated increase in r. This tax reform, too, would reduce the subsidiary's optimal birth weight, increase its initial cost of capital, but leave its size at maturity unaffected.

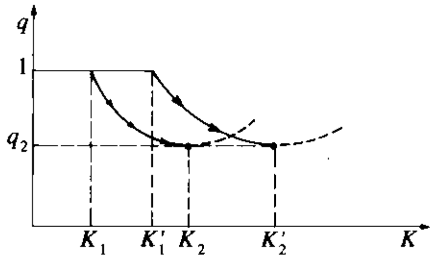

Fig. 3. Lowering the opportunity cost of direct investment

Domestic Tax Reforms with Excess Credits or Exemption

The way a domestic reform of corporate taxation affects direct investment depends very much on whether this reform will only affect the parent's opportunity cost of capital, $i(1 - \tau)$, or whether it will also change the tax burden on profit repatriations, r, and possibly even the capital gains tax rate, c. In this section, I disregard any effect on the capital gains tax rate and assume that the home country either employs the exemption method (as Germany does) or has tax rates low enough to create an excess credit position for the subsidiary considered (as, perhaps, in the United States).[12] The two latter assumptions imply that variations in the home country's corporate tax rate, τ, do not translate into variations in the overall rate of tax on repatriated profits (the case where they do will be analyzed in the sixth section). Note that, because of the possible existence of host-country withholding taxes, the case considered does not exclude the preference for deferral, as assumed with equation (1).

Under these conditions, the parent's reactions to an increase in the domestic rate of corporate tax, τ, is readily apparent from inspecting equations (9) through (11). The mature subsidiary's marginal value of equity q, as given by equation (10), does not change, but equation (11) reveals that its cost of capital, $f_K(K_2)$, decreases, implying that its stock of capital increases. Moreover, it follows from equation (9) that the slopes of the possible paths of q in phase 2, the period of internal growth, decrease in any given point of the (q, K) diagram (which means that the paths are becoming steeper). The unambiguous result is that the parent finds it optimal to provide its subsidiary with a larger starting stock of capital, K_1, and that the cost of equity capital at the time of foundation, $f_K(K_1)$, declines. Figure 3 illustrates the solution in (q, K) space, where the primes again characterize postreform values.

Once again the result is easy to explain intuitively if it is seen as an

implication of the parent's portfolio-choice problem. Under the given assumptions, an increase in the home country's corporate tax rate reduces the net rate of return from domestic investment and makes it attractive to channel more funds abroad both by increasing the initial equity transfer K_1 and by allowing the subsidiary to keep a higher stock of capital at maturity.[13] In fact, the result is indistinguishable from a decline in the pretax rate of return, i, on the parent's domestic investment opportunities (cf. eqs. [9] and [11]).

Royalties, Lump-Sum Taxes, and Intramarginal Deductibles

A fundamental wisdom that lobbyists tell their governments is that all taxes reduce investment, including pure lump-sum taxes. And a fundamental wisdom that economic theorists tell their students is that lump-sum taxes do not affect a firm's behavior because there is no income effect for competitive, profit-maximizing firms. The present model shows that they may both be wrong.

It is true that the flow of lump-sum taxes, X, that the firm has to pay at each point in time during its existence cannot directly affect the subsidiary's investment conditions. The maturity conditions (10) and (11) stay unaffected, and so does the marginal investment condition (7) for the phase of internal growth. However, as shown by equation (8), the lump-sum tax slows down the firm's accumulation of capital and implies that the slopes of possible paths in (q, K) space as given by eq. [9] are getting smaller (i.e., more strongly negative) at each point left of K_2. Given K_2 and q_2, this clearly implies that the initial capital transfer from the parent to the subsidiary rises and that, accordingly, the cost of capital $f'(K_1)$ declines. Figure 4 illustrates the solution.

In the light of the opinions cited previously, the result may, at first glance, seem counterintuitive. However, in fact, it describes a very rational response by the parent. With any given stock of initial capital, K_1, the subsequent payment of lump-sum taxes reduces the speed at which capital can be accumulated and at which the pretax rate of return, f_K, declines. Thus, an additional unit of equity made available to the subsidiary will grow at a higher rate and for a longer time, generating a higher present value of dividends than otherwise would have been the case. Lump-sum taxes raise the initial value of q for any given value of the starting stock of equity K_1 and make it wise to choose a higher value of this stock than would have been optimal without them.

The result is equally applicable to other lump-sum payments made or received by the subsidiary. For example, it implies that a developing country that charges a foreign subsidiary with a fixed royalty per annum does not necessarily have to be afraid of scaring direct investment away. While it is true

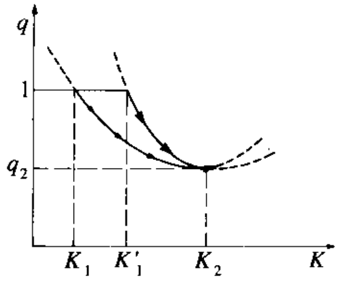

Fig. 4. Royalties and lump-sum taxes

that a sufficiently large royalty can render the whole enterprise unprofitable and prevent it from being started, it is not the case that the country has to suffer from reduced equity injections by the parent or a reduced scale of the mature subsidiary's operations *if* the investment is going to take place. On the contrary, the royalty does not affect the size of the mature subsidiary and even stimulates the parent to endow its subsidiary with a larger initial stock of equity capital than it otherwise would have done.

An obvious corollary of the result is that lump-sum subsidies or intramarginal deductibles in the host country's tax schedule reduce the investment. While these measures are neutral with regard to the subsidiary's size at maturity, they will increase the cost of capital for outside equity injections and reduce the subsidiary's optimal birth weight.

The ultimate reason for these surprising nonneutralities in a neoclassical model of the firm is to be found not in irrationalities, market imperfections, or flaws in economic theory. It is to be found in the asymmetries and rigidities of the tax laws. With an advantage of deferral, the subsidiary is an equity trap that provokes other reactions in the prey than conventional wisdom suggests.

Deferral and the Cost of Capital

Another unproven folk theorem in the theory of taxation is that deferral reduces the cost of capital and increases the marginal value of equity with any given stock of equity capital. This wisdom, too, is questioned by the present approach.

The conventional wisdom is based on the belief that the increase in the subsidiary's market value that results from the advantage of accumulating foreign earnings at a reduced tax rate carries over to an increase in the marginal value of equity, q. The lower the taxes on retained earnings, it is maintained, the higher is the rate at which an additional dollar of equity injected can grow to maturity and the higher is the present value of dividends that the dollar is able to generate.

The flaw in this argument is that it neglects the fact that the accumulation of earnings induced by the deferral reduces the firm's pretax rate of return to capital, $f_K(K)$. This reduction drives the posttax rate of return in the case of profit repatriations, $f_K \cdot (1 - r)$, to a value that is below the one available without the deferral. It is true, of course, that the firm's internal rate of return during the time of deferral, $f_K \cdot (1 - \tau^*)$, will be above the no-deferral rate $f_K \cdot (1 - r)$. However, the decline in the posttax rate of return in the phase of profit repatriations shows that there is an ambiguity in the impact of deferral on q that a purely verbal reasoning tends to conceal rather than resolve. It is unclear whether an additional dollar of equity given to a subsidiary that is growing from a no-deferral steady state toward a steady state with deferral will generate a higher present value of repatriations than a dollar given to a firm remaining in the no-deferral steady state would do.[14]

Unfortunately, an inspection of the three fundamental equations (9), (10), and (11) does not provide a quick answer either. A reduction in the tax rate on reinvested earnings, τ^* (or c), reduces the mature subsidiary's marginal value of equity q_2 (see eq. [10]), increases the corresponding stock of capital K_2 (eq. [11]), and makes the slopes of the possible paths in (q, K) space steeper (eq. [9]). Whether the intersection of the optimal path with the $q = 1$ line will shift to the left or to the right, that is, whether K_1 will decrease or increase is again unclear.

Nevertheless, the three equations can be used to derive a sufficient condition for the cost of capital at birth to increase with the introduction of deferral.[15] Let us assume, to consider the standard case, that investment occurs in a foreign tax haven that is sufficiently attractive to render the parent credit exhausted, that is, assume that $\tau = r$. And let us compare the case of no deferral with that of deferral, characterizing the optimal solutions for K_1, K_2, and q_2 in the latter case with primes.

Without deferral $[1 - \tau = (1 - c)(1 - \tau^*)]$ the domestic corporate tax rate applies uniformly to all earnings. The subsidiary will therefore be established in one step, receiving enough equity capital from the parent to satisfy the condition

$$f_K(K_1) = i, \quad K_1 = K_2 \text{ (no deferral)}. \tag{12}$$

With deferral $[1 - \tau < (1 - c)(1 - \tau^*)]$, equations (9) through (11) become

$$\frac{dq}{dK} = \frac{q[q'_2\, i - f_K(K)]}{f(K) - X}, \quad \text{for } K'_1 \le K \le K'_2, \tag{9'}$$

$$q = q'_2 \equiv \frac{1 - \tau}{(1 - c)(1 - \tau^*)} < 1, \quad \text{for } K = K'_2, \tag{10'}$$

and

$$f_K(K) = q_2'i, \quad \text{for } K = K_2'. \tag{11'}$$

The question is: will the subsidiary's marginal value of equity, q, associated with the optimal no-deferral endowment, K_1, fall short of unity? If the answer is yes, deferral reduces the subsidiary's optimal endowment with equity ($K_1' < K_1$) and increases its cost of capital at the time of birth [$f_K(K_1') > f_K(K_1)$].

To find an answer, it is useful to introduce two functions, $q(K)$ and $s(K)$. The former describes the optimal path of q in the phase of internal growth as predicted by the model, equations (9′) and (10′). The latter is defined as

$$s(K) \equiv f_K(K)/i. \tag{13}$$

Function $s(K)$ represents the marginal value of equity when all profits are being repatriated. In the range $q \leq 1$, its graph in (q, K) space is the geometrical locus of feasible maturity states attainable with different combinations of the tax rates $\tau = r$, τ^*, and c. Because of equation (12) and the definition of K_1',

$$q(K_1') = s(K_1) = 1, \tag{14}$$

and, because of equations (10′) and (11′),

$$q(K_2') = s(K_2') = q_2'. \tag{15}$$

The graphs of the two functions and other properties of the solution are shown in figure 5.

The general solution presented in figure 5 is the same as that illustrated in figure 1. However, the property that $q(K_1) < 1$ has yet to be derived.

Because $-\infty < q_K(K) < 0$ for $0 < K < K_2'$, equation (14), and equation (15), a sufficient condition for a solution with $q(K_1) < 1$ is

$$\frac{q_K(K)}{q(K)} > \frac{s_K(K)}{s(K)}, \quad \text{for } K_1 \leq K < K_2',$$

where the subscripts denote derivatives. After using equation (9′) and calculating s_K from equation (13), this inequality can be transformed to

$$\frac{q_2'i - f_K(K)}{f(K) - X} > \frac{f_{KK}(K)}{f_K(K)},$$

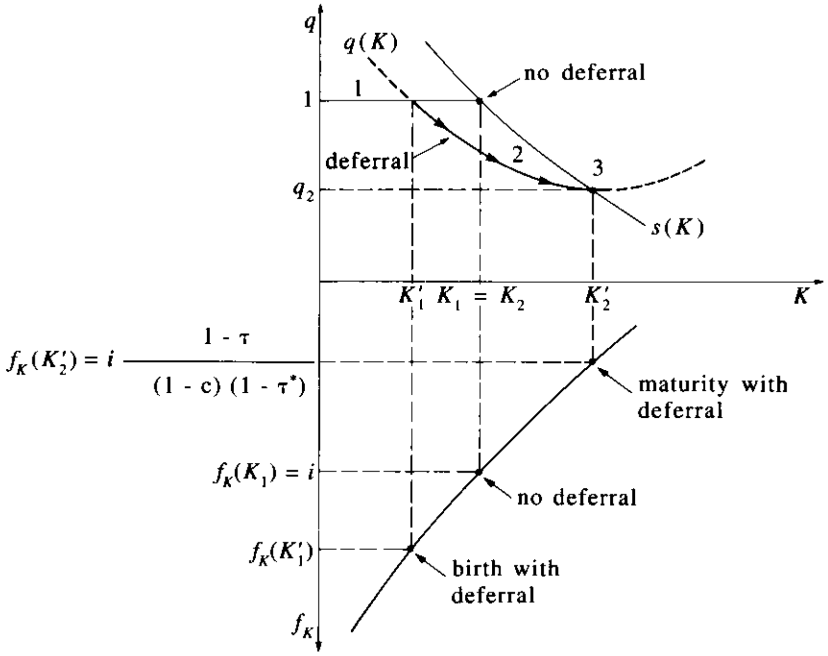

Fig. 5. The role of deferral

or

$$\frac{f_K - q_2'i}{f_K} < -\frac{f_{KK}}{f_K} K \cdot \frac{f}{f_K K} \left(1 - \frac{X}{f}\right). \tag{16}$$

To interpret this condition, let $f(K) \equiv \varphi(K,N)$ where φ is a linear homogeneous function of the factor capital and of a fixed factor, N, that is in the background and explains the existence of the subsidiary's rent. As mentioned earlier, this factor could, for example, be a local natural resource available to the subsidiary. Let $\sigma(K,N)$ be the Hicksian substitution elasticity, $\alpha(K,N)$ be the hidden factor's partial production elasticity, and $\beta(K,N)$ be the partial production elasticity of capital whereby, because of the linear homogeneity, $\alpha + \beta = 1$. Then, condition (16) can be written as

$$1 - \frac{q_2'i}{f_K} < \frac{\alpha/\beta}{\sigma} \left(1 - \frac{X}{f}\right). \tag{17}$$

Now, it follows from equation (12) and $f_{KK} < 0$ that $i/f_K \geq 1$ in the relevant range where $K \geq K_1$. Using this property and equation (10′) makes it possible to replace equation (17) with an even simpler sufficiency condition and to state the result that

$$K_1' < K_1, \quad f_K(K_1') > f_K(K_1) = i, \quad q(K_1) < 1, \tag{18}$$

if

$$1 - \frac{1-\tau}{(1-c)(1-\tau^*)} < \frac{\alpha/\beta}{\sigma}\left(1 - \frac{X}{f(K)}\right), \quad \text{for } K_1 \le K < K_2'.$$

This completes the proof that deferral may reduce the subsidiary's optimal endowment, increase the initial cost of capital, and reduce the value of q associated with the stock of capital chosen in the absence of deferral.

While condition (18) is only a sufficiency condition, it is an extremely weak condition when royalties are moderate or nonexistent. No detailed empirical investigation is necessary to see that the condition is very likely to be satisfied under realistic circumstances. An example may help clarify this. Suppose that $\tau = 0.4$, $\tau^* = 0.2$, $X = c = 0$, $\sigma = 1$ (Cobb-Douglas), and the subsidiary's pretax rate of return at maturity is 12 percent while the market rate of interest is 3 percent, both expressed in real terms. From the definition of $\beta(\beta \equiv f_K \cdot K/f)$ and equations (10′) and (11′), it follows that

$$\beta = \frac{1-\tau}{(1-c)(1-\tau^*)}\bar{\beta}$$

where $\bar{\beta}$ is the ratio of the interest rate to the pretax rate of return to capital. In the example, $\bar{\beta} = 0.03/0.12 = 0.25$ and $(1-\tau)/[(1-c)(1-\tau^*)] = 0.6/0.8 = 0.75$. Thus, $\beta = 0.1875$ and $\alpha = 1 - \beta = 0.8125$. Condition (18) becomes

$$1 - 0.75 < \frac{0.8125/0.1875}{1},$$

or

$$0.25 < 4.\bar{3}.$$

Obviously, it is satisfied with a very wide "safety margin".

As shown in condition (18), the margin shrinks when the host country collects royalties or intramarginal taxes to participate in the rents from direct investment. For the reasons explained in the previous section, such payments reduce the speed at which f_K declines and thus reduce the cost of capital at the time of birth. In the extreme case, where the host government collects all rents

that would occur under the no-deferral regime, that is, where $X/f(K_1) = \alpha$, the right-hand side of condition (18) reduces to α/σ or, in the example, to 0.8125. This is substantially less than $4.\bar{3}$, but it is still comfortably above 0.25.

Of course, it is possible to construct examples where sufficiency condition (18) is no longer satisfied. However, under a very wide range of plausible assumptions, there can be little doubt that condition (18) holds. While it is clear from the results of Hartman (1985) and Sinn (1984) that deferral reduces the cost of capital at the time of maturity, the model shows that it increases this cost at the time of birth. The fact that deferral reduces the birth weight of the subsidiary and creates an extended period of interior growth is the exact sense in which this model reproduces the nucleus hypothesis.

The economic reason for deferral making the initial capital shrink to a nucleus is the limitation of the available set of investment opportunities. If the deferral were possible up to a predetermined date at a fixed rate of return to capital, then it would, of course, be optimal to inject more equity capital into the firm to make use of these opportunities. The cost of capital at the time of birth would decline with the introduction of deferral. However, in the present model, where the investment opportunities are described by the concave production function $f(K)$, things are different. Here it is optimal to react to the possibility of deferral by injecting less equity into the subsidiary and accumulating more internally to exploit the tax advantages. Deferral creates an opportunity cost of equity transfers from the parent because it reduces the scope for useful internal investment. This opportunity cost increases the overall marginal cost of new equity injections above the cost of capital in the absence of deferral and implies that the birth weight sinks even though the subsidiary's market value rises.

I conclude this section by pointing to the similarities between the introduction of deferral and other tax reforms. It is obvious from equations (12), (9′), (10′), and (11′) that deferral affects the model solution exclusively by reducing the maturity level of q, q_2. Such a reduction can be, but does not have to be, brought about by a reduction in τ^*. An increase in the home country's corporate tax rate, τ, in a situation with deferral and credit exhaustion or a reduction in the capital gains tax rate, c, alter the solution of the model in exactly the same way. Starting from a situation with $q_2 = 1$, these measures, too, would reduce the cost of capital at the time of maturity and increase it at the time of birth.

The difference from the implications of an increase in the domestic tax rate in the case of excess credits is particularly striking. In an excess-credit situation, the domestic tax increase affects only the opportunity cost of direct investment, $i(1-\tau)$. This implies that the subsidiary receives a higher birth weight and is heavier when mature. In a situation of credit exhaustion, the increase in the domestic tax rate in addition increases the tax burden on profit repatriations that was discussed in isolation in the third section. Obviously, the latter effect dominates with regard to the birth weight and implies that the parent gives a lower endowment. However, for the new view's reasons, the increased tax on repatriations is irrelevant for the mature firm. After an increase in the domestic corporate tax rate, mature subsidiaries will employ a higher stock of capital even if the parent is credit exhausted.

A Comment on the Weighted Average Formulation of the Cost of Capital

The result that deferral increases the cost of capital cannot be reconciled with the popular weighted average formulations of the subsidiary's cost of capital. This section briefly describes the differences and explains the reasons for them.

The traditional formulation of the subsidiary's investment decision that dates back to Horst's (1977) seminal article is (in my notation)

$$\rho = (1 - \bar{\tau}) f_K(K), \tag{19}$$

where ρ is the parent's discount rate (which, in the present model, equals $i[1 - \tau]$) and $\bar{\tau}$ is a weighted average of the home and host country tax rates:

$$\bar{\tau} = \gamma\tau + (1 - \gamma)\tau^*. \tag{20}$$

The weights used in this expression are the dividend-payout ratio, γ, and one minus this ratio. Horst's approach is widely used in the public finance literature. However, there are at least three basic theoretical problems.

The first is that, in all likelihood, the weighted average formulation cannot be derived from a neoclassical firm's intertemporal optimization problem, such as the one set up in the second section, even if a constant dividend-payout ratio is introduced as an additional constraint.[16] It is true that Jun (1989) has provided an explicit optimization model that uses such a constant ratio and generates equations (19) and (20). However, he silently assumes that the subsidiary can repatriate its profits through a channel that avoids all taxes other than the host country's corporate tax on retained earnings, τ^*. In the equilibrium of the Jun model, which is characterized by $\dot{K} = 0$, the flow of tax-free repatriations equals $(1 - \gamma)(1 - \tau^*)f(\bar{K})$, where $\bar{K}$ is the stock of capital satisfying equation (19). A marginal dollar of investment undertaken in the subsidiary is entirely financed with a reduction in the tax-free repatriation and the future flow of returns this dollar generates is channeled into taxed and tax-free repatriations, where the proportions are given by γ and $1 - \gamma$. This feature explains the derivation of the weighted average formula.[17] The author describes his solution as one where "the subsidiary needs parent transfers in addition to retained earnings to finance investment" (Jun 1989, 10), however he models an equilibrium where the subsidiary transfers its "retained" earnings through an unspecified tax loophole to the parent.[18]

The second problem is that the assumption of a fixed dividend-payout ratio may be a rather poor description of the subsidiary's actual financing behavior. Signaling arguments that may be appropriate for publicly traded companies are certainly inappropriate for subsidiaries. The parent, at least, should be able to look through the subsidiary's "corporate veil". The actual behavior of subsidiaries first observed by Barlow and Wender (1955) and Penrose (1956 and 1959) cannot even be approximated by fixing the payout ratio, but it could be reproduced from the explicit optimization model derived here.

The third problem is that even the most sophisticated econometrician would be unable to construct "equivalent" weights in formula (20) in any meaningful way from a firm's dividend-payout behavior, if this firm behaved as described in the model. In his famous article on mature firms, Hartman (1985, 119) strongly defends the weighted average formulation for immature firms and he argues that "the [immature] subsidiary faces a tax rate between the host country tax rate and the home rate of taxing foreign source income, with the exact value depending on the timing of the deferred tax payments." If this view were correct, then the effective rate of tax on foreign direct investment ($\bar{\tau}$) would have to lie between the home- and host-country tax rates as long as the subsidiary is immature. Yet the previous section showed that the effective tax rate on marginal equity injections by the parent exceeds the home country's tax rate.[19] The weight, γ, in equation (20) would have to be greater than one and $1 - \gamma$ would have to be negative to justify the weighted average formulation.

The reason for some of these difficulties may be a conceptual mistake behind the weighted average formulation that relates to the cost of capital in the case of profit retentions. When all profits are retained ($\gamma = 0$), equations (19) and (20) imply that

$$\rho = (1 - \tau^*) f_K(K). \tag{21}$$

By way of contrast, this model's equation (7) implies for this case (with $c = 0$) that

$$\rho = (1 - \tau^*) f_K(K) + \dot{q}/q, \quad \text{where } \dot{q}/q < 0.$$

Equation (21) is certainly a plausible condition that seems correct at first glance. However, it is clear from my analysis here that the reinvestment of profits reduces q because it exhausts the available investment opportunities and drives the firm to a point where it no longer wants to reinvest. Only when this situation has been reached will q be a constant, and only then is equation (21) correct (cf. eq. [10′] and [11′]). However, then all profits are distributed, not retained.

In the light of the present model, a false interpretation of equation (21) is that τ^* is the tax on the returns from marginal investment projects. The true interpretation is that τ^* is a tax on the investment outlay that must be paid when an additional investment is financed with a reduction of the subsidiary's repatriations. Ignorance of this subtle but important difference may have contributed to the popularity of the weighted average formula.[20]

Conclusions

I have offered a model that describes the subsidiary's growth path from birth toward maturity and studied the effect of taxes on this growth path. In general, the tax influence on the optimal "birth weight" does not parallel that on the optimal "weight at maturity". Taxes on international profit repatriations reduce the optimal birth weight but do not affect the stock of capital employed at maturity. Deferral increases the optimal stock of capital at maturity, but reduces the optimal birth weight and increases the cost of equity transfer from the parent. An increase in the domestic corporate tax rate increases the optimal stocks of capital at both birth and maturity, when the parent is in an excess credit position. However, when the parent is credit exhausted, the domestic tax increase may reduce the optimal stock at birth and increase the optimal stock at maturity. Lump-sum taxes and royalties increase the subsidiary's equity endowment at birth and reduce its initial cost of capital, but they do not affect the subsidiary's behavior when mature.

Some of these results contradict the folk theorems of economics, but they all follow from a straightforward, purely neoclassical optimization model of the firm extended with the constraints imposed by the tax system. To understand them, it is crucial to see the subsidiary's cost of capital at birth in terms of the internal investment opportunities forgone when the initial equity endowment increases. As a rule, measures that facilitate or favor internal investment increase the opportunity cost of new equity injections and reduce the optimal starting stock of equity. This rule explains the seemingly perverse effects of deferral and lump-sum taxation. Deferral increases the cost of equity transfers from the parent because it favors retentions, and lump-sum taxes reduce the cost of equity transfers because they impede retentions.

The opportunity cost element sharply distinguishes the investment behavior derived in this paper from the results of the previous literature on taxation and direct investment. Typically that literature makes the choice of financial alternatives exogenous to the firm. When this choice is endogenized along the lines suggested here, the opportunity cost interpretation of the subsidiary's cost of capital is a natural implication.

The financial alternatives considered were, for sources of finance, equity transfers from the parent and withheld profit repatriations and, for uses of profits, repatriations and retentions. Debt financing has been neglected because it does not seem to be the central issue in direct investment. An optimal debt-equity choice, just like an optimal choice of other nonspecified input factors, was implicitly assumed to stand behind the function $f(K)$, which indicated the firm's maximum level of earnings associated with alternative values of its stock of equity capital, K. A more explicit treatment of debt financing may be useful, but it will probably not alter the conclusions of this paper if it includes factors that rule out the corner solutions resulting from a Modigliani-Miller specification.

Other extensions worth pursuing include a limitation of domestic investment opportunities, exchange risks, inflation, or international tax base differences. The present paper abstracted from these complications in order to focus on what, arguably, are the most important tax aspects of direct investment. However, it is clear that empirical models should pay more attention to the possible extensions than this theoretical study did.

APPENDIX

This appendix derives the basic properties of a solution.

Solving equation (4) for R, using equation (3), and associating Kuhn-Tucker multipliers μ_R and μ_T with the flow constraints and the costate variable q (Tobin's q) with K, the Hamiltonian of problem (5) can be expressed as

$$H = \left[\frac{1-r}{1-c} + (1-\tau^*)\mu_R\right]\left[f(K) - X - \frac{\dot{K} - T}{1-\tau^*}\right] + q\dot{K} - T(1-\mu_T).$$

The necessary conditions for a maximum of the Hamiltonian with regard to $\dot{K}$ and T are

$$q = \frac{1-r}{(1-c)(1-\tau^*)} + \mu_R, \tag{A1}$$

and

$$\mu_R + \mu_T = 1 - \frac{1-r}{(1-c)(1-\tau^*)}, \tag{A2}$$

which together imply

$$\mu_T = 1 - q. \tag{A3}$$

The canonical equation $\partial H/\partial K + \dot{q} = q\, i(1 - \tau)/(1 - c)$ can be specified as

$$(1 - \tau^*)\left[\frac{1 - r}{(1 - c)(1 - \tau^*)} + \mu_R\right] f_K + \dot{q} = q\, i\frac{1 - \tau}{1 - c},$$

or, using equation (A1), as

$$(1 - c)[(1 - \tau^*)f_K + (\dot{q}/q)] = i(1 - \tau). \tag{A4}$$

The Kuhn-Tucker conditions of the problem are

$$\mu_T T = 0, \quad \mu_T \geq 0, \quad T \geq 0, \tag{A5}$$

and

$$\mu_R R = 0, \quad \mu_R \geq 0, \quad R \geq 0. \tag{A6}$$

Since $q(t) = \partial M(t)/\partial K(t)$, the maximization of $M(t_1)$ with regard to the initial equity injection, K_1, gives

$$q(t_1) = 1 \quad \text{(phase 1)}. \tag{A7}$$

The transversality condition is

$$\lim_{t\to\infty} q(t)\, K(t) \exp\left[-(t - t_1)\, i\frac{1 - \tau}{1 - c}\right] = 0 \quad \text{(phase 3)}. \tag{A8}$$

It follows from the preference for deferral (assumption [1]) that the right-hand side of equation (A2) is strictly positive, implying that the Kuhn-Tucker multipliers cannot both be zero. Because of equations (A5) and (A6), this rules out the possibility that the subsidiary repatriates profits while it is receiving transfers from the parent. Note, moreover, that the subsidiary will never receive a flow of transfers from the parent in addition to the initial equity injection satisfying equation (A7). If it did receive such a flow ($T > 0$) in some nondegenerate interval of time, equations (A3) and (A5) would require that $\mu_T = \dot{q} = 0$, and, according to equation (A4), K would have to say constant: $\dot{K} = 0$. This, however, contradicts the condition $T > 0$ and its implication $R = 0$, which would both result in $\dot{K} > 0$. Thus, the Kuhn-Tucker conditions (A5) and (A6) leave room only for two phases characterized by $T = R = 0$; μ_T, $\mu_R \geq 0$, $t > t_1$, and $R > 0$, $T = \mu_R = 0$, $t > t_1$, in addition to an initial stock injection phase.

In the first of these phases (phase 2), the subsidiary has no transactions with the parent and, thus, K increases gradually because profits are reinvested as given by equation (8) in the text. The development of q is determined by the general condition (A4) that has to hold throughout.

In the other phase (phase 3), it follows from $\mu_R = 0$, equation (A1), and (1) that

$$q = \frac{1 - r}{(1 - c)(1 - \tau^*)} < 1, \tag{A9}$$

and $\dot{q} = 0$. Together with equation (A4), the latter produces the new view's marginal investment condition

$$f_K(K) = i\frac{1 - \tau}{(1 - c)(1 - \tau^*)}, \tag{A10}$$

which in turn implies that $\dot{K} = 0$. Since the firm does not receive transfers from the parent ($T = 0$) and does not grow, it repatriates all its profits.

The optimal growth path of the subsidiary is a combination of the three phases that satisfies the transversality condition (A8) and the general requirement that there be no foreseen jumps in the costate variable, q. The only possibility is to start with phase 1; continue with phase 2, where f_K is sufficiently large to make $\dot{q}/q$ negative (satisfying eq. [A4]); and to end with phase 3, where q stays at the constant level given by equation (A9) and K remains at the level satisfying equation (A10).

There cannot be an immediate move from phase 1 to phase 3 since this would require a downward jump of q from the level given in equation (A7) to that given in equation (A9). The subsidiary can neither begin with phase 2 nor stay there forever. Beginning with this phase would mean starting with no capital and no profit, with the result that the subsidiary never gets off the ground. Staying there forever means violating the transversality condition (A8). As it was assumed that $f(K)$ is unbounded from above and that X is sufficiently small to allow an internal growth with $\dot{K} > \epsilon > 0$ in all stages of the development process, internal accumulation must, in finite time, lead to a point after which

$$\frac{\dot{K}}{K} = \left[\frac{f(K)}{K} - \frac{T}{K}\right](1 - \tau^*) > f_K \cdot (1 - \tau^*).$$

Because of equation (A4), this implies that

$$\frac{\dot{K}}{K} + \frac{\dot{q}}{q} > i\,\frac{1 - \tau}{1 - c},$$

and that the transversality condition cannot be satisfied.

The terminal conditions (A9) and (A10), the starting condition (A7) and the equations of motion for $\dot{K}$ and $\dot{q}$, (4) and (A4), uniquely determine the subsidiary's optimal path in (q, K) space as illustrated in figure 1.

NOTES

The author wishes to thank David Bradford and Jim Hines for useful discussions of the subject. This paper was written while the author was Olin Visiting Fellow at Woodrow Wilson School, Princeton University. The support of that institution is gratefully acknowledged. The work is part of the NBER's research program on international aspects of taxation.

1. The result is an application of what has become known as the so-called new view of corporate taxation that originates from the work of King (1974a, 1974b, and 1977) and was further developed by Auerbach (1979 and 1983), Bradford (1981), Edwards and Keen (1984), the author, and others.

2. A similar approach has recently been chosen in a useful working paper by Hines (1992). Hines allows for a richer set of taxes and focuses on the firm's debt-equity choice, but he neither derives the nucleus hypothesis from an optimization model nor develops unambiguous comparative static results concerning the tax influence on investment. The reader is also advised to consider King (1989), where the role of taxes for a corporation's birth is studied in a two-period framework.

3. For extensive discussions of the tax incentives for share repurchases and acquisitions, see Bagwell and Shoven (1989); Sinn (1985, chap. 6).

4. The analysis abstracts from nonconstant tax rates. For this, the reader is referred to Hines (1992); Howitt and Sinn (1989); Leechor and Mintz (1990).

5. For details, see Sinn (1985, chap. 7); Alworth (1988); Ault and Bradford (1990); Keen (1990).

6. If this assumption is not satisfied, it is optimal for the subsidiary to finance all investment with transfers from the parent and return all profits to the parent when they accrue. In that case, no dynamic model of the firm is necessary.

7. Alternatively, eq. (2) can be shown to imply that the market value is the present net-of-tax value of the cash flow $R(1 - r) - T - c\dot{M}$, which is generated by the subsidiary where $i(1 - \tau)$ rather than $i(1 - \tau)/(1 - c)$ is the discount rate. For a discussion of these two alternative, but economically equivalent formulations, see Sinn (1985, chap. 3). That discussion includes the case of a variable rate of interest.

8. For simplicity and because of the overwhelming empirical importance of equity finance for direct investment, this paper abstracts from debt financing. Function $f(K)$ may be interpreted as the firm's profit net of interest payments and other costs of debt financing resulting from an interior debt equity choice. Similarly, $f(K)$ can be seen as the subsidiary's profit net of payments to such other marketable factors as labor and intermediate inputs. These factors are assumed to be available at fixed prices and to be optimally employed by the subsidiary.

9. A tax-free return of the subsidiary's original capital can be allowed in the present model without any change in the results, provided this return cannot occur before the subsidiary's surplus capital has been returned. See n. 18 and Sinn (1991a, sec. 4.3), for a brief discussion of this possibility.

10. As far as is known, no country allows subsidiaries to repurchase their own shares from their parents, except for fundamental reorganizations of the conglomerate's ownership structure. Moreover, effective provisions exist against purchases of other companies' shares. For example, the subpart F rules of the U.S. tax code classify such repurchases as profit repatriations and require that they be taxed in the United States.

11. The value of q as given in eq. (10) could be derived from eq. (11) by discounting the flow of aftertax profit repatriations resulting from an additional dollar of investment, $f_K \cdot (1 - r)$ with the net-of-tax interest rate $i(1 - \tau)$, i.e., by setting $q = f_K \cdot (1 - r)/[i(1 - \tau)]$ and replacing f_K with the value given in eq. (11).

12. While not more than 40 percent of U.S. parents were in such a situation before the 1986 tax reforms, some observers had argued this fraction would jump to 70 percent after the reform, a prediction that turned out to be a strong overstatement. Cf. Grubert and Mutti (1987); Hines and Hubbard (1990). I am grateful to Jim Hines for providing me with this information.

13. Provided the third derivative of $f(K)$ is positive, zero, or not too strongly negative—a condition satisfied by plausible production functions—it will even be the case that an increase in τ raises the stock of surplus capital that the subsidiary accumulates during its growth toward maturity, $K_2 - K_1$. This result follows from eq. (9). Since $f_{KKK} \gtrless -\epsilon$ for ϵ sufficiently small and $f_K > 0$, the slope dq/dK is greater (i.e., less strongly negative) for $K_2' - y$ than for $K_2 - y$ whatever the value of y ($y > 0$). Since $q_2' = q_2$, this implies that $K_2' - K_1' > K_2 - K_1$.

14. The reduction in the posttax rate of return could be avoided if the subsidiary did not operate under decreasing rates of return or could invest unlimited amounts in the capital market while still enjoying the tax advantages of deferral. For a number of reasons, these conditions are of limited relevance, however. First, direct investment typically exploits unique and limited investment opportunities where true economic rents can be captured. Second, tax authorities have reduced the incentive for unlimited deferrals where they were extensively used. For example, the U.S. tax code (subpart F) categorizes interest income earned by subsidiaries as passive earnings and requires that it be taxed like profit repatriations. Third, excessive foreign financial investment progressively increases the parent's cost of monitoring, controlling, and protecting the assets. Fourth, there is the additional theoretical problem that the solution to the firm's planning problem would fail to exist if the subsidiary could invest at the same rate of interest as the parent, while still enjoying the advantages of deferral. Cf. Sinn's (1985, chap. 5.3.4) criticism of Stiglitz's (1973) neutrality result.

15. The proof resembles one given in Sinn (1991a, appendix). However, it is not identical because the latter referred to a variant of the model where $X = \tau = c = \tau^* = 0$ and $r > 0$, and was not phrased in terms of the deferral problem.

16. It is possible, however, to derive a weighted average formulation similar to eqs. (19) and (20) if the weights reflect the proportions of marginal investment financed with equity transfers from the parent and retained earnings within the subsidiary, respectively, and if it is assumed that all profits from this investment are repatriated. This is the approach chosen by Fullerton and King (1984) in a closed economy context. The other objections to Horst's specification, which will be given below, also apply to this approach. See Sinn (1988) for further details.

17. See Jun (1989), eq. (17), (18), (21) through (23).

18. Jun mentions the possibility of returning the original capital after all surplus capital has been returned (1989, 6). If this is the channel his equations are meant to refer to, then the equilibrium would not only be of limited duration; what is worse, it would not be feasible since the rule cited here prevents the firm from replacing its original capital with surplus capital.

In the present model, the possibility of returning the original capital after the surplus capital would be irrelevant for the solution since the firm would prefer to declare its repatriations as a return of original capital when $q < 1$; however, whenever $q < 1$, it has surplus capital that first must be returned (cf. fig. 1).

In a normal corporation, a loophole of the kind Jun's formulae require could be share repurchases (see, e.g., Poterba and Summers [1985]; Goulder and Summers [1989]). However, as mentioned in n. 10, this is not an admissible legal possibility for subsidiaries.

19. In the present model, eq. (19) can be written as $i(1 - \tau) = (1 - \bar{\tau})f_K$. As $f_K > i$ when the subsidiary receives equity from the parent, it follows that $\bar{\tau} > \tau > \tau^*$.

20. For a more extensive discussion of the misinterpretation of eq. (21), see Sinn (1991b, sec. 3).

REFERENCES

Alworth, J. S. 1986. A cost of capital approach to the taxation of foreign direct investment. In J. S. S. Edwards, J. Franks, C. Mayer, and S. Schaefer, eds., *Recent Developments in Corporate Finance*, 185–204. Cambridge: Cambridge University Press.

Alworth, J. S. 1988. *The Finance, Investment and Taxation Decisions of Multinationals*. Oxford: Basil Blackwell.

Auerbach, A. J. 1979. Wealth maximization and the cost of capital. *Quarterly Journal of Economics* 94:433–36.

Auerbach, A. J. 1983. Taxation, corporate financial policy and the cost of capital. *Journal of Economic Literature* 21:905–40.

Ault, H. J., and D. Bradford. 1990. Taxing international income: Analysis of the U.S. system and its economic premises. In A. Razin and J. Slemrod, eds., *Taxation in the Global Economy*, 11–46. Chicago: University of Chicago Press.

Bagwell, L. S., and J. Shoven. 1989. Cash distributions to shareholders. *Journal of Economic Perspectives* 3:129–40.

Barlow, E. R., and I. I. Wender. 1955. *Foreign Investment and Taxation*. Englewood Cliffs, N.J.: Halliday Lithograph.

Bradford, D. 1981. The incidence and allocation effects of a tax on corporate distributions. *Journal of Public Economics* 15:1–22.

Edwards, J. S. S., and M. J. Keen. 1984. Wealth maximization and the cost of capital: A comment. *Quarterly Journal of Economics* 99:211–14.

Fullerton, D., and M. King. 1984. *The Taxation of Income from Capital: A Comparative Study of the United States, the United Kingdom, Sweden, and West Germany*. Chicago: University of Chicago Press.

Goulder, L. H., and L. H. Summers. 1989. Tax policy, asset prices, and growth. *Journal of Public Economics* 38:265–96.

Grubert, H., and J. Mutti. 1987. The impact of the Tax Reform Act of 1986 on trade and capital flows. In *Treasury Compendium of Tax Policy Research*. Washington, D.C.: U.S. Department of the Treasury.

Hamada, K. 1966. Strategic aspects of taxation on foreign investment income. *Quarterly Journal of Economics* 80:361–75.

Hartman, D. 1985. Tax policy and foreign direct investment. *Journal of Public Economics* 26:107–21.

Hines, J. R. 1992. Credit and deferral as international investment incentives. Paper presented at TAPES, Munich, July 11–13, 1992.

Hines, J. R., and R. G. Hubbard. 1990. Coming home to America: Dividend repatriations by U.S. multinationals. In A. Razin and J. Slemrod, eds., *Taxation in the Global Economy*, 161–200. Chicago: University of Chicago Press.

Horst, T. 1977. American taxation of multinational firms. *American Economic Review* 67:376–89.

Howitt, P., and H.-W. Sinn. 1989. Gradual reforms of capital income taxation. *American Economic Review* 79:106–24.

Jun, J. 1989. Tax policy and international direct investment. National Bureau of Economic Research, Working Paper no. 3048. Mimeo.

Keen, M. 1990. Corporation tax, foreign direct investment and the single market. *Economic Policy*. Forthcoming.

Kemp, M. C. 1962. Foreign direct investment and national advantage. *Economic Record* 38:56–62.

Kemp, M. C. 1964. *The Pure Theory of International Trade*. Englewood Cliffs, N.J.: Prentice-Hall.

King, M. A. 1974a. Dividend behaviour and the theory of the firm. *Economica* 41:25–34.

King, M. A. 1974b. Taxation and the cost of capital. *Review of Economic Studies* 41:21–35.

King, M. A. 1977. *Public Policy and the Corporation*. London: Chapman and Hall.

King, M. A. 1989. Economic growth and the life-cycle of firms. *European Economic Review* 33:325–34.

Leechor, C., and J. Mintz. 1990. On the taxation of multinational corporate investment when the deferral method is used by the capital exporting country. Department of Economics and Institute for Policy Analysis, University of Toronto, Working Paper no. 9013. Mimeo.

MacDougall, G. D. A. 1960. The benefits and costs of private investment from abroad: A theoretical approach. *Oxford Bulletin of Economics and Statistics* 22:189–211.

Musgrave, P. B. 1969. *United States Taxation of Foreign Investment Income: Issues and Arguments*. Cambridge, Mass.: Harvard University Law School.

Penrose, E. T. 1956. Foreign investment and the growth of the firm. *Economic Journal* 66:220–55.

Penrose, E. T. 1959. *The Theory of the Growth of the Firm*. Oxford: Basil Blackwell.

Poterba, J. M., and L. Summers. 1985. The economic effects of dividend taxation. In E. Altman and M. Subrahmanyam, eds., *Recent Advances in Corporate Finance*, 227–85. Homewood, Ill.: Irwin.

Razin, A., and J. Slemrod. 1990. *Taxation in the Global Economy*. Chicago: University of Chicago Press.

Richman, P. B. 1963. *Taxation of Foreign Investment Income: An Economic Analysis*. Baltimore: Johns Hopkins University Press.

Robbins, S. M., and R. B. Stobaugh. 1973. *Money in the Multinational Enterprise: A Study of Financial Policy*. New York: Longman Group.

Sato, M., and R. M. Bird. 1975. International aspects of the taxation of corporations and shareholders. *International Monetary Fund Staff Papers* 22:384–455.

Sinn, H.-W. 1984. Die Bedeutung des Accelerated Cost Recovery System für den internationalen Kapitalverkehr. *Kyklos* 37:542–76.

Sinn, H.-W. 1985. *Kapitaleinkommensbesteuerung*. Tübingen: Mohr-Siebeck. English ed.: *Capital Income Taxation and Resource Allocation*. Amsterdam: North-Holland, 1987.

Sinn, H.-W. 1989. The policy of tax-cut-cum-base-broadening: Implications for international capital movements. In M. Neumann and K. Roskamp, eds., *Public Finance and Performance of Enterprises*, 153–77. Detroit: Wayne State University Press.

Sinn, H.-W. 1991a. The vanishing Harberger triangle. *Journal of Public Economics* 45:271–300.

Sinn, H.-W. 1991b. Taxation and the cost of capital: The "old" view, the "new" view, and another view. *Tax Policy and the Economy* 5:25–55.

Sørensen, P. B. 1989. Issues in the theory of international tax coordination. University of Copenhagen. Mimeo.

Stiglitz, J. E. 1973. Taxation, corporate financial policy, and the cost of capital. *Journal of Public Economics* 21:1–34.