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TAXATION AND THE TRANSFER OF TECHNOLOGY BY MULTINATIONAL FIRMS

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Abstract:

This paper analyzes a multinational's transfer of technology to a foreign subsidiary for the case where there is a risk of expropriation. An expropriation is assumed to give rise to competition between the parts of the previous multinational enterprise. To reduce the benefit of expropriation, the multinational generally transfers an inferior technology, even if the transfer of technology is costless. With a reduced benefit of expropriation, the multinational has to pay lower taxes to prevent expropriation. The multinational optimally transfers additional technology over time if it has a finite horizon in the country. For this case, tax payments also are shown to increase over time in a tax holiday like fashion.

I. Introduction

A chief factor in economic development is the transfer of technologies from the industrialized countries to the less developed countries. In the theoretical literature, technology transfers are frequently thought to be coincident with capital inflows. Koizumi and Kopecky (1977), for instance, assume that the rate of technology transfer increases with the extent of foreign ownership of a country's capital. Findlay (1978) along similar lines assumes that technology transfers are related to the volume of foreign-produced capital goods in a country, and to the technology gap between the capital-exporting and capital-importing countries. Wang (1990) further examines technology transfers related to trade in physical capital in a growth model.

While technology transfers undoubtedly are in part the passive byproducts of international capital flows, they also to some extent reflect decision making by international enterpises. International enterprises first decide on their organizational form, i.e. they determine whether they will serve a foreign market by exporting, by licensing their technology, or by setting up a foreign subsidiary. Several papers, including Horstmann and Markusen (1987), Ethier (1986), and Wright (1993), examine how imperfections in the market for technology affect organizational choice. Multinational enterprises owning foreign subsidiaries arise, if the difficulties associated with selling information to an independently owned foreign firm are prohibitive. For a multinational, a second issue is the volume and timing of the transfer of technology to a foreign subsidiary. Wang (1992) shows that a multinational firm may strategically transfer less than state-of-the-art technology, if there are unintended spill-overs of transfered technologies to the multinational's local competitors. This result is consistent with the evidence on the age of transfered technologies in Mansfield and Romeo (1980).

This paper examines how the multinational's technology transfer decision is affected by expropriation risk. Expropriation can be an independent reason for the multinational to withhold its best technology, even if the transfer of this technology is costless. The multinational optimally transfers a somewhat backward technology to ensure that the foreign country cannot compete effectively with the original multinational enterprise, if it decides to expropriate the multinational's foreign production facility.[1] As a result, the multinational enterprise has to pay the host country less in taxes to prevent expropriation.

The longer the multinational's horizon in the foreign country, the larger the tax savings that the multinational firm can achieve by withholding technology. As a corrollary, the multinational firm faces an incentive to transfer additional technical expertise to its foreign subsidiary, as the multinational advances to the conclusion of its involvement in the foreign country. Corresponding to the gradual transfer of technology, the multinatio-nal's tax payments to the country are shown to increase over time in a tax holiday like fashion. The country is willing to accept low or even negative tax payments early on in the knowledge that the multinational firm will transfer more advanced technical know-how giving rise to higher tax payments in the future. Bond and Samuelson (1986) have shown that a tax holiday can arise in a two period model as a signal of the quality of a country's infrastructure or other factors affecting the profitability of foreign direct investment.

Previous work on the implications of expropriation risk for the taxation of foreign direct investment has primarily focused on its repercussions for international capital mobility. Eaton and Gersovitz [1984], for instance, demonstrate that expropriation risk can explain an inefficiently low movement of physical capital. This paper shows that expropri-ation risk similarly can explain an inefficiently low level of international technology transfer. Section 2 sets out the model of this paper, while section 3 concludes.

II. The model

Let there be a single multinational enterprise that operates plants at home and abroad. The multinational's output at plant i (i = h,f) is denoted x_t^i. The multinational firm exports its home and foreign output to a third country where it is a monopolist supplier. The outputs from the two plants are generally imperfect substitutes. Let $p_t^i(x_t^i, x_t^j)$ (i = h,f, $j \neq i$). be the price of good i in the third country, with dp_t^i/dx_t^i, $dp_t^i/x_t^j < 0$.[2] The multinational firm produces at unit cost, c_t^i, in country i. The unit cost, c_t^i, is assumed to be a choice variable for the multinational firm, subject to a lower bound, c_m, that reflects the firm's state-of-the-art technology. The lower bound, c_m, is given to the firm.[3] An alteration in the unit cost of production in country i, c_t^i, by the multinational firm is assumed to be costless. This assumption reflects the public goods nature of technical know-how. Only the multinational firm, however, can install or change a production technology at either plant.

The multinational enterprise is assumed to have a horizon of n periods in the foreign country. A multinational's horizon generally can be finite, because it has to replace an important fixed investment such as, for instance, a building each n periods. Alternatively, the horizon may be fixed, because the multinational manufactures products with a finite product cycle. The international real interest rate is constant and it is denoted r.

The multinational is subject to a risk of expropriation by the foreign country each period. The country is assumed to be able to operate the foreign plant with the previously transfered technology after an expropriation. An expropriation, however, is assumed to preclude the transfer of additional technology. The multinational firm pays the country an amount, T_t, in taxes in period t to preclude expropriation. Taxes are assumed to be levied on, say, the firm's sunk capital investments, and are assumed to not distort the production decision for a given transfered technology.[4] The multinational's home country instead does not tax the multinational. In the absence of any taxes, the multinational obviously chooses to produce at minimum cost, c_m, at home as well as abroad so that $c_t^j = c_m$. Given symmetric demands for the two goods, output levels, x_t^i and x_t^j, are then equal at both locales, and they remain constant through time. This section shows, however, that the risk of expropriation induces the multinational firm to produce at higher than minimum cost at its foreign plant.

The risk of expropriation stems from the foreign country's inability to commit to a path of non-confiscatory taxes on the multinational firm. In the present model, an expropriation implies a change in market structure, as the two plants enter into competition with each other after an expropration of the multinational's foreign plant. The nationalized subsidiary and the original parent company can be assumed to compete in, for instance, Cournot-Nash fashion if an expropriation has occurred. Combined duopoly profits after expropriation are clearly less than the before-expropriation worldwide pre-tax surplus generated by the original multinational enterprise. This follows as the intact multinational chooses output levels at the two plants so as to maximize world surplus, given the technical knowledge available at the two plants. The change in market structure brought on by an expropriation is an independent cost of expropriation. This cost is in addition to the break-down of the process of technology transfer, if any, within the multinational firm.[5] Previously, Eaton and Gersovitz [1984] have stressed that expropriation is costly, if the multinational firm withdraws management services or other skilled labor from its expropriated foreign investment. Alternatively, Cole and English [1991] asssume that expropration is costly, if the expropriating country cannot replace or add to the capital stock at the expropriated investment.

Pre-tax profits in country i, π_t^i, at time t are given by,

$$\pi_t^i = p_t^i(x_t^i, x_t^j)x_t^i - c_t^i x_t^i \tag{1}$$

In what follows, we have to distinguish between profits at a plant as operated by the intact multinational firm or as operated independently. To this end, let $\pi_t^{i,m}$ be the pre-tax profits in country i at time t, as obtained by a monopolist multinational enterprise. Similarly, let $\pi_t^{i,d}$ be the pre-tax profits in country i in the duopoly regime. Equilibrium duopoly profits in country i, $\pi_t^{i,d}$, are assumed to decline with unit cost at plant i, c_t^i, while they increase with the unit cost in country j, c_t^j, as follows,

$$\frac{d\pi_t^{i,d}}{dc_t^i} = x_t^{i,d}\left[\frac{dp_t^i}{dx_t^{j,d}}\frac{dx_t^{j,d}}{dc_t^i} - 1\right] < 0 \tag{2}$$

and,

$$\frac{d\pi_t^{i,d}}{dc_t^j} = x_t^{i,d}\frac{dp_t^i}{dx_t^{j,d}}\frac{dx_t^{j,d}}{dc_t^j} > 0$$

where we assume $dx_t^{j,d}/dc_t^i > 0$ and $dx_t^{j,d}/dc_t^j < 0$.[6]

We will assume that the foreign country expropriates the foreign plant if by doing so it can achieve higher profits than it receives in taxes from an intact multinational enterprise. Expropriation will in fact never occur, as the multinational will pay just sufficient taxes to make an expropriation unprofitable. Note that any after-expropriation duopoly profits given a transfered technology are constant for the remainder of the investment's lifespan, while tax payments, T_t, generally vary with time in the absence of an expropriation. It now follows that expropriation at time t is precluded if,

$$\sum_{s=t}^{n} \frac{\pi_t^{f,d}}{(1 + r)^{(s-t)}} \leq \sum_{s=t}^{n} \frac{T_s}{(1 + r)^{(s-t)}} \tag{3}$$

While the foreign country cannot commit to refrain from expropriation, let us assume that the firm similarly cannot commit to a plan of technology transfer to its foreign subsidiary. If such a plan were possible, then the joint surplus maximizing outcome would be for the country to offer the firm a sum of money upfront to once-and-for-all transfer its least-cost technology to its foreign subsidiary. This approach may be difficult for the country, however, if the necessary sum of money is large and if the country for whatever reason has limited access to international credit.

Let us now turn to the implications of expropriation risk for the path of technology transfers and taxes paid. To be precise, the order of events each period is as follows: (i) the multinational firm sets the minimum production costs at the two plants, (ii) the multinational offers the country a lump sum tax payment, (iii) the country accepts the tax payment offer or confiscates the foreign plant, (iv) the firm produces and exports its output to a third country (v) the country receives the tax payment. The n-period problem is solved backwards. Starting with period n, the firm sets the n^{th}-period cost variables, c_n^h and c_n^f, recognizing that the n^{th}-period tax payment, T_n, will equal $\pi_n^{f,d}$, conditional on c_n^h and c_n^f. Given these n^{th}-period variables, the firm then determines the cost variables c_{n-1}^h and c_{n-1}^f, etc.

The firm maximizes the present value of after-tax worldwide profits as follows,

$$V_0 = \sum_{t=0}^{n} [\pi_t^{f,m} + \pi_t^{h,m} - T_t] \frac{1}{(1 + r)^t} \tag{4}$$

subject to (3) and to,

$$c_t^h,\ c_t^f \geq c_m$$

The optimality conditions with respect to the firm's problem of choosing c_t^h and c_t^f, respectively, are given in (5) and (6) as follows,[7]

$$-\ x_t^{h,m}\ -\ \frac{1+r}{r}\left[1\ -\ \frac{1}{(1\ +\ r)^{n+1-t}}\right]\frac{d\pi_t^{f,d}}{dc_t^h}\ =\ 0 \quad \text{with } c_t^h \geq c_m \tag{5}$$

or,

$$<\ 0 \quad \text{with } c_t^h\ =\ c_m$$

$$-\ x_t^{f,m}\ -\ \frac{1+r}{r}\left[1\ -\ \frac{1}{(1\ +\ r)^{n+1-t}}\right]\frac{d\pi_t^{f,d}}{dc_t^f}\ =\ 0 \quad \text{with } c_t^f \geq c_m \tag{6}$$

or,

$$<\ 0 \quad \text{with } c_t^f\ =\ c_m$$

In deriving (5) and (6), use is made of the following facts,

$$\frac{d(\pi_t^{f,m}\ +\ \pi_t^{h,m})}{dc_t^h}\ =\ -\ x_t^{h,m}\ <\ 0$$

$$\frac{dT_t}{dc_t^h}\ =\ \frac{1+r}{r}\left[1\ -\ \frac{1}{(1\ +\ r)^{n+1-t}}\right]\frac{d\pi_t^{f,d}}{dc_t^h}\ >\ 0$$

$$\frac{d(\pi_t^{f,m} + \pi_t^{h,m})}{dc_t^f} = - x_t^{f,m} < 0$$

$$\frac{dT_t}{dc_t^f} = \frac{1+r}{r}\left[1 - \frac{1}{(1 + r)^{n+1-t}}\right]\frac{d\pi_t^{f,d}}{dc_t^f} < 0$$

From (5), we can easily see that dV_t/dc_t^h, which is the left hand side of (5), is negative for any possible value of c_t^h so that c_t^h is optimally set equal to the lower bound c_m, corresponding to the second line of (5). Turning to the foreign cost variable, c_t^f, we will first consider the foreign cost at time n, c_n^f. If the multinational selects to produce at minimum cost abroad, i.e. if $c_n^f = c_m$, then we see dV_n/dc_n^f, which is the left hand side of (6), is positive. This follows after we substitute for $d\pi_t^{f,d}/dc_t^f$ from (2) into (6) noting that $x_t^{f,d}$ exceeds $x_t^{f,m}$.[8] The multinational, therefore, optimally produces at higher than least-cost at the foreign plant in period n so that $c_n^f > c_m$ as in the first line of (6). The multinational in essence withholds technology from its own subsidiary in period n, as by doing so it achieves a reduction in its foreign tax liability that exceeds the reduction in pre-tax, worldwide profits. The withholding of technology by the multinational firm, of course, reduces the pre-tax worldwide profits achieved by the multinational.

Working backwards, we will now consider the optimal next-to-last period foreign cost variable, c_{n-1}^f. Equation (6) now implies that with $c_{n-1}^f = c_n^f$ we have $dV_{n-1}/dc_{n-1}^f > 0$. It follows that optimally $c_{n-1}^f > c_n^f$, or that the multinational chooses to produce at higher cost abroad in period n - 1 than in period n. The multinational finds it advantageous to withhold relatively more technology in period n - 1, as in the next-to-last period the present value of taxes that the multinational firm has to pay to prevent expropriation is more sensitive to the amount of technical knowledge transferred. The reason is that a withholding of technology in period n - 1 forces the country to operate with a relatively backward technology for two periods after an expropriation rather than only a single period. This result generalizes to earlier periods so that the optimal sequence of foreign production costs, from period 0 onwards, is characterized by $c_0^f > c_1^f > ... > c_n^f$. As a corrollary, the multinational transfers additional know-how to its foreign operation each period for the entire life-span of its involvement in the foreign country.

Next let us consider the implications of the gradual transfer of technology to the foreign country for the path of tax payments by the multinational enterprise. In period n, the tax payment, T_n, simply equals the foreign duopoly profits, $\pi_n^{f,d}$, in case of an expropriation. The tax liability in period n - 1, $T_{n-1,}$ is now solved from,

$$T_{n-1} + \frac{T_n}{1 + r} = \pi_{n-1}^{f,d}[1 + \frac{1}{1 + r}] \tag{7}$$

where $\pi_{n-1}^{f,d}$, of course, is conditional on c_{n-1}^f and c_{n-1}^h.

As $c_{n-1}^f > c_n^f$, it follows that $\pi_{n-1}^{f,d} < T_n = \pi_n^{f,d}$. Equation (7) now immediately implies that the tax payment in period n - 1, T_{n-1} is less than the tax payment in period n, T_n. By analogous reasoning, we find that the multinational increases its tax payment each period in a tax holiday like fashion or that $T_0 < T_1 < ... < T_n$. Note that the initial tax payment can very well be zero or even negative. Early negative payments by the country to the firm, if any, are followed by positive tax payments by the firm to the country in later periods. Of course, the net present value of payments from the firm to the country is positive.

Note that the multinational firm will also withhold technology from its foreign subsidiary, if it has an infinite horizon in the country. This can be seen by letting n be infinite in equations (5) and (6). In this case, the foreign cost variable, c_t^f, will be at a constant level above c_m. Also note that equation (6) implies that optimally $c_t^{f,d}$ is chosen such that $x_t^{f,d} < x_t^{f,m}$. This means that an expropriation, if any, leads to a duopoly foreign output level that is lower than the foreign output level, as set by an intact multinational firm. The break-up leads the foreign plant to reduce its output following the increased output at the home plant despite the break-up of the multinational firm.

III. Conclusion

This paper has shown that expropration risk may induce a multinational firm to withhold its least-cost technology from a foreign subsidiary, even if the transfer of this technology is costless. This result is complementary to the analysis of Wang (1992), who shows that the spill-over of technology from a multinational's subsidiary to local competitors provides a reason for the multinational firm to not transfer its best technologies abroad. An alternative explanation for differences in production techniques across countries is, of course, provided by differences in the prices of the factors of production, and in particular in the wage.

For the case where the multinational has a finite horizon, the paper finds that the multinational gradually transfers additional technical know-how to its foreign subsidiary. Even in the last period, however, the multinational's subsidiary does not produce at least cost. Corresponding to the gradual technological transfers, the multinational increases its tax payments to the foreign country over time in a tax holiday like fashion.

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Endnotes

1. A clear analogy to the reasoning in this paper is the military hardware export decision for a country such as the United States. The United States limits the sale of state-of-the-art military equipment to unstable allies to ensure that it can win a war against these allies if they turn against the weapons provider.
2. To guarantee positive levels of production, we assume that $p_t^i(0,\ x_t^j)$ exceeds the minimum cost c_m.
3. Wright (1993) analyzes how the prospects for transfering technology can affect the incentives to undertake R & D.
4. Alternatively, the foreign country could levy a tax on output or on some variable input. In these instances, expropriation risk and taxation would distort production for a given transfered technology as well as the original transfer of technology.
5. A break-up of the multinational firm has two generally opposite effects on the welfare of the third importing country: the break-up affects goods prices immediately, and dynamically given the halting of technology transfer. Markusen (1984) has shown that the welfare implications of the establishment of a multinational firm are generally ambiguous for the case where consumers are in the same two countries where the multinational operates.
6. A sufficient condition for these derivatives is $2(dp_t^i/dx_t^i) + d^2p_t^i/(dx_t^i)^2 < dp_t^i/dx_t^i + d^2p_t^i/(dx_t^i dx_t^j) < 0.$
7. We assume that $d^2V_t/(dc_t^f)^2$, $d^2V_t/(dc_t^h)^2 < 0$.
8. The duopoly output level, $x_t^{f,d}$, exceeds the monopoly output level, $x_t^{f,m}$, at both plants if they operate with equal unit costs.