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TRANSFER PRICING AND DIRECT FOREIGN INVESTMENT WITH EXPROPRIATION RISK

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This paper develops a game-theoretic model of direct foreign investment (DFI) in a country where the government cannot commit to refraining from expropriation of sunk investments by transnational enterprises (TNEs). In this situation, when the government lacks the necessary resources to finance the sunk costs of investment, DFI would be possible if there are self-enforcing contracts that give the investing TNE a minimum amount of the surplus generated by the project. We argue such contracts may exist if there are possibilities of transfer pricing on the part of the TNE. The particular example of transfer pricing examined here is a situation where the TNE is supposed to transfer its technology to the host country in exchange for a royalty. While transfer pricing is often seen as a negative aspect of TNE investments, our findings suggest that transfer pricing opportunities may indeed enhance DFI.

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I. INTRODUCTION

Direct foreign investment (DFI) by transnational enterprises (TNEs) is an important vehicle of capital and technology transfer among countries. However, the possibility of heavy taxation and expropriation by the governments of host countries, especially in the case of less developed countries (LDCs), seems to be a serious impediment to the more extensive use of DFI as a means of improving resource allocation and technological diffusion among countries. Of course, such fears are not a major issue in countries where democratic political systems and independent courts provide the government with credible

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commitment mechanisms. However, this is not the case in the majority of LDCs. As a result, DFI occurs in these countries only if there are other mechanisms to assure TNEs a normal return on their sunk investments. In this context, identifying the conditions under which the host governments and TNEs can sustain mutually beneficial implicit contracts is crucial for understanding the pattern of TNE investment and for designing DFI policies.

At the first glance, it may seem that LDC governments can solve the above time-inconsistency problem by simply paying for the sunk costs of investment. But, this apparent solution has two fundamental problems. First, these governments typically lack resources to pay for any significant amount of DFI. Second, even if a government has access to some capital, it cannot be sure that a TNE receiving the money in exchange for its sunk costs will actually invest. When governments in countries with limited commitment capability can pay for the costs and ensure proper implementation, they often simply hire TNEs with proprietory technologies to carry out projects for them.

Contracting problems over DFI may not arise if host governments are concerned about their reputations in the international business community. However, reputational concerns are obviously limited by the extent to which a government expects to lose the benefits of future DFI as a consequence of implicit or explicit expropriation of an existing enterprise. Moreover, many forms of effective taxation are not easily verifiable by third parties and, thus, a TNE's claim of overtaxation may be seen as a means for pressing the government to give up some of its legitimate tax claims.[1] Thus, it is important to ask whether there are other mechanisms that can help sustain an implicit contract between a TNE and a host government without requiring a collective punishment capability on the part of all TNEs.

In this paper, we argue that when the host government cannot fully finance the sunk costs of DFI, moral hazard on the part of TNEs may counteract with the government's time-inconsistency problem and, as a result, render certain implicit contracts feasible. The main point is that when a TNE is in a position to gain from its hidden action, it may be able to guarantee itself "informational rents" that help make DFI attractive even when the TNE has to incur some upfront sunk costs. Therefore, transfer pricing opportunities may enhance DFI's benefits to LDCs. This insight can shed light on the geographic and sectoral pattern of DFI in LDCs and, thus, help extend the implications of the intangible assets theory of TNEs. This result is in contrast with the widespread view in LDCs that transfer pricing is a negative aspect of TNE investments. While the latter view emphasizes the *ex post* undesirability of transfer pricing, our model draws attention to their *ex ante* role and shows that in a country with severe

[1] Taxation can take many implicit forms such as reneging on promises made for the provision of subsidies or protection, a subsidy to a foreign enterprise's domestic rivals, a reduction in the provision of infrastructure, an increase in the cost of services provided to the foreign enterprise by the government or by domestic firms, and a restriction on the repatriation of profits.

government time-inconsistency problems, investment in detection of transfer pricing may be counter-productive.

Our model builds on a number of recent studies examining DFI under threat of explicit or implicit expropriation, in particular, Doyle and Van Wijnbergen (1984), Eaton and Gersovitz (1984), Bond and Samuelson (1986 and 1989), Brander and Spencer (1987), Thomas and Worrall (1990), and Raff (1991). In these models, typically no foreign investment occurs unless either there are no sunk costs born by the TNE or the possible forms of taxation are restricted - either exogenously or through government commitment - such that the TNE ends up with a positive share of the surplus. Doyle and Van Wijnbergen (1984) and Bond and Samuelson (1986), for example, have developed models where there are sunk costs in DFI, but tax holidays in the intial periods provide foreign investors with an opportunity to recoup their sunk costs before the government has a chance to impose new taxes.[2] Since tax holidays are normally five to ten years long and, moreover, governments have many indirect ways to tax foreign enterprises if they choose to do so, credibility of such schemes obviously requires a highly robust commitment by the government. Brander and Spencer (1987), on the other hand, rule out any commitment on the part of the government, but restrict tax forms to proportional ones so that the equilibrium rate of taxation is always less than 100%. Bond and Samuelson (1989) assume some bargaining power on the part of foreign investors so that tax rate can be kept below 100%. But, the source of bargaining power is left outside the model. Finally, Thomas and Worrall (1990) do not consider sunk costs in their model and Eaton and Gersovitz (1984) and Raff (1991) focus on the costs of explicit expropriation and ignore the possibility that the government may allow TNEs continue their operations but leave them little profits to take home.

In our model, the mechanism limiting the government's ability to tax DFI is informational and enforcement problems. As Prusa (1990) has pointed out, the superior information of TNEs concerning the conditions of their subsidiary provides them with opportunities to transfer their profits or capital from one country to another and avoid taxation or regulatory restrictions through overinvoiced input costs or underinvoiced output prices. Of course, most governments have developed extensive machinery to curb such practices. Nonetheless, in the complex world of modern industry, their success in detecting transfer pricing is unavoidably limited. While large penalties imposed by the government may be a means of preventing disguised movement of capital and profits [see Kant (1998)], the size of such penalties is restricted by liability limits, particularly the present value of the after tax profits that a TNE expects to earn in the country. Therefore, the government's ability to control transfer pricing ultimately depends on the TNE making positive after-tax profits. In this

2 In the Bond and Samuelson model, tax holidays also signal the host country's economic environment.

sense, in our models, elements of moral hazard on the part of the TNE counteract with the host government's time-inconsistency problem and diminish the TNE's concern over the implicit expropriation of its sunk costs.

Although part of the risk of DFI is the possibility of explicit expropriation, we focus on the threat of implicit expropriation (i.e., various forms of taxation). To allow for explicit expropriation, the model needs to be set up as a nonstationary environment where in some situations the government finds it more advantageous to take over the operations of a TNE's subsidiary rather than taxing the subsidiary's profits.[3] This complicates our model and dilutes the main message of the paper. We assume that is too costly for the government to explicitly expropriate TNE subsidiaries because the country lacks the necessary know-how to operate the enterprises.

To present our arguments, in section Ⅱ, we develop a basic repeated-game model of DFI where the only contracting problem is the government's inability to convince TNEs that it will not expropriate sunk costs born by TNEs. In section Ⅲ, we incorporate an additional moral hazard into the basic model. We assume that the host government has difficulty in observing TNEs' actions with regard to a transfer of a technology that has externalities for the host country. Implications of the models developed here for sectoral pattern of DFI are discussed in section Ⅳ, which also concludes the paper.

Ⅱ. A MODEL OF DFI WITH SUNK COSTS

We view DFI as an infinitely repeated game between the government of a host country and a large (infinite) number of identical TNEs that perceive an opportunity to earn profit by investing in a given project in the country. Only one of the TNEs can invest and operate the project in each period. To run the project, the investing TNE establishes a subsidiary in the host country and provides it with the necessary capital and technology. The subsidiary operates the project and transfers its after-tax profits to the parent organization. The government as well as the TNEs are assumed to be infinitely-lived and risk neutral with a common discount factor, $\delta<1$.[4]

The project requires a one-time sunk investment, s, in the first period that it starts operation. Each period the project produces a net output, $q>(1-\delta)s$. When the project does not operate in a given period, the government receives a payoff of zero in that period. Also, the payoff of a TNE that does not operate the project is normalized to zero.

The problem of DFI in this model emanates from the fact that the government is in a position to deprive the investing TNE of any returns to its

[3] See, for example, Raff(1991) and Eaton and Gersovitz (1984).

[4] The assumption of a common discount factor simplifies our model by removing the capital arbitrage motivation for DFI, which could have simply taken the form of foreign lending.

sunk investment in the project. Resolution of this time-inconsistency problem would be trivial if the government could pay for all the sunk costs and be sure that the TNE in charge of the project will not "run away" with the money. However, most governments, especially in LDCs, do not have access to the necessary capital and, even if they do, cannot be sure that all payment they make to a TNE will be properly spent for the project. This is what blocks the simple solution.

We model this aspect by assuming that there is a maximum amount, $\bar{p}$, that the government can contribute toward the investment costs without running the risk of embezzlement by the investing TNE. This contribution can take the form of government provision of infrastructure and certain services necessary for setting up the project. Any amount spent for the project in excess of $\bar{p}$ will be lost if the TNE takes the money and refuses to complete the project. Note that the limit on upfront transfers may also be modeled as a liquidity constraint. Yet, we prefer to focus on a moral hazard interpretation because in the absence of commitment problems the government should, in principle, be able to borrow the required funds.

We are interested in the characteristics of the deals offered by the government that induce a TNE to invest in the host country. Because of the stationary nature of the model, we focus on stationary contracts. A contract, σ, between the government and the investing TNE has two components:

1. An upfront payment, $p \in [-\infty, \bar{p}]$, from the government to the TNE (p may be negative if the TNE makes an upfront payment to the government).
2. A tax, $t \in [0, q]$, to be levied on the TNE each period when the project operates.

The restriction on the range of t is imposed to simplify presentation. It has no consequence for the final outcome. The contract implicitly assumes that the TNE will invest in the project and produce each period. It also assumes that the government will pay p and impose a tax no greater than t each period. The TNE interprets any tax in excess of t a violation of the contract and a sign that the government will not abide by the contract in the future. In order to focus on the sustainability of implicit contracts, we assume that the terms of the contract and the output of the project are not enforceable by third parties due to verifiability problems. Only the government and the TNE in charge of the project know the actual history of the play. Therefore, $\sigma = (p, t)$ is implemented only if it is self-enforcing; that is, if at each stage of the game both sides find it in their best interest to abide by the contract.

The government's selection of a TNE for the operation of the project is assumed to be a competitive one in the sense that from the government's point of view, the expected benefits of the agreement reached between the government and the selected TNE cannot be improved upon if an alternative TNE were chosen. When the government is indifferent among a number of TNEs, it chooses one of them randomly.

In deciding whether to reinstate the incumbent TNE at the beginning of each period, the government breaks up the relationship if the TNE has breached the implicit contract in the past by refusing to produce. On the other hand, the TNE breaks up the relationship if in a previous period the government has imposed a tax greater than t. These decisions are supported by the beliefs of the government and the TNE that if one side of the contract has cheated, it will cheat in the future as well if the contract is renewed. Below we will show that these beliefs are consistent with a perfect equilibrium.

To characterize the equilibrium contracts at the start of the project, it is necessary to first understand what would happen after an original contract has terminated. We call this situation the "punishment phase." In this phase, the government will try to have a TNE continue the operation of the project. For simplicity, we assume there are no additional setup or investment costs involved in replacing one TNE with another as the operator of the project. Thus, in the punishment phase, the government's problem is simply to encourage a TNE to produce the output. A contract in this phase must again specify a tax level, t, and an upfront payment, p.

The Punishment-Phase Equilibrium

To determine the equilibrium contract, (p, t), in the punishment phase, we follow the common practice of first focusing on a typical period, τ, after the contract has gone into effect and taking the future play of the game parametrically. The play in such a period goes through three stages (See Figure 1). First, the government and the TNE decide whether to maintain their pre-existing contract. The contract terminates if either side decides to opt out. Second, the TNE decides whether to produce or not. Third, the government observes the output and imposes a tax, T, which may be different from t.

[Figure 1]

Gov't and the TNE decide whether to maintain the contract or not.	TNE decides to produce or not.	Gov't observes output and imposes a tax.	
Stage 1 Period τ	Stage 2	Stage 3	Period $\tau+1$

For the punishment-phase contract to be self-enforcing, it must be in the best interest of the government to set $T \leq t$ given the future play of the game. Let the long-term payoff of the government from period $\tau+1$ onwards be equal to W if the current contract is maintained and equal to $\overline{W}$ if the contract is terminated. Note that if $T > t$, then the government will receive at most q in the current period. Therefore, the government's maximum total payoff from violating the contract is $q+\delta\overline{W}$, while its payoff from honoring the contract is $t+\delta W$. It follows that the government will set $T=t$ if

$$t-q+\delta(W-\overline{W})\geq 0, \tag{2.1}$$

otherwise the government will take over the output, $T=q$.

To examine the TNE's decisions in period τ, let its long-term payoff in period $\tau+1$ be V if the current contract is in force and $\overline{V}\geq 0$ otherwise. If (2.1) is violated, the TNE can do best by not producing. When (2.1) holds, the TNE will produce if

$$q-t+\delta(V-\overline{V})\geq 0. \tag{2.2}$$

Note that if the TNE decides not to produce, it is better off leaving the contract in the first stage and when it benefits from production, it can do best by continuing under the contract. That is, (2.2) is also a continuation condition for the TNE. Similarly, when (2.1) holds, the government will reinstate the TNE in the first stage because terminating the contract in the current period will bring the government at most $\delta\overline{W}$, which by virtue of (2.1) does not exceed $t+\delta W$. Therefore, when (2.1) and (2.2) hold, the contract is self-enforcing.

A quick comparison of (2.1) and (2.2) reveals that for a tax, t, to exist such that the contract is self-enforcing, we must have

$$W-\overline{W}+V-\overline{V}\geq 0. \tag{2.3}$$

That is, the aggregate surplus of a self-enforcing contract must be non-negative. Inversely, when (2.3) holds, there is always a tax, t, at which the contract is self-enforcing. In that case, $V=(q-t)/(1-\delta)$ and $W=t/(1-\delta)$. Therefore, (2.3) can be rewritten as

$$\frac{q}{1-\delta}\geq \overline{W}+\overline{V}. \tag{2.4}$$

When a contract, (p, t), satisfies (2.1) and (2.2), it is acceptable to both the government and the TNE as long as p is such that

$$\frac{t-q}{1-\delta}+\overline{V}\leq p\leq \frac{t}{1-\delta}-\overline{W}. \tag{2.5}$$

Note that given (2.4), a p always exists such that (2.5) is satisfied. When $\overline{W}+\overline{V}$ is strictly less than $q/(1-\delta)$, then a range of possible self-enforcing contracts is feasible. These contracts all allow the project to be implemented.

But, they differ in the way they distribute their surplus, $q/(1-\delta)-\overline{W}-\overline{V}$, between the government and the TNE. The entire range of surplus distribution is feasible. The question is whether there is a surplus. To answer this question, we need to determine $\overline{W}$ and $\overline{V}$.

The value of the government's reservation payoff depends on the response of the TNEs to termination of an existing contract. If they all refuse to accept a contract from the government, then $\overline{W}=0$. We believe this is not plausible. Given that the actual plays of the two parties are not verifiable by outsiders and that the termination of a contract may be for the purpose of renegotiating another one, it seems reasonable to assume that the TNEs are willing to accept any contract, σ, that satisfies (2.5) with $\overline{W}$ being the most the government can earn in such contracts. This is in fact the concept of renegotiation-proofness by Pearce (1987). Note that if σ itself is not the government's best such self-enforcing option, then the government would want to use the competition among TNEs to renegotiate σ to obtain the best option in the first place. Therefore, the equilibrium contract must be the one that serves as its own punishment and, in that set, yields the highest payoff to the government. The ability of the government to renegotiate the contract with many TNEs further implies that $\overline{V}$ must be equal to zero.

In the context of our model, a renegotiation-proof contract, $\sigma^0(p^0, t^0)$, can be constructed by letting $\overline{W}=t^0/(1-\delta)-p^0$ and then finding the t^0 and p^0 that maximizes $\overline{W}$ subject to (2.1), (2.2), and (2.5), with $\overline{V}=0$. Substituting for $V, \overline{V}, W,$ and $\overline{W}$ in these constraints reduces them to:

$$0 \leq \frac{q-t^0}{\delta} \leq p^0. \tag{2.6}$$

It is easy to see that the set of contracts satisfying (2.6) is nonempty. In maximizing $\overline{W}$, the two constraints in (2.6) must bind. Thus, in the punishment phase, the only renegotiation-proof contract is $t^0=q$ and $p^0=0$. This contract yields a long-term payoff to the government, $\overline{W}=q/(1-\delta)$.

Lemma 1. *In the model of DFI with sunk costs, a unique renegotiation-proof equilibrium, σ^0, exists in the punishment phase. This contract is characterized by $p^0=0$ and $t^0=q$. It yields a net present value, $\overline{W}^0=q/(1-\delta)$ for the government and $V^0=0$ for the TNE.*

Equilibrium Contract at the Start of the Project

We proceed with the analysis of the contract offered at the start of the project when the selected TNE has to pay for the sunk costs. The self-enforcement constraints on this contract can be derived in the same way as the ones in the punishment phase. In particular, within each period, conditions (2.1) and (2.2) must still be satisfied, with the difference that the reservation payoffs of the government and the TNE are now fixed at $\overline{W}=q/(1-\delta)$ and $V^0=0$. This immediately implies that $t=q$. The remaining task is to determine p, given that the TNE must invest s after the upfront payment has been made. Obviously, the TNE does not expect any profits from the operation of the project and will invest in it only upto $\overline{p}$. Therefore, a feasible contract exists only if

$$\overline{p}\geq s. \tag{2.7}$$

When this is the case, any contract, (p, q), where p satisfies $s\leq p\leq q/(1-\delta)$, is feasible. Competition among potential TNEs leads to $p=s$.

Proposition 1. *The model of DFI with sunk costs has a renegotiation-proof equilibrium, $\sigma^*(p^*, t^*)$, if and only if $\overline{p}\geq s$. When an equilibrium exists, $t^*=q$ and $p^*=s$.*

The main result of this section is that, in the absence of institutional commitment mechanisms, the time-inconsistency problem deterring DFI can be resolved only if the government pays for the sunk costs of the project and control the process of investment. This is, of course, an intuitive result. The purpose of deriving it through a formal model is to develop a framework for the main task of the paper; i.e., showing that the presence of possibilities for transfer pricing may reduce the required level of upfront payment by the government. Such a reduction helps render the project feasible when the government cannot pay for the entire sunk costs.

Ⅲ. A MODER OF DFI WITH SUNK COSTS AND TNE MORAL HAZARD

We modify the model developed in the previous section to include moral hazard on the part of the selected TNE. The specific example worked out here is one where the project can generate a positive per-period externality, ηz, for the host country if in the second stage of each period the TNE transfers its technology to the subsidiary at an additional cost, $z>0$. We assume $\eta>1$ so that transfer of technology is economically desirable.

The technology of TNEs usually takes one of two forms. Some technologies, such as chemical processes and technology embodied in machinery, are typically transferable among countries in a short period of time and usually in one transaction. Other technologies, such as management and operation skills, have to be transferred over time with repeated or continuous transactions. Our model focuses on the latter type of technologies as a means in the hands of the TNE to recuperate its sunk investments.

However, the government cannot verify with the certainty whether technology has been transferred or not. In particular, we assume that in the third stage of each period the government can detect the absence of technology transfer only with probability θ, with $0<\theta<1$. This information is formally modeled as a signal, $S\in 0,1$, where $S=1$ with probability θ when technology transfer has not occurred and $S=0$, otherwise. We assume that the TNE also observes the realization of S and knows whether the government has detected its "cheating" or not. This imperfection in observability is what provides the TNE with an opportunity to engage in transfer pricing by claiming the cost, z, while no technology has been transferred.

If at the end of a given period the government detects that technology has not been transferred, it can punish the TNE by terminating the contract, as it does when the TNE has not produced. However, the government may be able to do better by imposing a penalty and continuing the relationship if the TNE pays the penalty. The reason is that by imposing a penalty the government may be able to extract any rents that may accrue to the TNE in the future, while termination destroys the rents.[5] Indeed, in actual DFI relationships, imposition of fines and penalties for violation of the rules is far more common than termination of the relationship.

Suppose the penalty specified in the contract for failing to transfer technology is $f\in[0,\infty]$. Thus, a contract, γ, between the government and the TNE is now represented by three components, (p, t, f). Adherence to the contract by the government requires that the actual tax, T, imposed on the TNE does not exceed t and that the actual penalty, F, satisfies $F=Sf$. The TNE is said to have violated the contract if it does not produce or refuse to pay t or f when $S=1$. Note that our primary focus in this section is on contracts that presume the TNE will transfer its technology to the host country. If the maximal payoff of such contracts to the government is less than what the government can secure without requiring technology transfer, then the equilibrium is simply the one derived in section 2. The procedure for the analysis of this model is essentially the same as in section 2. However, each period in this model has a fourth stage in which the TNE decides to pay $T+F$ or not. Let $V, \overline{V}, W,$ and $\overline{W}$ denote, as before, the long-term payoffs of the TNE and the government from period $\tau+1$ onwards with and without γ remaining in force. To save notation, from the outset we let $\overline{V}=0$. If the contract has been violated prior to the fourth stage of period τ, then the TNE will lose the net output in the current period and the contract terminates. If, on the other hand, the contract has not been violated, then the TNE will pay $T+F$ if

[5] A penalty for refusing to produce does not help in the same way because, in the absence of technology transfer, the TNE does not earn any rents.

$$q-T-F+\delta V\geq 0. \tag{3.1}$$

Note that $q+\delta V$ is the maximum tax and penalty revenues the government can expect in any given period. If $t+f$ is higher than this amount, the government cannot actually charge the total tax and penalty specified in the contract and part of $t+f$ is redundant. Therefore, to facilitate presentation and to avoid spurious multiple equilibria where a range of contracts implement the same allocation, we assume

$$q-t-f+\delta V\geq 0. \tag{3.2}$$

Since (3.2) guarantees compliance by the TNE in the fourth stage, we can now proceed with the analysis of equilibrium conditions in the first three stages of each period. Our first task is to determine the equilibrium in the punishment phase.

[Figure 2]

Gov't and the TNE decide whether to maintain the contract or not.	TNE decides on technology transfer and produces the output.	Gov't observes signal S and imposes a penalty, f, and a tax, t.	TNE decides to pay $f+t$ or not	
Stage 1	Stage 2	Stage 3	Stage 4	
Period τ				Period $\tau+1$

The Punishment-Phase Equilibrium

Suppose the game has reached period, τ, under a contract, γ, which has been accepted by a TNE after an earlier contract has been terminated (see Figure 2 above). Given (3.2), the government sets $T=t$ and $F=Sf$ if

$$t+Sf-q+\delta(W-\overline{W})\geq 0, \tag{3.3}$$

otherwise $T+F=q$, which is the maximum the government can collect in case of termination.

When (3.3) is violated, the TNE has no incentive to transfer its technology to the host country. When (3.2) and (3.3) hold, the TNE will engage in technology transfer if its lifetime expected profits from doing so is at least as great as what it expects to earn by avoiding the transfer. In the latter case, with probability $1-\theta$ the firm gains $q-t+\delta V$ and with probability θ it gains $q-t-f+\delta V$. Thus, technology transfer occurs if

$$q-t-z+\delta V\geq(1-\theta)(q-t+\delta V)+\theta(q-t-f+\delta V)\ \rightarrow\ z\leq\theta f. \tag{3.4}$$

Condition (3.4) simply requires the expected penalty exceed the cost of technology transfer. This implies that the government needs to keep t below $q+\delta V$, the total value of the subsidiary in the fourth stage, by at least z/θ so that the TNE has something to lose if the penalty is imposed. In other words, z/θ is the minimum surplus the TNE should receive to have an incentive to transfer its technology.

When the TNE has an incentive to transfer its technology, it also finds continuation under the contract, γ, worthwhile. To see this point, note that when (3.2)-(3.3) hold, production and technology transfer are jointly profitable if $q-t-z-\delta V\geq 0$, which is satisfied by virtue of (3.4), given (3.2). By an argument similar to the one made in section 2, it is easy to see that the government also prefers to reinstate the TNE as long as (3.3) holds. Therefore, any contract, γ, that satisfies (3.2)-(3.4) is self-enforcing.

It is easy to see that a necessary and sufficient condition for a self-enforcing contract to exist is

$$\delta(W-\overline{W}+V)\geq\frac{z}{\theta}. \tag{3.5}$$

This condition has an interpretation similar to (2.4). However, in this case, the discounted future aggregate surplus of the contract must exceed z/θ, which is the expected amount of profit the TNE can keep to himself by refraining from technology transfer. Without this minimum surplus, the TNE cannot be motivated to honor the contract. Considering the fact that for self-enforcing contracts, $S=0$, $V=(q-t-z)/(1-\delta)$, and $W=(t+\eta z)/(1-\delta)$, condition (3.5) can be written as

$$q\geq(1-\delta)\overline{W}+\frac{z}{\theta}\frac{1-\delta}{\delta}-(\eta-1)z. \tag{3.6}$$

A self-enforcing contract, γ, is acceptable to both the government and the TNE if

$$\frac{t+z-q}{1-\delta}\leq p\leq\frac{t+\eta z}{1-\delta}-\overline{W}. \tag{3.7}$$

Note that (3.6) is a sufficient condition for the existence of a self-enforcing and acceptable contract. In fact, as long as (3.6) holds, there is a range of feasible contracts.

We use the renegotiation-proofness concept again to determine $\overline{W}$. Suppose $\gamma^1(p^1, t^1)$ is renegotiation-proof. It should maximize $\overline{W}=(t^1+\eta z)/(1-\delta)-p^1$ subject to (3.2)-(3.4) and (3.6). Substituting for V, W, and $\overline{W}$ in these constraints, they can be reduced to $\theta f^1\geq z$ and

$$q-\delta p^1 \leq t^1 \leq q-\delta z-(1-\delta)f^1. \tag{3.8}$$

The left-hand inequality in (3.8) is due to (3.3) and the right-hand one follows from (3.2). It is easy to see that the set of contracts defined by (3.8) is nonempty. The solution to this problem is rather straightforward. First, note that because the contract is self-enforcing, the penalty does not play a role in the objective function of the government and only adversely affects the feasible ranges of tax and upfront payment determined by (3.8). Therefore, the penalty must be set at its lowest level, $f^1=z/\theta$. Next, observe that because the objective function is increasing in t^1 and decreasing in p^1, both constraints in (3.8) must bind:

$$t^1=q-\delta z-(1-\delta)\frac{z}{\theta} \quad \text{and} \quad p^1=z+\frac{1-\delta}{\delta}\frac{z}{\theta}. \tag{3.9}$$

Under this contract, $\overline{W}^1=\frac{q+(\eta-1)z}{1-\delta}-\frac{z}{\delta\theta}$. The total payoff of the TNE from the project is $V^1+p^1=\frac{z}{\delta\theta}$. Note that in the presence of moral hazard on the part of the TNE, the government cannot capture the total net product of the project and yields $z/\delta\theta$ to the TNE operating the project. The reason is that overcoming moral hazard requires a rent to be paid to TNE. Since the government has an incentive to extract that rent through renegotiation, the contract is sustainable only if it includes a sufficiently large upfront payment by the government.

In the punishment phase, the government has the option to offer a contract with or without technology transfer. The choice between the two depends on the relative values of $\overline{W}^1$ and $\overline{W}^0$ calculated in section 2. Technology transfer will be required if

$$\eta \geq \frac{1-\delta}{\delta\theta}-1. \tag{3.10}$$

Lemma 2. *In the model of DFI with imperfectly observable technology transfer, a unique renegotiation-proof equilibrium exists in the punishment phase. If (3.10) does not hold, this equilibrium entails a contract,* σ^0, *with no technology transfer requirement, where* $p^0=0$, $t^0=q$, *and* $\overline{W}^0=q/(1-\delta)$. *If (3.10) holds, the equilibrium contract,* γ^1, *induces technology transfer, with* $t^1=q-\delta z-(1-\delta)\frac{z}{\theta}$, $p^1=z+\frac{1-\delta}{\delta}\frac{z}{\theta}$ *and* $f^1=\frac{z}{\theta}$. *Under this contract, the reservation payoff of the government is* $\overline{W}^1=\frac{q+(\eta-1)z}{1-\delta}-\frac{z}{\delta\theta}$ *and the long-term payoff of the TNE is* $V^1+p^1=\frac{z}{\delta\theta}$.

Equilibrium Contract at the Start of the Project

Once the sunk investment is in place, the game in the first period of the project is exactly the same as the one in the punishment phase, with (3.2)-(3.4) being the conditions for self-enforcement. When (3.10) holds, the government's reservation payoff in the third stage of the game is $\overline{W}^1$. Using this value and substituting for the long-term payoffs in (3.2) and (3.3) yields

$$q-\delta z-(1-\delta)\frac{z}{\theta}\leq t\leq q-\delta z-(1-\delta)f. \tag{3.11}$$

The only solution to (3.4) and (3.11) is $f^{**}=\frac{z}{\theta}$ and $t^{**}=q-\delta z-(1-\delta)\frac{z}{\theta}$. Thus, it remains to determine whether there exists a $p\leq\overline{p}$ that makes the contract with this tax-penalty combination acceptable to the government and the TNE. Given the above values of tax and penalty, the acceptability condition can be obtained as follows

$$\frac{q-t^{**}-z}{1-\delta}+p-s\geq 0 \quad \text{and} \quad \frac{t^{**}+\eta}{1-\delta}-p\geq 0.$$

$$\rightarrow \; s-(\frac{1}{\theta}-1)z\leq p\leq\frac{q+(\eta-1)z}{1-\delta}-(\frac{1}{\theta}-1)z. \tag{3.12}$$

Since $q>(1-\delta)s$, there is always a range of upfront payments that satisfy (3.12). Therefore, the existence of a feasible contract with technology transfer depends on whether there is any p in this range that is less than or equal to $\overline{p}$:

$$\overline{p}\geq s-(\frac{1}{\theta}-1)z. \tag{3.13}$$

When (3.10) does not hold, then (3.2) and (3.3) can be jointly written as

$$\delta z-\delta q\leq t\leq q-\delta z-(1-\delta)f. \tag{3.14}$$

But, when for $\eta<\frac{1-\delta}{\delta\theta}-1$, there is no t and $f\geq\frac{z}{\theta}$ that can satisfy (3.14). Therefore, in this case, the only possible solution is the contract without transfer of technology analyzed in section 2. That solution exists only if (2.7) holds.

When (3.10) holds but (3.13) is violated or (3.10) does not hold and (2.7) is violated, no investment in the project is feasible. The following proposition summarizes the above results.

Proposition 2. *The model of DFI with sunk costs and TNE moral hazard in technology transfer has a renegotiation-proof equilibrium with technology transfer if and only if both (3.10) and (3.13) hold. The equilibrium contract,* $\gamma^{**}(p^{**}, t^{**})$, *is characterized by* $f^{**} = z/\theta$, $t^{**} = q - \delta z - (1-\delta)\frac{z}{\theta}$, *and* $p^{**} = s - (\frac{1}{\theta} - 1)z$. *When (3.10) does not hold but (2.7) is satisfied, the equilibrium contract is* σ^0 *specified in Proposition 1. In all other circumstances, investment in the project does not materialize.*

The main implication of the above results is that the need for an upfront payment by the government declines with the degree of moral hazard on the part of the TNE. According to (3.13), as the detection probability of TNE malfeasance declines and the size of its activities with positive externality to the host country increases, the rent that the TNE can collect increases. The presence of this rent induces the TNE to invest some of its own funds without fear of implicit expropriation in the future. However, as (3.10) indicates, such contracts may not be feasible if the detection probability (θ), the degree of externality (η), or the discount factor, δ, is too small.

Ⅳ. CONCLUSION

The idea that time-inconsistency on the part of a host government deters DFI is an old one. Earlier studies have shown that if one assumes restricted forms of taxation or some bargaining power on the part of TNEs, then the problem may be diminished. Our point in this paper is that even in the absence of such assumptions DFI may be feasible if TNEs enjoy hidden information. Such TNE advantages are quite likely due to the very nature of TNEs, which often originates from possession of assets that are not likely to be traded easily in markets. To the extent that TNEs' assets allow them to collect rents over time, they may be able to combine the services of those assets with their investments and manage to recoup the sunk costs of their subsidiaries. However, different assets may present different opportunities in this direction. Therefore, TNEs in various sectors face different possibilities for investment in LDCs, where government time-inconsistency problems are typically acute. In particular, this effect may explain the fact that DFI in these countries is heavily concentrated in, for example, pharmaceuticals which require components to be purchased from the parent company.

To focus on our main point, we have tried to keep our model simple. As a result, many important real-world phenomena are absent from the model. In particular, expropriation remains a potential and does not actually occur in equilibrium. However, in the real world, actual expropriation or nationalization is observed from time to time. To develop models that capture this aspect of reality, one needs to modify the above model by introducing stochastic elements that change the costs and benefits of honoring contracts over time. These elements could originate, for example, from changes in the host government's valuation of tax revenues and DFI externalities.

Presence of stochastic elements can open up other interesting research avenues as well. For example, consider a situation where the value of foreign exchange to the economy fluctuates overtime. When the host government badly needs foreign exchange, it may be willing to yield greater concessions to foreign investors, but it is at the same time more likely to tax or expropriate DFI. Examination of the conditions under which each effect dominates can provide useful implications for the attractiveness of the incentives offered by highly indebted countries to encourage DFI and debt-equity swaps. This remains as a future research topic.

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