Governance, Trade, and Investment*

by
Avinash Dixit
Princeton University

First draft: May 21, 2011
This version: July 26, 2014

Abstract

Imperfections in the rule of law create new problems of contractibility, in addition to the familiar one of unverifiability of information. Alternative social institutions for governance of property and contract arise but are also imperfect, and can interact well or poorly with the formal state institutions. Security of property and contract is especially problematic for foreign traders and investors. This paper considers some theoretical analysis of such situations. The game-theoretic ideas and methods range from simple two-stage games with strategic moves, to bilateral and multilateral repeated games with added issues of asymmetric information and imperfect communication.

Address of author:

Avinash Dixit, Department of Economics, Princeton University, Princeton, NJ 08544–1021, USA.

Phone: 609-258-4013. Fax: 609-258-6419.

E-mail: `dixitak@princeton.edu`

Web: `http://www.princeton.edu/~dixitak/home`

*This is a slightly revised version of a paper presented at the mini-workshop on "Applications of Game Theory in Trade and Development," at the Game Theory Society's 2011 Summer Festival, Stony Brook, NY, USA. I thank the participants for perceptive comments. I also thank Nuffield College, Oxford for its hospitality when the first draft of the paper was written.

1 Introduction

In the standard game-theoretic formulation of contract theory, the contracting parties' stipulated actions can be conditioned on any information that is verifiable to the judge responsible for enforcing the contract. In most of these models, such a judge is simply assumed to exist, to be available should a dispute arise, and to perform his function efficiently (and usually costlessly). In most economic analyses, property rights are likewise assumed to be well defined and protected. In reality, the institutions of property right and contract enforcement are imperfect: costly, inexpert, inexperienced, biased, or corrupt. In some countries, the very governments and their agents who are supposed to protect property and enforce contracts are the worst predators. Therefore governance deficiencies become causes of non-contractibility separate from, and perhaps more basic than, the usual cause, namely non-verifiability.

In such situations, traders and investors construct alternative mechanisms based on ongoing relationships, whether bilateral or multilateral ones in social networks, and the associated norms of behavior, channels for communicating information about the identity and reputation of members, and sanctions for violation of norms. These cannot usually deliver first-best outcomes, and sometimes reinforce but sometimes conflict with the imperfect formal governance provided by the state, but they can often improve upon the highly imperfect status quo. Theoretical models of such alternative modes and institutions of economic governance combine ideas from the theory of repeated games and the theory of games with asymmetric information and contract theory. Overviews of the issues, and some illustrative models, are in Dixit (2004, 2009).

These problems become even more serious when the transactions cross international boundaries. Governments may violate the rights of foreigners with less fear of domestic political consequences (indeed sometimes in expectation of positive domestic political benefit) than they would violate their own citizens' and supporters' rights. Courts may be biased in favor of nationals, explicitly or implicitly. In any case, the fear of this may deter foreign traders and investors from undertaking transactions where the local government has more opportunities to intervene, and entering into contracts that carry significant risk of dispute requiring recourse to courts. There are international forums for commercial dispute resolution, but these are also costly, time-consuming, and sometimes lacking in the expertise needed to render accurate judgments. Therefore the alternative institutions based on relationships, norms, and networks acquire even greater importance in international trade and investment. Here I focus on some models that illustrate the problems and some solutions.

Some of the ideas are simple enough (such as commitment in a two-stage game) that a mere outline will enable the reader to construct the details; in other cases the models need to be developed more fully.

I focus on models that highlight the applications of game theory to issues of international trade and foreign direct investment in situations of imperfect governance, leaving out many models of substantive interest which involve only the decisions of a single actor or a competitive equilibrium. Even within this restriction, I will develop in detail only one illustrative model of each kind, one for trade and one for FDI. Then I will give very brief accounts of some other models. Discussions of broader issues and related empirical evidence can be found in Dixit (2011).

2 International Trade

The model I have chosen to illustrate the themes is an adaptation of that in Anderson and Young (2006) and Anderson (2009). In my version, foreign sellers run the risk that domestic buyers will repudiate their contracts if circumstances make it unprofitable for them to go through with the promised purchases. In the original papers the situation is more symmetric and not inherently linked to international trade and the domestic buyer versus foreign seller distinction, but that context makes the weakness of governance especially pertinent as explained above.

A relatively small number (in a sense to be made precise later) of foreign sellers is contemplating entering a market. Each seller has one unit of the good (or service), and his cost of supplying it to this market is c. To enter the market, the seller must incur a sunk cost. Sellers are ranked by the order of increasing entry cost, that of the q^{th} seller is given by $T^S(q)$. The buyers have willingness to pay drawn from a density $f(b)$ and cumulative distribution function $F(b)$, over the support $[b_{\text{min}}, b_{\text{max}}]$. To avoid inessential complications I assume $c < b_{\text{min}}$.[1] The buyers also have to incur sunk entry costs, ranked in increasing order and given by $T^B(q)$. The sellers and buyers are all risk-neutral.

The market has two parts, contract and spot. Each trader can decide which part to enter, if either. However, we will see that all sellers will find it optimal to take the contract route. The contract price p^c will be determined in the equilibrium.

[1]Anderson and Young (2006) also allow c to be random, but that is not essential for my purpose.

Buyers have a more active role in the process. The sequence of events is shown in Figure 1. First each buyer decides whether to enter, and if so, chooses the mode, contract or spot. Those who choose contract will be matched with sellers at random. Then each buyer will find out his individual willingness to pay b, and based on this, decide whether to honor or default on the contract. We will see that if this is below a threshold to be determined, he will choose to default. In this case, with probability θ a court will nevertheless force him to comply. Thus θ measures the quality of governance.

**** Figure 1 here ****

Sellers are themselves not allowed to repudiate their contracts; this could be because the home country courts are biased and will always rule against a seller who tries to repudiate.[2] Sellers whose contracts are repudiated go to the spot market. Buyers who repudiated contracts, and buyers who chose the spot mode at the outset, form the other side of this market. It is assumed that there are more of these buyers than sellers. The buyers are matched to the available sellers at random. Thus each buyer has a probability $\pi < 1$ of finding a seller. The value of π will be determined in equilibrium. In each pair on the spot market, the available surplus $(b - c)$ is split; a fraction ω goes to the seller and $(1 - \omega)$ to the buyer, where ω is the exogenous bargaining power of the seller. Buyers on the spot market who are not matched to any seller get zero surplus.[3]

Begin the analysis by considering a buyer who has entered and chosen to sign a contract. After realizing his b, fulfilling the contract gives him surplus $(b - p^c)$. If he defaults on the contract, with probability θ the court will force him to fulfill it, and with probability $(1 - \theta)$ he can escape to the spot market, meet another random seller with probability π, and get surplus $(1 - \omega)(b - c)$. Therefore he will choose default if

$$b - p^c < \theta\,(b - p^c) + (1 - \theta)\,\pi\,(1 - \omega)\,(b - c)\,,$$

[2]Anderson and Young (2006) allow sellers to default, but show that in the case of their "excess demand equilibrium," which is also the case I consider, no seller will choose to default. They also allow renegotiation of repudiated contracts and prove that it will not occur in equilibrium. Again, to save space I simply assume it away.

[3]An alternative specification would be to make the spot market a standard competitive market with an equilibrium price p^s. Buyers with willingness to pay $b > p^s$ succeed and get surplus $b - p^s$; each seller gets $p^s - c$. However, assumption of such an organized market is somewhat contrary to the context of a country with poor governance. Also, this set-up precludes the coexistence of contract and spot markets in equilibrium. Details are left for interested readers.

or

$$b - p^c < \pi\,(1-\omega)\,(b-c)\,,$$

or

$$b < b^* \equiv \frac{p^c - \pi\,(1-\omega)\,c}{1 - \pi\,(1-\omega)}\,. \tag{1}$$

Now move one step back, to a buyer who has paid the entry cost, and consider his choice between the contract and spot methods. At this point b is unknown. The buyer calculates that if he signs a contract, and if the realized value is $< b^*$ he will default, whereas if $b \geq b^*$ he will voluntarily fulfill. The surpluses in the two cases are as in the analysis of the default decision above. Therefore the expected surplus from the contract is

$$\int_{b_{\text{min}}}^{b^*} \left[\,\theta\,(b-p^c) + (1-\theta)\,\pi\,(1-\omega)\,(b-c)\,\right] dF(b) + \int_{b^*}^{b_{\text{max}}} (b-p^c)\,dF(b)\,.$$

The expected surplus if he goes directly to the spot market is

$$\int_{b_{\text{min}}}^{b_{\text{max}}} \pi\,(1-\omega)\,(b-c)\,dF(b)\,.$$

The expected surplus from the contract is a decreasing function of the contract price p^c; the derivative is

$$\begin{aligned}
&= -\int_{b_{\text{min}}}^{b^*} \theta\; dF(b) - \int_{b^*}^{b_{\text{max}}} dF(b) + \left[\theta\,(b-p^c) + (1-\theta)\,\pi\,(1-\omega)\,(b-c) - b - p^c\right] \frac{db^*}{dp^c} \\
&= -\theta\; F(b^*) - [1 - F(b^*)] + 0\,\frac{db^*}{dp^c} \qquad \text{using (1)} \\
&= -\;\left[\,\theta\,F(b^*) + 1 - F(b^*)\,\right] < 0\,.
\end{aligned}$$

Therefore there can be at most one p^c that makes the buyer indifferent between the contract and spot markets. In Section (a) of the Appendix I show that there is in fact a $p^c \in (c, b_{\text{max}})$ that satisfies the indifference condition. Therefore in equilibrium there is a unique, interior solution to the buyers' choice between signing contracts and going directly to the spot market.

As shown in the Appendix, Section (b), the indifference condition

$$\begin{aligned}
\int_{b_{\text{min}}}^{b^*} \left[\,\theta\,(b-p^c)\right. &+ \left.(1-\theta)\,\pi\,(1-\omega)\,(b-c)\,\right] dF(b) + \int_{b^*}^{b_{\text{max}}} (b-p^c)\,dF(b) \\
&= \int_{b_{\text{min}}}^{b_{\text{max}}} \pi\,(1-\omega)\,(b-c)\,dF(b)\,.
\end{aligned} \tag{2}$$

simplifies to

$$b^* - b_{\text{av}} = (1-\theta)\int_{b_{\text{min}}}^{b^*} F(b)\,db\,, \tag{3}$$

where b_{av} is the mathematical expected value of b over its distribution.

The indifference equation (2) defines the equilibrium contract price p^c, but after simplification to (3) it actually yields an implicit solution for b^*, and then p^c can be found from (1) as

$$p^c = [1 - \pi(1-\omega)]\; b^* + \pi(1-\omega)\; c\,. \tag{4}$$

In many of these equations and derivations an entity appears that has a useful interpretation; abbreviate it as

$$\beta = \theta\, F(b^*) + 1 - F(b^*)\,. \tag{5}$$

This is the fraction of contracts that are fulfilled: the fraction $[1 - F(b^*)]$ is voluntarily fulfilled by buyers; the fraction $\theta\, F(b^*)$ is repudiated by buyers but enforced by courts. Correspondingly, the fraction

$$1 - \beta = (1-\theta)\, F(b^*)$$

goes unfulfilled: repudiated and unenforced.

The main interest of the analysis is the effect of improvement in the quality of governance θ. Some comparative statics follow immediately. Differentiating (3) gives

$$\frac{\mathrm{d}b^*}{\mathrm{d}\theta} = -\int_{b_{\text{min}}}^{b^*} F(b)\, db + (1-\theta)\; F(b^*)\; \frac{\mathrm{d}b^*}{\mathrm{d}\theta}\,,$$

or

$$\frac{\mathrm{d}b^*}{\mathrm{d}\theta} = -\,\frac{1}{1 - F(b^*) + \theta\, F(b^*)} \int_{b_{\text{min}}}^{b^*} F(b)\, db = -\,\frac{1}{\beta} \int_{b_{\text{min}}}^{b^*} F(b)\, db < 0\,. \tag{6}$$

Then

$$\frac{\mathrm{d}\beta}{\mathrm{d}\theta} = F(b^*) - (1-\theta)\; \frac{\mathrm{d}b^*}{\mathrm{d}\theta} > 0\,. \tag{7}$$

These are intuitive: better governance lowers the cutoff of the willingness to pay below which buyers default, and also reduces the subfraction of the already smaller fraction consisting of defaulted contracts that go unenforced by the courts.

The comparative statics of p^c is more complicated because it involves π which is also endogenous. To determine it, consider the buyers' and sellers' entry decisions. Begin with the buyers. As they are indifferent between the contract and spot modes, their expected utility EU^B upon entry can be found using either mode. The latter is easier, yielding

$$EU^B = \int_{b_{\text{min}}}^{b_{\text{max}}} \pi\,(1-\omega)\,(b-c)\, dF(b) = \pi\,(1-\omega)\,(\,b_{\text{av}} - c)\,. \tag{8}$$

Buyers will enter until the marginal buyer Q^B is indifferent between entering and staying out, so his entry cost is $T^B(Q^B) = EU^B$. Therefore the total number of buyers will be

$$Q^B = (T^B)^{-1}(EU^B) = (T^B)^{-1} \left(\pi \, (1-\omega) \, (\, b_{\text{av}} - c) \, \right) \, . \tag{9}$$

The right hand side contains only one endogenous variable, namely π.

Each inframarginal buyer q gets surplus equal to

$$T^B(Q^B) - T^B(q) = \pi \, (1-\omega) \, (\, b_{\text{av}} - c) - T^B(q) \, .$$

For each q, this is an increasing function of π. Therefore the buyers unanimously want their country to choose the governance quality θ so as to maximize π. The implication for θ will be determined shortly.

Now turn to the decisions of the sellers. Each seller prefers the contract mode to the spot mode. Roughly speaking, the intuition is that by going directly to the spot mode, he will merely increase the likelihood of meeting a buyer who has found out that his willingness to pay is low. Section (c) of the Appendix contains the formal proof. Then each seller's expected utility from entering the market, EU^S, is that under the contract mode, namely

$$EU^S = \int_{b_{\text{min}}}^{b^*} \left[\, \theta \, (p^c - c) + (1-\theta) \, \omega \, (b-c) \, \right] \, dF(b) + \int_{b^*}^{b_{\text{max}}} (p^c - c) \, dF(b) \tag{10}$$

All the entities on the right hand side can be expressed in terms of the exogenous variables and one remaining endogenous variable π.

The number of sellers entering the market is

$$Q^S = (T^S)^{-1}(EU^S) \, . \tag{11}$$

Of these, $(1-\theta) \, F(b^*) \, Q^S$ will have their matched buyers default on the contracts, and go to the spot market. The other side of that market will consist of all those buyers except those whose contracts were fulfilled either voluntarily or by court enforcement; those number

$$Q^B - \left[\theta \, F(b^*) + 1 - F(b^*) \, \right] \, Q^S .$$

Therefore the probability that a buyer on the spot market will find a seller is the ratio

$$\pi = \frac{(1-\theta) \, F(b^*) \, Q^S}{Q^B - \left[\theta \, F(b^*) + 1 - F(b^*) \, \right] \, Q^S} = \frac{(1-\theta) \, F(b^*) \, Q^S}{(Q^B - Q^S) + (1-\theta) \, F(b^*) \, Q^S} \tag{12}$$

Assume there is excess demand, that is, for each π, we have $Q^B > Q^S$. Then (12) can have a solution with $\pi \in (0,1)$. Write it as

$$\frac{\pi}{1-\pi} = \frac{(1-\theta)\, F(b^*)\, Q^S}{Q^B - Q^S}\,. \tag{13}$$

From (8) we see that EU^B is an increasing function of π, and from (9), Q^B is an increasing function of EU^B; therefore Q^B is an increasing function of π. Next, from (4), p^c is a decreasing function of π, from (10), EU^S is an increasing function of p^c,[4] and from (11), Q^S is an increasing function of EU^S; therefore Q^S is a decreasing function of π.Then the right hand side of (13) is a decreasing function of π. The left hand side is an increasing function of π, and goes from 0 to ∞ as π goes from 0 to 1. Therefore (13) yields a unique solution for π. That completes determination of the equilibrium.

The comparative statics of π with respect to the governance quality θ can in general be complicated. But one property is obvious from (12): when $\theta = 1$, $\pi = 0$. This is the worst outcome for the importing country's buyers.[5] Since buyers want to maximize π, they will want their domestic government to provide less than perfect governance! The intuition is that imperfect governance allows each buyer some possibility of escaping from his contract if he finds out that his willingness to pay is low. Of course the prospect of having their contracts repudiated deters lowers the sellers' expected utility and therefore reduces their numbers entering, and that is bad for buyers. Therefore how far the buyers' optimal π falls short of 1 depends on the elasticity of supply of sellers, that is, the steepness of their entry cost function $T^S(Q^S)$. If this function is steep, the sellers' supply is inelastic, so their numbers are not reduced much by the prospect of lower EU^S, and buyers can benefit more from bad domestic governance.

For simplicity of exposition, suppose that the behavior of π as a function of θ is simple and unimodal: it increases up to θ^* and decreases thereafter. Then θ^* is the buyers' optimal choice, and suppose their domestic political economy produces this outcome. How are the sellers affected? Section (d) of the Appendix shows that EU^S is an increasing function of θ over the range $[\theta^*, 1]$: sellers would prefer governance to be improved beyond what the importing country chooses, and in fact improved to perfection. This is borne out by the

[4]Note that at this point all the exogenous variables are held constant, and therefore in both of these cases b^*, which depends only on θ, is held unchanged as π changes.

[5]As $\theta \to 1$, we see from (3) that $b^* \to b_{\text{av}}$. Then (4), together with $\pi = 0$, implies $p^c = b_{\text{av}}$. Therefore buyers expect zero surplus.

nature of discussions and diplomatic pressures between advanced exporting countries with good governance, and less developed or transitional importing countries that have weaker governance.

2.1 Sample of Other Literature

Traders will not simply let mutually beneficial opportunities lapse for want of external contract governance. They will attempt to devise relation-based and reputation-based self-governing institutions. Avner Greif was a pioneer of such models in economic history; his work is collected in his book (2006). These models are not specific to the context of international trade, but they could be interpreted in that context. Similarly, Dixit (2004, Ch. 3) develops a model of the limits on trade enforced solely by considerations of reputation. Traders are distributed along a circle, and matched in pairs. The probability of being matched to someone distance x away along the arc of the circle decreases as x increases, but the potential value of such trade increases with x. If a trader cheats his partner in one such match, the news of the misbehavior spreads from the victim, with a probability that decreases with distance from the victim. In equilibrium, there is a threshold distance X such that traders honor contracts if matched with someone within that distance, but cheat if matched with someone farther away. This model squeezes the action into two periods. For an infinite-horizon version with some other generalizations and extensions, see Masten and Prüfer (2013). Dixit (2004, Ch. 4) models third-party for-profit contract enforcement. This converts a sequence of one-off relationships among traders into repeated relationships of each of them with the third-party enforcer. Sustaining equilibria with good behavior requires two dynamic incentive compatibility conditions to be met. The enforcer's fee or retainer for his service must be high enough to give him enough rent to keep him honest, and simultaneously low enough to give each trader enough surplus to prevent his cheating. This is feasible if the parties are sufficiently patient.

With bad contract enforceability, organizational form of firms affects its international trade and vice versa. Suppose a firm in country A supplies an intermediate good to, or buys an intermediate good from, a firm in country B, which has weak governance. Therefore contracts concerning payment for, or the quality of, this intermediate good may go unenforced. A vertically integrated multinational firm can better cope with this situation than can two separate firms. Conversely, recognition of the governance problem may lead to a merger of the firms or an acquisition of one by the other. This is similar to the transaction cost theory of vertical integration, or more generally the of organizational forms and transaction technologies (Williamson 1996, pp. 12, 311-12), but now applied to international trade and multinational firms. Such expansion of firms across national boundaries constitutes foreign direct investment leading to intra-firm trade; thus the issues span my two categories of trade and investment.

This is a flourishing area of research. Its substantive importance is clear, but its game-theoretic content is relatively straightforward. Antràs and Rossi-Hansberg (2009) have given us an excellent survey, so I will merely refer interested readers to it.

Lack of security of property rights also affects trade. Most interestingly, countries can invest resources for predatory or defensive purposes - to seize others' property or defend their own. These resources are then no longer available for production of goods and services for consumption. That can change the relative factor endowments of countries and change their patterns of trade and the possibility of gains from trade. Garfinkel et al. (2009) construct a model of this. They augment the standard Heckscher-Ohlin model of production and trade by making one of the factors (land) disputable, and introducing a third good (guns) that the countries deploy to acquire a share of the disputed land. Two consumption goods are produced using two factors, labor and land. Each country has its own secure endowment of the two factors. In addition, there is a disputed quantity of land, and its shares between the countries depend on the quantities of guns they choose to produce using some of their secure factors. For example, if the quantities of guns are G_1 and G_2, a logistic contest success will award a share $G_1/(G_1 + G_2)$ to country 1. This game of conflict is embedded in the model of competitive equilibrium of trade.

In autarky, the country that has a smaller relative endowment of land will have a higher relative price of the land-intensive good, and therefore will have a larger marginal benefit from acquiring more land. It will produce more guns unless the production of guns is even more land-intensive. International trade equalizes product prices, and under usual conditions, also equalizes factor prices. This equalizes the incentive to acquire more land, and in an equilibrium where war will be followed by free trade in goods, the two countries produce equal quantities of guns.[6] So long as the conditions for factor price equalization are met, this result is unaffected by their absolute endowments of the secure factors; thus a larger or more affluent country need not be militarily more powerful. Of course production of guns

[6]In the strict logic of the two-country model, it is difficult to think of them fighting a war over land and then trading goods amicably in a competitive equilibrium. But stretching the interpretation of the model somewhat, we can think of them as two countries in a large multi-country world.

leaves less of the factors for producing consumer goods; therefore the additional security costs of the conflict can outweigh the gains from trade.

When government enforcement of contracts is lacking, traders will develop private mechanisms of governance based on bilateral or multilateral relationships. International transactions of this kind are facilitated by ethnic networks of migrants; see the survey by Rauch (2001). The ideas are fairly straightforward to translate into formal models.

3 Foreign Investment

A foreign firm that invests in a country with poor governance exposes itself to risks beyond the usual ones like currency fluctuations. Its property right may be insecure, open to challenge by a local person who may get favored treatment by the country's courts, or subject to expropriation by the host country's government. Such expropriation does not have to be direct and complete seizure of the investment. It can take many indirect and partial forms such as arbitrary changes in tax rates, forced sale for eminent domain using unfairly low valuation, or ex post restrictions on repatriation of profits.

**** Figure 2 here ****

The basic game between the firm contemplating investment and the country with poor governance is shown in Figure 2. The firm has to sink the cost K to invest. If the country does not expropriate, the operating profits are split between it and the country in amounts F and C respectively, perhaps as a result of a prior bargaining game or contract that splits the surplus, so $F > K$ and $C > 0$. But after the fact, the country can expropriate the investment directly or indirectly, enjoying a payoff $C' > C$. Then in the subgame-perfect equilibrium the firm does not invest. But the terminal node where the firm invests and the country does not expropriate is preferred by both, so even the country has an ex ante interest in establishing a mechanism that would remove its ex post temptation.

Several such mechanisms are conceivable; here are a few:

[1] The firm could be given a sufficiently large up front payment to induce it to invest. This can be a grant of land, a subsidy, or a tax holiday. Some such schemes do exist, but they are not without problems. The governments of countries with poor governance are often constrained in their ability to raise taxes or to borrow. Making an up-front payment or forgoing tax revenue may merely transform the issue of credibility of non-expropriation

of direct investment into that of credibility of repayment of government debt. When feasible and used, such schemes seem to exhibit a gradual shift of bargaining power from the firm to the country. At the outset, the firm seems to be getting a highly favorable deal. Then gradually the country gets more of the surplus, and at some point may even expropriate the investment; this is sometimes called an "obsolescing bargain" (Vernon 1971, Kobrin 1987). In fact the whole sequence of events is explicitly or implicitly understood from the outset as a dynamic political bargain tailored for credibility (Eden, Lenway and Schuler 2004).

[2] The firm may be able to tweak its investment in such a way that the country is unable to operate it and derive sufficient payoff from it after expropriation. Many less-developed countries lack labor with high levels of skills in technology and management. Even though LDC wages are lower, the productivity of skilled labor may be lower still, raising the skilled wage in efficiency units for the country higher than the firm's cost of bringing expatriate skilled workers and managers. By making the investment excessively skill-intensive, the firm can raise the country's cost of using it.

**** Figure 3 here ****

Figure 3 illustrates this. The isoquant shows the combinations of unskilled labor (L) and skilled labor in efficiency units (E) that produce output of unit value. The two lines show those combinations that cost one unit to the firm and the country. There is no difference in the cost of the local unskilled labor, so the intercepts of the two lines on the horizontal axis coincide. But the firm is able to buy more efficiency units of skilled labor than the country, so the intercept on the vertical axis is higher for the firm. The firm's conventionally optimal choice is at the point A, where its factor price ratio equals the marginal rate of technical substitution between the two inputs. But in order to make the investment unprofitable for the country, the firm will choose the relatively more skill-intensive technology B. Casting this as a subgame-perfect equilibrium in a two-stage game is easy and left to the readers.

[3] Governments that want to attract foreign investors can develop reputations for treating them fairly. If the time horizon is infinite or indefinite, good behavior can be sustained as usual, and as usual there are serious issues of non-uniqueness. With a finite fixed horizon, the famous Kreps-Wilson (1982 b) analysis of the chain store paradox adapts easily to this situation. The only difference is that the credibility of a promise, not that of a threat, is in question. As the theory is very well known from the other context, I will give only a very brief heuristic presentation of actions on the possible paths of play.

Suppose countries are of two types, an honorable type (H) that will never expropriate foreign investment, and an opportunistic type (O) that will expropriate whenever it is in its national economic interest to do so, taking into account the full game over time. Suppose there are N periods or successive investment opportunities, and to keep the algebra simpler ignore discounting over time. The same firm or different firms may be the prospective investors in the periods, so long as there perfect recall or information communication about the history of the country's past actions. The payoffs of each investment are as in Figure 2. The firms' prior probability at the outset of the country being an H-type is π. All this is common knowledge.

Let θ denote the probability of meeting a non-expropriation response that will keep the firm indifferent between investing and not investing on any one occasion. That is,

$$\theta\ (F-K)+(1-\theta)\ (-K)=0$$

or

$$\theta = K/F\,. \tag{14}$$

With n investment opportunities remaining, let

$$p_n^* = \theta^n$$

and let p_n denote the posterior probability of an H-type country based on the history of the previous $(N-n)$ plays. Then there is a sequential equilibrium of the full game with the following properties:

(i) Firms' strategies:

$$\begin{aligned}
&\text{If } p_n \ > \ p_n^*\,,\ \text{then invest}\\
&\text{If } p_n \ < \ p_n^*\,,\ \text{then don't invest}\\
&\text{If } p_n \ = \ p_n^*\,,\ \text{then randomize, with Prob(Invest) } \phi \equiv (C'-C)/C'
\end{aligned}$$

(ii) O-type country's strategy:

$$\begin{aligned}
&\text{If } n=1,\ \text{expropriate}\\
&\text{If } n>1 \text{ and } p_n \geq p_n^*,\ \text{don't expropriate}\\
&\text{If } n>1 \text{ and } p_n < p_n^*,\ \text{randomize, with Prob(Don't Expropriate) } q_n \equiv \frac{p_n/(1-p_n)}{p_n^*/(1-p_n^*)}
\end{aligned}$$

(iii) Probabilities are conditioned on actions using Bayes' Rule. Since an H-type country never expropriates, any expropriation on the equilibrium path at any stage n leads to the probability of the country being H-type to be revised to $p_{n-1} = 0$. It is assumed that the same happens following any action off the equilibrium path where Bayes' Rule does not apply. In particular, if ever a country that is believed to be surely O-type ($p_n = 0$) gets an investment and does not expropriate it, this is ignored and the country is continued to be believed O-type ($p_{n-1} = 0$).

The result is checked for sequential equilibrium using the third part of the Kreps-Wilson (1982 a) definition; I omit the details of this.

**** Figure 4 here ****

The typical path of play can then be depicted as in Figure 4. When the game starts with all N opportunities remaining, we have $p_N = \pi$, the prior probability. If N is large enough to make $p_N^* = \theta^N < \pi$, even an O-type country does not expropriate. As both types have the same action in equilibrium, nothing is learned from this, and the posterior probability at the next stage remains equal to the prior, namely $p_{N-1} = \pi$. If $p_{N-1}^* = \theta^{N-1} < \pi$, then non-expropriation continues. This goes on until the the first time p_n^* exceeds π. Call this number of opportunities remaining M; this is the largest integer for which

$$\theta^M > \pi, \quad \text{or} \quad M \ \ln(\theta) > \ln(\pi)\,.$$

Both θ and π are in $(0,1)$, so both logarithms are negative numbers. Therefore the inequality is better understood as

$$-\ M \ \ln(\theta) < -\ \ln(\pi)\,.$$

Then M is the largest integer for which

$$\theta^M > \pi, \quad \text{or} \quad M < \frac{-\ \ln(\pi)}{-\ \ln(\theta)}\,. \tag{15}$$

When M stages remain, therefore, we have $p_M^* > \pi = p_M$, so an O-type country randomizes, with probability of non-expropriation

$$q_M = \frac{p_M/(1-p_M)}{p_M^*/(1-p_M^*)}\,.$$

Combining the probabilities of the country being H-type or O-type at this stage with the probabilities of non-expropriation conditional on type, the firm calculates the overall probability of non-expropriation at stage $(M-1)$ as

$$p_M \times 1 + (1-p_M) \times q_M = p_M + \frac{p_M}{p^*_M/(1-p^*_M)} = p_M \left[1 + \frac{1-p^*_M}{p^*_M}\right] = \frac{p_M}{p^*_M} = \frac{\pi}{\theta^M}\,.$$

By definition of M as the largest integer satisfying (15), we have $\theta^{M+1} \leq \pi$, therefore $\pi\,/\,\theta^M \geq \theta$: the firm's perceived probability of non-expropriation is sufficiently large to induce it to invest. In fact, ruling out an exceptional configuration of the parameters, the inequality will be strict and there will not even be any need to make a tie-breaking assumption to ensure investment.

After the firm has invested in the M^{th} game from the end, if the country's randomization results in expropriation, it is revealed as an O-type with probability 1. The game reverts to the complete information continuation and there is no further investment.

Suppose the country's randomization results in non-expropriation. Then at stage $(M-1)$ the posterior probability of the country being H-type is

$$\begin{aligned} p_{M-1} &= \frac{\text{Prob(Type H at } M) \times \text{Prob(Non-expropriate} \,|\, \text{Type H)}}{\text{Total Prob(Non-expropriation at } M)} \\ &= \frac{p_M}{p_M/p^*_M} \quad \text{Using result immediately above} \\ &= p^*_M \end{aligned}$$

Also $p^*_{M-1} = \theta^{M-1} = p^*_M/\theta$, so $p^*_{M-1} > p_{M-1}$. Therefore at stage $(M-1)$ the O-type country again randomizes. The same steps of calculation as at stage M show that the total probability of non-expropriation at stage $(M-1)$ is

$$p_{M-1} \times 1 + (1-p_{M-1}) \times q_{M-1} = p_{M-1}\,/\,p^*_{M-1} = \theta\,.$$

This is exactly the value for which the firm randomizes between the choice of investing and not investing. The result is a mixed strategy equilibrium at this stage.

The path of such mixed strategy stage equilibria can continue so long as the two randomizations yield a combined outcome where the firm invests and the O-type country does not expropriate. If or when the outcome is one with non-investment or expropriation, the game is over.

Finally consider optimality of the O-type country's strategies. Let V_n denote the value to the country at the node for the n^{th} play from the end after the firm has invested. Clearly

$V_1 = C'$. Turning to V_2, immediate expropriation would yield C'; non-expropriation would yield C at this stage, followed at stage 1 by investment with probability ϕ, and expropriation if investment occurs. Therefore

$$V_2 = \max\left(C' \,,\, C + \phi\, C' \right).$$

When $\phi = (C' - C)/C'$, the two arguments are equal. Then the country is indifferent between the two actions (and willing to randomize). Therefore this is the mixing on the firm's part that sustains the mixed strategy equilibrium at stage 2. The resulting value to the country is $V_2 = C'$. This continues up to and including stage M.

At stage $M+1$, the country knows that if it does not expropriate immediately, investment will occur with certainty at the next stage. Therefore

$$V_{M+1} = \max\left(C' \,,\, C + C' \right) = C + C'$$

and non-expropriation is optimal. The same is true for the remaining stages, with

$$V_n = (n - M)\; C + C' \quad \text{for } n > M\,.$$

The important result to note from (15) is that M is independent of the total number of plays N. Thus, for the first $(N - M)$ plays, which constitutes most of the game for large finite N, the O-type country will create and maintain sufficient reputation for honorable behavior and continue to attract investment.

3.1 Sample of Other Literature

Foreign direct investment in a country with poor governance is subject to a variety of risks. The host country's government or its agents may be corrupt and dealing with them may increase the costs of production. They may impose arbitrary ex post taxes or restrictions on repatriation of profits. Local partners and firms may steal technology. All of this affects the decision of whether to invest, and in what form to invest. A firm whose home country also has poor governance may have better experience of coping with such situations and may therefore enter or succeed where a technologically superior firm from an advanced country with clean governance stays out or fails.

Dixit (2011) discusses this using a slight extension of the model of Javorcik and Wei (2009). The firm F based in country O (origin) can make a direct investment in country H (host). It uses a technology in O that is too capital or skill intensive for economic conditions in H; denote by t the excess. Country H has defective governance (e.g. corruption). Denote by r the level of defectiveness; thus higher r means worse governance.

F can stay away (labelled Z), enter into a joint venture (J), or establish a wholly owned subsidiary (full vertical integration V). The revenue from the FDI project (plant, or subsidiary) depends on the mode it chooses. Denote the revenues under V and J by R_V and R_J respectively; $R_V > R_J$ because the partner in J must be given a bigger cut in exchange for help in dealing with local officials and in adapting the technology to suit local conditions. The production costs of the two modes are assumed to be

$$C_J = C_0 + c\,r + a\,t\,, \qquad C_V = C_0 + (c+\theta)\,r + (a+\mu)\,t\,,$$

where the parameters C_0, c, a, θ and μ are all positive. C_0 would be the basic cost in the host country using the technology appropriate for its economy (if the "technology excess" t equalled 0), and operating in a hypothetical regime of perfect governance ($r = 0$); the other terms are costs added because of inappropriate technology and poor governance. The parameter a is positive because by assumption the O-country technology is already too capital and skill intensive for H-country conditions, so a higher t increases costs. θ and μ are positive because it is even more costly for the O-country firm to cope on its own with bad H-country governance and to adopt technology to H-country conditions. Thus taking on a partner saves production costs. But it increases the risk and cost of technology leakage; this cost is specified as

$$L_J = (\gamma + \phi\,r)\,t$$

Thus the cost is higher the more advanced the S-country firm's technology. And for each given level of technology, the cost is higher the worse the governance in the H-country, because there is less contractual remedy if the local partner steals the technology. All these functional forms of the costs are chosen purely to keep the calculations simple; the qualitative results remain valid for more general functions that are increasing and interactive in qualitatively similar ways.

With these specifications, the expressions for the profits of the two FDI modes are

$$\begin{aligned}
\Pi_V &= R_V - C_0 - (c+\theta)\,r - (a+\mu)\,t \\
\Pi_J &= R_J - C_0 - c\,r - (a+\gamma)\,t - \phi\,t\,r
\end{aligned}$$

Of course $\Pi_Z = 0$. The mode with the highest profit is chosen.

**** Figure 5 here ****

Figure 5 shows the (r, t) space divided into three regions in each of which one of the three choices is optimal for firm F. The region to the north-east has Z as the optimal choice: H-country governance is so poor and the cost of technology leakage is so high that it is best not to invest at all. In the region to the left V is optimal: the governance is good enough that the O-country firm should invest directly without having to enlist the help of a local H-country partner. In the third region, J is optimal because a local partner helps with governance issues and the technology is not so advanced that the cost of losing it would be decisive.

This figure yields implications of two differences between southern and northern firms:

(1) Generally northern firms use more advanced technology (have higher t) in their home countries than southern firms. Therefore their FDI choices differ. They are shown by three vertical lines, each corresponding to a different level of H-country governance (different given r values), with a northern (N) firm at the top and a southern (S) firm at the bottom. The leftmost line is positioned where H-country governance is quite good. Then it is possible that the northern firm uses the V mode while the southern firm uses J: the southern firm is more likely to use a local partner because it has less to lose from technology leakage. In the central case, with mediocre H-country governance, the line shows the northern firm staying out while the southern firm uses V; its technology is more suitable to the H-country environment, so it can be profitable because of a lower cost of production. In the rightmost case with really bad H-country governance, the northern firm stays out while the southern firm enters using J: the low technology enables it to use a local partner with a lower risk of leakage, and the resulting lower cost of coping with the poor governance.

(2) Southern firms are better used to coping with bad governance in their home countries. This gives them lower values of c and/or θ. Lowering these parameters shifts all three separating curves in the figure rightward. Compare two firms, one southern and one northern, with a common level of technology t. If this common t is high, the northern firm may be in its region Z (stay out), while the southern, with its dividing curve between V and Z farther to the right, may be in its region V (enter with vertical integration). Similarly, for a lower common value of t, a southern firm may enter with a joint venture while a northern firm stays out, or a southern firm may enter with vertical integration while a northern firm must use a joint venture.

4 Concluding Comments

I have presented a few examples of game-theoretic models of foreign trade and investment when property rights and contracts are not well-enforced by governments. The game theory involved is relatively simple by present-day standards: strategic moves in two-stage games, elementary theory of repeated games, and some asymmetric information. There is much scope for application of theory in this area, and I hope to have stimulated interest in doing so.

Appendix

(a) Solution for $\mathbf{p^c}$

Each buyer's expected surplus from the contract is

$$C(p^c) \equiv \int_{b_{\min}}^{b^*} [\, \theta\,(b-p^c) + (1-\theta)\,\pi\,(1-\omega)\,(b-c)\,]\; dF(b) + \int_{b^*}^{b_{\max}} (b-p^c)\, dF(b)\,.$$

The expected surplus if he goes directly to the spot market is

$$S \equiv \int_{b_{\min}}^{b_{\max}} \pi\,(1-\omega)\,(b-c)\, dF(b)\,.$$

When $p^c = b_{\max}$, we have $b - p^c < 0$ for all b in the integrands in the expression for $C(p^c$. Therefore

$$\begin{aligned} C(b_{\max}) &< \int_{b_{\min}}^{b^*} (1-\theta)\,\pi\,(1-\omega)\,(b-c)\, dF(b) \\ &< \int_{b_{\min}}^{b^*} \pi\,(1-\omega)\,(b-c)\, dF(b) \\ &< \int_{b_{\min}}^{b_{\max}} \pi\,(1-\omega)\,(b-c)\, dF(b) = S \end{aligned}$$

When $p^c = c$,

$$\begin{aligned} C(c) &= \int_{b_{\min}}^{b^*} [\, \theta\,(b-c) + (1-\theta)\,\pi\,(1-\omega)\,(b-c)\,]\; dF(b) + \int_{b^*}^{b_{\max}} (b-c)\, dF(b) \\ &= \int_{b_{\min}}^{b^*} \theta\,[1-\pi(1-\omega)]\,(b-c)\, dF(b) + \int_{b_{\min}}^{b^*} \pi\,(1-\omega)\,(b-c)\, dF(b) \\ &\quad + \int_{b^*}^{b_{\max}} [1-\pi(1-\omega)]\,(b-c)\, dF(b) + \int_{b^*}^{b_{\max}} \pi(1-\omega)\,(b-c)\, dF(b) \end{aligned}$$

The first integral on each of the last two lines is positive, while the second integrals on the two lines add up to S. Therefore $C(c) > S$.

In the text it was shown that $C(p^c)$ is a decreasing function. Therefore there is a unique $p^c \in (c, b_{\max})$ that solves $C(p^c) = S$.

(b) Derivation of (3)

Write the equation as

$$\begin{aligned} & [\, \theta + (1-\theta)\,\pi\,(1-\omega)] \int_{b_{\min}}^{b^*} b\, dF(b) + \int_{b^*}^{b_{\max}} b\, dF(b) \\ & -\theta\, p^c\, F(b^*) - \pi\,(1-\theta)\,(1-\omega)\, c\, F(b^*) - p^c\,[1-F(b^*)] \\ = \;& \pi(1-\omega)\; b_{\mathrm{av}} - \pi\,(1-\omega)\, c\,, \end{aligned}$$

or

$$
\begin{aligned}
& [\,\theta + (1-\theta)\,\pi\,(1-\omega)] \int_{b_{\min}}^{b^*} b\,dF(b) + b_{\text{av}} - \int_{b_{\min}}^{b^*} b\,dF(b) \\
& -[\theta\,F(b^*) + 1 - F(b^*)]\; p^c - \pi\,(1-\theta)\,(1-\omega)\,c\,F(b^*) \\
= \;& \pi(1-\omega)\; b_{\text{av}} - \pi\,(1-\omega)\,c\,,
\end{aligned}
$$

or

$$
\begin{aligned}
& [1-\pi(1-\omega)]\; b_{\text{av}} - (1-\theta)\,[1-\pi(1-\omega)] \int_{b_{\min}}^{b^*} b\,dF(b) \\
= \;& [\theta\,F(b^*) + 1 - F(b^*)]\; p^c - [1-(1-\theta)\,F(b^*)]\;\pi(1-\omega)\,c\,,
\end{aligned}
$$

or

$$
[1-\pi(1-\omega)] \left\{ b_{\text{av}} - (1-\theta) \int_{b_{\min}}^{b^*} b\,dF(b) \right\} = [\theta\,F(b^*) + 1 - F(b^*)]\; [\,p^c - \pi(1-\omega)\,c\,]\;.
$$

Using (1), this becomes

$$
b_{\text{av}} - (1-\theta) \int_{b_{\min}}^{b^*} b\,dF(b) = [\theta\,F(b^*) + 1 - F(b^*)]\; b^*\,.
$$

Next, integrate by parts to write

$$
\begin{aligned}
\int_{b_{\min}}^{b^*} b\,dF(b) &= b^*\;F(b^*) - b_{\min}\;F(b_{\min}) - \int_{b_{\min}}^{b^*} 1\,\cdot\,F(b)\,db \\
&= b^*\;F(b^*) - \int_{b_{\min}}^{b^*} F(b)\,db\,,
\end{aligned}
$$

and substitute in the above equation to get

$$
b_{\text{av}} - (1-\theta) \left\{ b^*\;F(b^*) - \int_{b_{\min}}^{b^*} F(b)\,db \right\} = [\theta\,F(b^*) + 1 - F(b^*)]\; b^*\,,
$$

which immediately simplifies to (3) in the text.

(c) Seller's choice between contract and spot

If a seller enters the contract side of the market, his contract may be repudiated and he may have to go to the spot market if the buyer he meets then finds out $b < b^*$ and the court does not enforce, otherwise the contract will be honored. The seller's resulting expected utility is

$$
\int_{b_{\min}}^{b^*} [\,\theta\,(p^c - c) + (1-\theta)\,\omega\,(b - c)\,]\; dF(b) + \int_{b^*}^{b_{\max}} (p^c - c)\,dF(b)\,.
$$

Entering the spot market directly would yield the seller the expected utility

$$\int_{b_{\min}}^{b_{\max}} \omega\,(b-c)\,dF(b)\,.$$

The contract mode is better for the seller if the former is larger, that is,

$$\begin{aligned}
0 \;&<\; \int_{b_{\min}}^{b^*} \left[\,\theta\,(p^c - c) + (1-\theta)\,\omega\,(b-c)\,\right]\,dF(b) + \int_{b^*}^{b_{\max}} (p^c - c)\,dF(b) \\
&\qquad - \int_{b_{\min}}^{b_{\max}} \omega\,(b-c)\,dF(b) \\
&= \int_{b_{\min}}^{b^*} \left[\,\theta\,(p^c - c) + (1-\theta)\,\omega\,(b-c)\,\right]\,dF(b) + \int_{b^*}^{b_{\max}} (p^c - c)\,dF(b) \\
&\qquad - \int_{b_{\min}}^{b^*} \omega\,(b-c)\,dF(b) - \int_{b^*}^{b_{\max}} \omega\,(b-c)\,dF(b) \\
&= \int_{b_{\min}}^{b^*} \theta\,\left[\,(p^c - c) - \omega\,(b-c)\,\right]\,dF(b) + \int_{b^*}^{b_{\max}} \left[\,(p^c - c) - \omega\,(b-c)\,\right]\,dF(b) \\
&= \theta\,p^c\,F(b^*) - \theta\,\omega \int_{b_{\min}}^{b^*} b\,dF(b) - \theta\,(1-\omega)\,c\,F(b^*) \\
&\qquad + p^c\,[1 - F(b^*)] - \omega \int_{b^*}^{b_{\max}} b\,dF(b) - (1-\omega)\,c\,[1 - F(b^*)] \\
&= [p^c - (1-\omega)c]\,[1 - F(b^*) + \theta\,F(b^*)] - \theta\,\omega \int_{b_{\min}}^{b^*} b\,dF(b) - \omega\,\left\{ b_{\mathrm{av}} - \int_{\min}^{b^*} b\,dF(b) \right\} \\
&= \{\,[1 - \pi(1-\omega)]\;b^* + \pi(1-\omega)\;c - (1-\omega)c\,\}\,[1 - F(b^*) + \theta\,F(b^*)] \\
&\qquad - \theta\,\omega \int_{b_{\min}}^{b^*} b\,dF(b) - \omega\,\left\{ b_{\mathrm{av}} - \int_{\min}^{b^*} b\,dF(b) \right\} \quad \text{Using (1)} \\
&= \{\,[1 - \pi(1-\omega)]\;b^* - (1-\pi)\,(1-\omega)c\,\}\,[1 - F(b^*) + \theta\,F(b^*)] \\
&\qquad - \omega\,\left\{ b_{\mathrm{av}} - (1-\theta) \int_{\min}^{b^*} b\,dF(b) \right\} \\
&= \{\,[1 - \pi(1-\omega)]\;b^* - (1-\pi)\,(1-\omega)c\,\}\,[1 - F(b^*) + \theta\,F(b^*)] \\
&\qquad - \omega\,\left\{ b_{\mathrm{av}} - (1-\theta)\;b^*\,F(b^*) + (1-\theta) \int_{\min}^{b^*} F(b)\,db \right\} \quad \text{Integrating by parts} \\
&= \{\,[1 - \pi(1-\omega)]\;b^* - (1-\pi)\,(1-\omega)c\,\}\,[1 - F(b^*) + \theta\,F(b^*)] \\
&\qquad - \omega\,\{ b^* - (1-\theta)\;b^*\,F(b^*)\,\} \qquad \text{Using (3)} \\
&= (1-\pi)\,(1-\omega)\,[1 - F(b^*) + \theta\,F(b^*)]\;(b^* - c)\,.
\end{aligned}$$

All the factors in the final expression are positive, so proving the desired inequality.

(d) Signing dEU^S/dθ

The expression (10) "simplifies" to

$$
\begin{aligned}
EU^S &= \int_{b_{\min}}^{b^*} \left[\, \theta\,(p^c - c) + (1-\theta)\,\omega\,(b - c) \,\right] \, dF(b) + \int_{b^*}^{b_{\max}} (p^c - c)\, dF(b) \\
&= \left[\theta\,(p^c - c) - (1-\theta)\,\omega\, c\right] F(b^*) + (1-\theta)\,\omega \int_{b_{\min}}^{b^*} b\, dF(b) + (p^c - c)\,[1 - F(b^*)] \\
&= (p^c - c)\,[\theta\, F(b^*) + 1 - F(b^*)] - (1-\theta)\,\omega\, c\, F(b^*) + (1-\theta)\,\omega \int_{b_{\min}}^{b^*} b\, dF(b) \\
&= (b^* - c)[1 - \pi(1-\omega)]\,[\theta\, F(b^*) + 1 - F(b^*)] - (1-\theta)\,\omega\, c\, F(b^*) \\
&\qquad + (1-\theta)\,\omega \int_{b_{\min}}^{b^*} b\, dF(b) \quad \text{Using (4)} \\
&= (b^* - c)[1 - \pi(1-\omega)]\,[\theta\, F(b^*) + 1 - F(b^*)] - (1-\theta)\,\omega\, c\, F(b^*) \\
&\qquad + (1-\theta)\,\omega \left\{ b * \; F(b^*) - \int_{b_{\min}}^{b^*} F(b)\, db \right\} \quad \text{Integrating by parts)} \\
&= (b^* - c)\; \{\; [1 - \pi(1-\omega)]\,[\theta\, F(b^*) + 1 - F(b^*)] + (1-\theta)\,\omega\, F(b^*) \;\} \\
&\qquad - (1-\theta)\,\omega \int_{b_{\min}}^{b^*} F(b)\, db \\
&= (b^* - c)\; \{\; [1 - \pi(1-\omega)] - (1-\pi)\,(1-\omega)\,(1-\theta)\, F(b^*) \;\} \\
&\qquad - (1-\theta)\,\omega \int_{b_{\min}}^{b^*} F(b)\, db
\end{aligned}
$$

Therefore

$$
\begin{aligned}
\frac{\mathrm{d}EU^S}{\mathrm{d}\theta} &= \{\; [1 - \pi(1-\omega)] - (1-\pi)\,(1-\omega)\,(1-\theta)\, F(b^*) - (1-\theta)\omega\, F(b^*) \;\} \; \frac{\mathrm{d}b^*}{\mathrm{d}\theta} \\
&\qquad - (b^* - c)\,(1-\pi)\,(1-\omega)\,(1-\theta)\, f(b^*)\, \frac{\mathrm{d}b^*}{\mathrm{d}\theta} \\
&\qquad + (b^* - c)\,(1-\pi)\,(1-\omega)\, F(b^*) + \omega \int_{b_{\min}}^{b^*} F(b)\, db \\
&\qquad - (b^* - c)\,(1-\omega)\,[1 - F(b^*) + \theta\, F(b^*)]\, \frac{\mathrm{d}\pi}{\mathrm{d}\theta} \\
&= [1 - \pi(1-\omega)]\; [1 - F(b^*) + \theta\, F(b^*)\,]\; \frac{\mathrm{d}b^*}{\mathrm{d}\theta} \\
&\qquad - (b^* - c)\,(1-\pi)\,(1-\omega)\,(1-\theta)\, f(b^*)\, \frac{\mathrm{d}b^*}{\mathrm{d}\theta} \\
&\qquad + (b^* - c)\,(1-\pi)\,(1-\omega)\, F(b^*) + \omega \int_{b_{\min}}^{b^*} F(b)\, db \\
&\qquad - (b^* - c)\,(1-\omega)\,[1 - F(b^*) + \theta\, F(b^*)]\, \frac{\mathrm{d}\pi}{\mathrm{d}\theta}
\end{aligned}
$$

$$
\begin{aligned}
= \quad & -\left[1-\pi\,(1-\omega)\right] \int_{b_{\min}}^{b^*} F(b)\,db \qquad \text{Using (6)} \\
& \quad - (b^*-c)\,(1-\pi)\,(1-\omega)\,(1-\theta)\,f(b^*)\,\frac{\mathrm{d}b^*}{\mathrm{d}\theta} \\
& \quad + (b^*-c)\,(1-\pi)\,(1-\omega)\,F(b^*) + \omega \int_{b_{\min}}^{b^*} F(b)\,db \\
& \quad - (b^*-c)\,(1-\omega)\left[1-F(b^*)+\theta\,F(b^*)\right]\frac{\mathrm{d}\pi}{\mathrm{d}\theta} \\
= \quad & (1-\pi)\,(1-\omega)\left\{ (b^*-c)\,F(b^*) - \int_{b_{\min}}^{b^*} F(b)\,db \right\} \\
& \quad - (b^*-c)\,(1-\pi)\,(1-\omega)\,(1-\theta)\,f(b^*)\,\frac{\mathrm{d}b^*}{\mathrm{d}\theta} \\
& \quad - (b^*-c)\,(1-\omega)\left[1-F(b^*)+\theta\,F(b^*)\right]\frac{\mathrm{d}\pi}{\mathrm{d}\theta}
\end{aligned}
\tag{16}
$$

Observe the expression in the large brackets in the first line of this final expression. The function $F(b)$ is increasing. Therefore the integral is less than $(b^* - b_{\min})\,F(b^*)$, which in turn is less than $(b^*-c)\,F(b^*)$. Therefore the whole expression is positive. Figure 6 illustrates this. The integral is the area under the curve $F(b)$; it is being subtracted from the area of the whole rectangle.

**** Figure 6 here ****

Thus, in the final expression (16) for $\mathrm{d}EU^S/\mathrm{d}\theta$, the first line is positive. The second line has a negative sign leading, and $\mathrm{d}b^*/\mathrm{d}\theta$ is negative. The third line also has a negative sign leading, and over the range $[\theta^*, 1]$, the derivative $\mathrm{d}\pi/\mathrm{d}\theta$ is negative. Therefore we have $\mathrm{d}EU^S/\mathrm{d}\theta > 0$, as was to be proved.

References

Anderson, James E. and Leslie Young. 2006. "Trade and contract enforcement." *Contributions to Economic Analysis and Policy* 5(1), Article 30.

Anderson, James E. 2009. "Does trade foster contract enforcement?" *Economic Theory* 41(1), 105–131.

Antràs, Pol, and Esteban Rossi-Hansberg. 2009. "Organizations and trade." *Annual Review of Economics* 1, 43–64.

Dixit, Avinash. 2004. *Lawlessness and Economics: Alternative Modes of Governance.* Princeton, NJ: Princeton University Press.

Dixit, Avinash. 2009. "Governance institutions and economic activity." *American Economic Review* 99(1), March, 5–24.

Dixit, Avinash. 2011. "International trade, foreign direct investment, and security." *Annual Reviews of Economics* 3, 191-213.

Eden, Lorraine, Stefanie Lenway and Douglas A. Schuler. 2004. "From the obsolescing bargain to the political bargaining model." Texas A&M University, Bush School Working Paper No. 403.

Garfinkel, Michelle R., Stergios Skaperdas, and Constantinos Syropoulos. 2009. "International trade and transnational security: How comparative advantage and power are jointly determined." CES-IFO Munich: Working Paper No. 2680.

Greif, Avner. 2006. *Institutions and the Path to the Modern Economy: Lessons from Medieval Trade.* New York: Cambridge University Press.

Javorcik Beata S. and Shang-Jin Wei. 2009. "Corruption and cross-border investment in emerging markets: Firm-level evidence." *Journal of International Money and Finance* 28, 605–624.

Kobrin, Stephen. 1987. "Testing the bargaining hypothesis in the manufacturing sector in developing countries." *International Organization* 41: 609–638.

Kreps, David M. and Robert B. Wilson. 1982 a. "Sequential equilibria." *Econometrica* 50(4), July, 863–894.

Kreps, David M. and Robert B. Wilson. 1982 b. "Reputation and imperfect information." *Journal of Economic Theory* 27: 253–279.

Masten, Scott and Prüfer, Jens. 2013. "On the evolution of collective enforcement institutions: Communities and courts." TILEC Discussion Paper No. 2011-017; U of Michigan Law & Econ, Empirical Legal Studies Center Paper No. 11-013.

Rauch, James E. 2001. "Business and social networks in international trade." *Journal of Economic Literature* 39(4), December, 1177–1203.

Vernon, Raymond. 1971. *Sovereignty at Bay: The Multinational Spread of US Enterprises.* New York: Basic Books.

Williamson, Oliver E. 1996. *The Mechanisms of Governance.* New York: Oxford University Press.

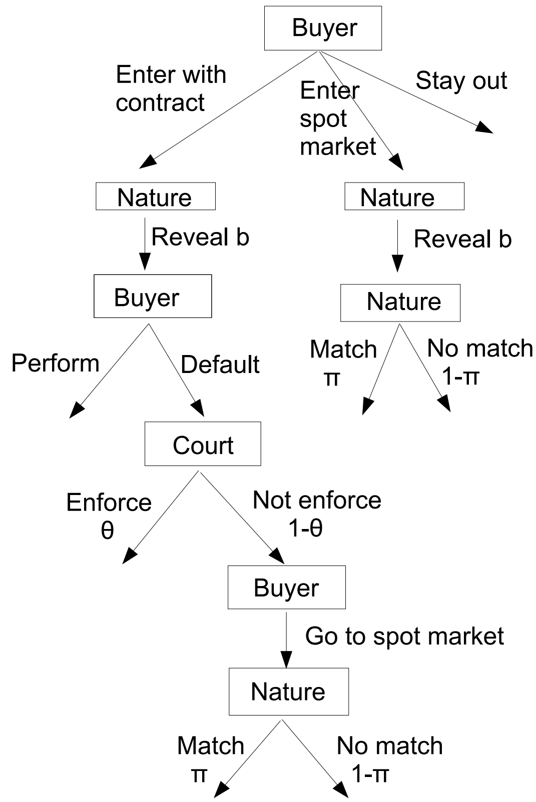

Figure 1: Tree of moves

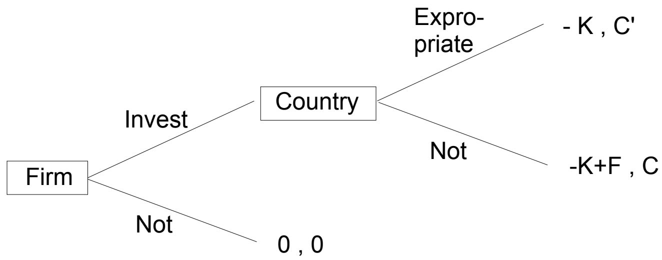

Figure 2: Basic (non-)investment game

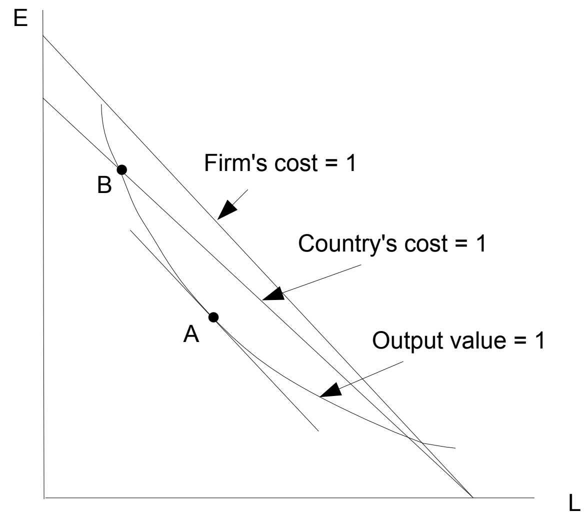

Figure 3: Use of skill-intensive technique

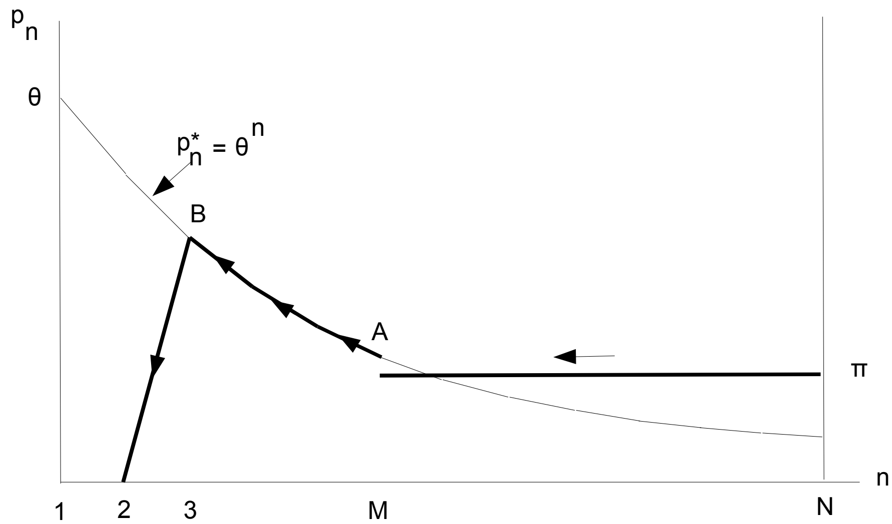

Figure 4: Reputation for non-expropriation

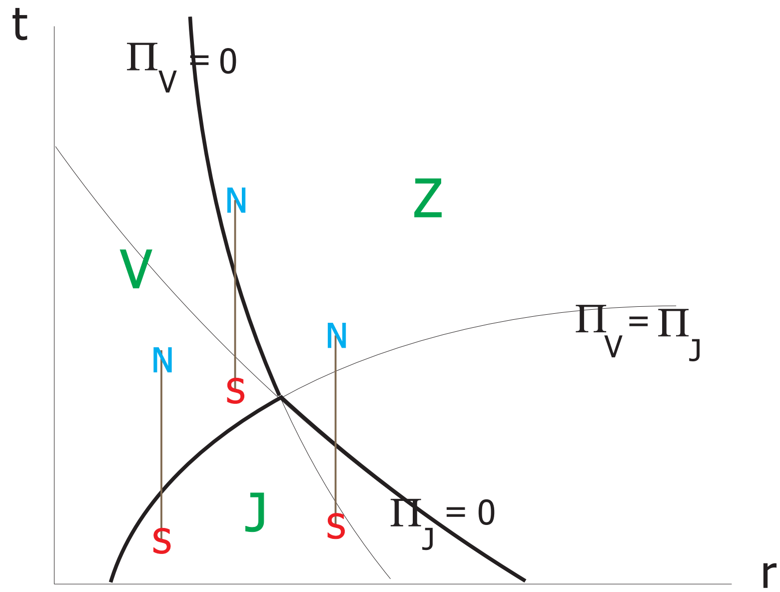

Figure 5: Differences in FDI by northern and southern firms. Reprinted with permission from the Annual Review of Economics, Volume 3. © 2011 by Annual Reviews, http://www.annualreviews.org.

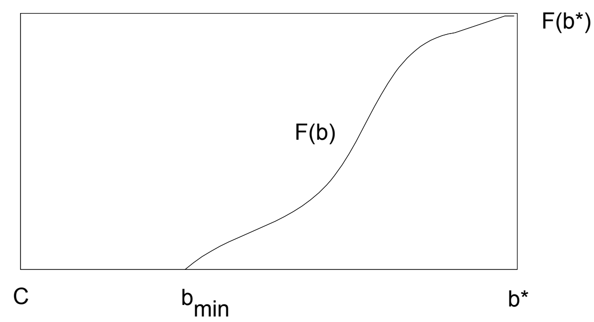

Figure 6: Geometric argument in Proposition 1