Technical Appendix

PERVERSE INCENTIVES IN STRATEGIC INTERACTIONS INVOLVING AN INTERNATIONAL DEVELOPMENT COOPERATION AGENCY

by

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A strategic interaction is any interaction between two or more actors, whose outcome depends on the strategies chosen by those actors. Strategic interactions pervade everyday life, in the form of economic transactions, political campaigns, legal cases, and social interactions—to name a few. The interactions between an International Development Cooperation Agency (IDA) and its own government, as well as the governments and officials of target recipient nations, are strategic.

A game is any strategic interaction which is governed by rules and is characterized by a well-defined and publicly verifiable outcome. This definition narrows the scope of strategic interactions considerably. Without rules, almost anything can happen. The players can choose practically any strategy, and the chaos that results can be impossible to analyze. Without a well-defined outcome, it may not be possible to know how a game ended, or even that it ended—like playing basketball without keeping score and without a clock. Again, without public verifiability, it may not be possible for different analysts to agree on what happened—like playing soccer where the referee has the game clock, and no one else can see it. (Gardner, 1995)

With the structure implicit in a game, one can erect an entire mathematical theory of games. This theory has proved useful in its own right—we now have a much improved understanding of literal games like Chess, Poker, and Blackjack. The theory has proved just as useful as a model of human affairs, especially in economics and political science, but increasingly in anthropology, sociology, psychology, and biology as well. The goal of this Technical Appendix is to usefully model the strategic interactions involving an IDA as a game.

A major finding of the last half century of IDA activity is that perverse incentives pervade such activity, and often vitiate its results. Notable failures, such as Sweden/Tanzania and USA/Zaire serve to highlight the problem of perverse incentives.

We use game theory to explain this major finding. Then we use the results of our game theory analysis to inform policy recommendations to IDA.

Start with initial conditions, prior to IDA involvement in the target recipient. Indeed, we have the following:

1. **Initial conditions in the target recipient are often driven by perverse incentives, so an IDA is faced with pre-embedded perverse incentives at the outset.**

IDAs don't operate in countries like Norway or Sweden—countries that have the best investment climate, the lowest corruption, and the highest per capita GDP in the world. ID**As** operate in countries exhibiting bad results—terrible investment climate, high levels of corruption, and very low per capita. There are lots of reasons for bad economic results, and bad initial conditions. We focus here on two phenomenona linked to bad economic results—the tragedy of commons, and the principal-agent problem. We find these two phenomena in almost every country where an IDA might consider operating, and these two phenomena—if not improved upon—can doom IDA efforts to failure as a consequence.

Consider first a common-pool resource, or CPR. A CPR is defined by two characteristics: exclusion is prohibitively costly, but consumption is rivalrous. Thus, CPRs are polar opposites of club goods. While club goods rarely if ever have tragic outcomes, CPRs are plagued by outcomes exhibiting short-run inefficiency and long-run unsustainability (destruction)—a phenomenon popularly known as the Tragedy of the Commons. This tragedy is observed the world over in target recipient countries. Here are just 3 examples:

- deforestation in subsaharan Africa, forests being a CPR
- degradation of irrigation networks in the Himalayas, the irrigation network being a CPR
- overfishing of Atlantic cod, salmon, and swordfish, the fish being a CPR

Ostrom (1990) contains many more such examples.

Ostrom, Gardner, and Walker (1994) study CPRs from the point of view of game theory, insitutional analysis, empirical political science, and experimental economics. We find conditions under which tragic outcomes have been or can be averted. Figure 1 gives a very simple example of the problems inherent with a CPR. There are n players, each having the same access to the CPR. CPR production is given by a concave production function F(X), where X is the number of players using the CPR. Each player has a dichotomous choice:

(1) use the CPR, in which case the player's payoff is F(X)/X
or
(2) do not use the CPR, in which case the player's payoff is w.

(1) follows from the equal access assumption; (2) represents a fixed outside opportunity, w, available to all potential users.

CPR production is shown on the vertical axis of figure 1; inputs X into production, here the number of users, on the horizontal axis.

First determine the Nash equilibrium of the game played by the n potential users of a CPR, the players. A player will use the CPR in the event that (1) pays better than (2);

$F(X)/X > w$ then use the CPR

A player will be indifferent between using the CPR and exercising his outside option when (1) and (2) pay the same:

$F(X)/X = w$ then use the CPR or exercise outside opportunity

A player will exercise the outside opportunity in the event that (2) pays better than (1):

$F(X)/X < w$ then exercise outside opportunity

At a Nash equilibrium, each player individually has maximized payoff; hence, this is a number of players X using the commons such that

$F(X)/X = w$
Or
$F(X) = wX$,

The point labeled Nash EQ (for equilibrium) in figure 1.

Next, consider the optimization problem posed by a CPR. One wants to maximize net output, which is the difference between CPR output and opportunity cost:

Maximize $F(X) - w X$

Using the theorem of the mean value from calculus, it is clear that the above maximum occurs at the point marked OPT (for optimum) in figure 1.

It follows from concavity of the production function that the number of users at OPT is always less than the number of users at Nash EQ. So the situation portrayed in figure 1 is completely general. So we have as an immediate implication that the CPR is **overused** at a Nash equilibrium.

This already implies an inefficiency. Define efficiency to be

Efficiency = (total payoff at Nash EQ)/(total payoff at OPT)

This definition is a literal rendition of Debrue's coefficient of resource utilitization (Debreu, 1953). For the case shown in figure 1, we have

Efficiency $= wX/[F(X^*) + w(X-X^*)] < 1$

Indeed, this efficiency will be well below 100%, since CPR production in figure 1 occurs in the counterproductive zone, where marginal product is negative. As long as average product is positive, no matter how low, one may get a Nash equilibrium at that level---all it takes is a low enough outside opportunity w.

Here is the recipe for ultimate tragic outcomes: w near 0 (low value outside opportunity) and large X (many potential users, for whom the CPR is the best thing they've got). The outcome is very low efficiency, as the Nash equilibrium is driven further and further towards zero---which must be reached in the limit as X grows large, again by concavity. In the limit for large X as w goes to zero, efficiency is driven to zero:

Lim Efficiency = lim w X/ [F(X*) + x(X-X*)] = 0/ F(X^) = 0

Where X^ is the X satisfying F'(X^) = 0, where maximum CPR output occurs.

We identify low efficiency of CPR utilitzation as a short-run tragedy. However, overuse also has long-run implications. Indeed, if overuse is not sustainable, then the CPR is inevitable degraded, and may even be destroyed as a result. We identify destructions of the CPR as a long-run tragedy.

Most countries, identified as target recipients by IDAs, reflect the short-run and long-run tragic outcomes associated with CPRs. There is a real and persistent market failure here, which opens a window of opportunity for IDAs to enjoy development success—address the tragedy of the commons in the target recipient.

We should point out that besides CPRs in a literal sense, CPRs in a metaphorical sense can usefully model other relevant phenomena. Two such models, of particular importance to an IDA, are corruption and rent seeking. Section 4 below explores this point in considerable detail.

A second phenomenon which is almost surely encountered in a target recipient country is the principal-agent problem. Indeed, this problem is likely to be encountered at almost every level of society and of our analysis of society, from personal interactions to the interaction between the Central Government and a Ministry of that Government.

A principal is an person or firm that hires another person or firm to perform services. An agent is any person or firm hired to perform services for a principal. A homely example is a person with a legal problem (the principal) who hires a lawyer (the agent) to solve that legal problem. In precisely the same sense, a Central Government tasks its Ministry of Foreign Affairs to conduct its foreign policy in the desired manner. See Gardner, 1995, chapter 10, for detailed analysis.

The reason relationships between a principal and an agent can lead to problems is that often, the interests of the principal and of the agent do not coincide. A person with a legal problem may want his or her lawyer to work harder than the lawyer wants to. A Central Government may want a certain policy carried out with regards another country, while the Ministry of Foreign Affairs prefers another policy be carried out with regards to that country.

Figure 2 shows a simple, but typical, Principal-Agent Problem. The Principal moves first in this tree diagram. At first move, the Principal either offers the Agent a contract, or not. If the Principal does not offer the Agent a contract, then the game ends with the payoffs

(0,0) = (0 for Principal, 0 for agent).

0 is a normalization, representing no relationship or worthless relationship.

If the Principal offers the Agent a contract, then it is the Agent's turn to move. The Agent either accepts the contract of does not accept the contract. If the Agent does not accept the contract, then the game ends with the payoffs

(0,0) = (0 for Principal, 0 for Agent)

Finally, if the Agent accepts the contract, the Agent again has to decide whether to expend High effort or Low effort in fulfilling the contract. This decision by the Agent is the crux of the Principal-Agent Problem.

Consider the situation portrayed in Figure 2. The optimum choice—the first-best arrangement—is for the Agent to expend High effort. This yields the payoff vector

(4,4) = (4 for Principal, 4 for Agent)

with a total of 8, the largest available in the entire diagram.

However, the Agent, whose choice it is, prefers to expend Low effort. This yields the payoff vector

(1,5) = (1 for Principal, 5 for Agent)

with a total payoff of 6, the second largest available in the entire diagram.

What is 25% better for the Agent (5 > 4) is 25% worse for society (6 < 8).

In this case, the Principal-Agent Problem leads to a loss in efficiency of 25% relative to optimum.

Even in the most advanced economies, Principal-Agent problems pose challenges. In countries targeted as recipients by IDAs, these problems are overwhelming.

When faced with Tragedies of the Commons, and with Principal-Agent Problems pervading the economy, there is no escaping the conclusion: the initial situation facing an IDA in a target recipient country is already bad.

Suppose the IDA enters the initial situation (this entry decision we model below in section 3, immediately following this analysis).

2. Entry **by an IDA into a bad initial** situation may make things worse, rather **than better. Improved results are not guaranteed.**

So much depends on how the entry into initial situation is actualized in the game, and whether perverse incentives are intensified or reduced. Indeed, if the IDA enters simply as another player, worse results are guaranteed.

(1) The IDA enters the commons as simply another player.
To see the implications of this, consider the Tragedy of the Commons (figure 1). The initial Nash equilibrium is based on n players. With an n+1 player, all the following occur:
Input to the commons X increases
Output from the commons F(X) decreases
Average product from the commons F(X)/ X decreases
Efficiency of the commons decreases.
In terms of the figure, the Nash equilibrium gets further from the optimum, and closer towards complete waste of the commons.
So if the IDA enters as just another player, a worse outcome is guaranteed.

To complete the analysis, consider also the following two possibilities:
(2) The IDA enters by replacing one of the existing players.
To see the implications of this, again refer to figure 1. The number of players, n, has not changed. Therefore, the Nash equilibrium has not changed. So if the IDA enters by replacing an existing player, nothing changes. Neither a worse outcome, nor a better outcome results.

(3) The IDA enters by replacing more than one of the existing players.
To see the implications of this, again refer to figure 1. Now the number of players has been reduced to at least n-1. The Nash equilibrium changes in all the following ways:
In put to the commons X decreases
Output from the commons F(X) increases
Average product from the commons F(X)/X increases
Efficiency of the commons increases
In this case, an improvement in results is observed.

What we have just shown is that decision to enter taken by the IDA does not necessarily change or improve perverse incentives already present. Without a major transformation of the game (removal of at least 2 players), the IDA only makes things worse by entering.

This analysis has all been based on the assumption that the IDA enters at the same level as the players in the pre-existing game in the target recipient country. In sections 4-6, we consider the implications if the IDA enters at a higher level than the players in the pre-existing game. It should come as no surprise that here too, one often encounters intensification of perverse incentives.

In the previous section, we took the decision by the IDA to enter a target recipient country as given. We now formalize that entry decision using game theory. Indeed, we arrive at the following conclusion:

3. The decision **to enter** represents a classic 3-scenario format of strategic analysis, **which any IDA is strongly advised to utilize.**

Consider each of the three cases above, which are now depicted in the decision tree diagrams of figure 3. In each of the three diagrams, the vector at the far right represents (payoff to IDA, efficiency observed in target recipient).

All payoffs are relative to the status quo of No Entry. Furthermore, all payoffs to the IDA are
simply recorded as "+" for improvement, "0" for no change, and "-" for worsening.

This is done to avoid quantifying something—the preferences of a complex organization—which is hard to quantify. One suggested quantification however, would be to measure IDA payoffs as changes in efficiency. If in addition, the payoffs of the target recipient country are also measured as changes in efficiency, then we have a game of **Common Interest,** where both players have the same payoff function. This is the best possible situation that an IDA can be in—every game of Common Interest has a Pareto-efficient Nash equilibrium, and the set of Nash equilibria are Pareto-ranked. For such games, there is a readily available strategy for each player to solve the problem of perverse incentives: utilize the strategy that leads to best Nash equilibrium.

In figure 3 (a), the IDA can enter, in which case the payoffs are
(+, +10%)
which means an improvement for the IDA, and a 10% improvement in the efficiency of the commons;
or the IDA can stay out, in which case the payoffs are
(0, 0%)
which represents no change. A 10% change in a real-world setting would be considered a development success.
Since the IDA prefers an improvement to no change, the IDA enters. This is represented by the arrow attached to the branch market "Enter" in figure 3 (a).

In figure 3(b), the IDA can enter, in which case the payoffs are
(0,0%)
which means no change for the commons or the IDA;

or the IDA can stay out, with the same consequences. In this case, the IDA is indifferent between entering and staying out. From a results standpoint, there is no difference.

In figure 3(c), the IDA can enter, in which case the payoffs are
(-,-10%)
which means a worsening for the IDA, and a 10% loss of efficiency of the commons;
or the IDA can stay out, in which case the payoffs are
(0,0%)
which represents no change. A 10% loss of efficiency in a real-world setting would be considered a development failure.
Since the IDA prefers no change to a worsening, it stays out of the target recipient country. This is represented by the arrow attached to the branch marked "Stay Out" in figure 3(c).

A useful way of interpreting the above analysis is in terms of foreseen consequences. If a player in a game can foresee the consequences of his or her actions, then that player can adopt good strategies and avoid bad strategies.

Morever, by considering all three logical possibilities in terms of foreseen consequences, a decision-maker will never be caught totally by surprise, by either a good or a bad outcome. It is thus useful to construct, or at least to be aware of, outcomes that correspond to the best imaginable, the worst imaginable, and a benchmark in between, representing the consensus foreseen consequence. Such a construction is called the **3 scenario format.** By constructing a 3-scenario analysis, the IDA better anchors its judgment whether to enter a target recipient country or not. Indeed, most major decisions are usefully modeled by this format.

Thus, if the possibilities in Figure 3 correspond to the best imaginable (3 (a)), worst imaginable (3(c)), and consensus benchmark in between (3(b)), there is no compelling reason for the IDA to enter the target recipient. Entry has no special appeal, as no change in results is the foreseen consequence.

So far we have looked at IDA entering a situation at the same level as that of the existing players. Often, the IDA enters as a player on a higher level, so that the pre-existing game is now <u>embedded</u> in a larger game. This embedding unfortunately includes any perverse incentives present in the pre-existing situation. And that implies the following:

4. **Embedding does not alter our conclusion from #2. In particular, embedding does not by itself make perverse incentives go away, and an intensification of perverse incentives can easily result. Embedding does make the arguments more subtle, and renders the effects more subtle.**

To make this point as vividly as possible, we consider the case where the CPR takes the form of a foreign direct investment (FDI), and the users of that CPR are corrupt officials charging bribes so that FDI can take place. This is a CPR problem in the extended sense, and game theory can treat it (see Waller, Verdier, and Gardner (2000) for more details).

Corruption is a hallmark of almost every potential target recipient—it is one of the fundamental guarantors of bad initial results in such countries. We model corruption as a public official using public office for private gain. In particular, suppose a public official can give or deny permits for a foreign investor to invest in a given country—think of licenses, permits, fire inspections, tax inspections, and the like. The public official does not distribute permits on the basis of merit. Rather, the public official asks for a bribe, which is the price a foreign investor must pay to get this permission. The more permissions a foreign investor must get, the higher the price in terms of total bribes.

The basic situation before the IDA enters the country is shown in Figure 4. Quantity of FDI, denoted Q, is shown on the horizontal axis; the price in terms of total bribes, B, is shown on the vertical axis. The demand for permits is the piecewise linear function with vertical intercept at

$Q = 0, \quad B = k$

And horizontal intercept at

$Q = 1, \quad B = 0.$

The vertical intercept represents the willingness to invest of the foreign investor with the highest value investment project, denoted by the parameter $\underline{k}$. The higher this parameter, the more investment demand there is, for a given slope (which we hold constant). For simplicity, we assume linearity of demand in the figure. However, the main result is true for any demand function which displays monotone elasticity of demand—demand elastic at high prices, inelastic at low prices.

Depending on how corruption is organized, various outcomes along the demand function are possible:

* first-best. The country has no corruption; or if it once had corruption, an anti-corruption drive has succeeded in wiping it out. In either case, B = 0, no bribes are taken, and all willing FDI enters the country. This case is represented by the horizontal intercept in Figure 4. We normalize Q = 1 to mean that 100% of all willing FDI enters the country.

* second-best. The country has corruption, but that corruption is coordinated. For instance, the coordinator may be the President or Prime Minister, or some family member of the above. The coordinator sees that the most money possible is raised from bribes. This outcome is denoted Coordinated Equilibrium in Figure 4. The Coordinated Equilibrium is precisely what a monopoly public official would charge if he or she were handling bribes. This sort of equilibrium is encountered in one-family states or kleptocracies, such as Indonesia or Azerbaijan.

* third-best. The country has corruption, indeed is rife with it, and the corruption is decentralized. That is, there are n corrupt officials, with n large, and each corrupt official charges a bribe on his or her own. This is just like many users, each using a CPR on his or her own, and not internalizing the implications of that use on the entire set of users. Just as in any CPR, one gets overuse of the CPR, much higher bribes in total are charged, and much less FDI enters the country, compared to either first- or second-best. This

outcome is denoted Decentralized Equilibrium in Figure 4. Russia and Ukraine, the countries rated as the very worst in the world for investment climate according to World Competitiveness Report. (HIED, 1999), exhibit the Decentralized Equilibrium. A typical value of n for Ukraine is 30.

Now note how the Tragedy of the Commons arises. As n goes to inifinity, the bribe charged at the Decentralized Equilibrium,

$B = nk/(n+l)$

Approaches k, the reservation price of the most willing investor. That is, with enough corrupt public officials making enough inspections, FDI is completely discouraged. Thus, only the most risk-seeking foreign investors are found in Russia, while the biggest component of FDI into Ukraine comes from Russian investors, for whom Ukraine is a better investment climate than home.

So once again, the initial situation facing the IDA before entry into the target recipient is bad, especially if it faces the Decentralized Equilibrium. Generally speaking, 3 things can happen when the IDA itself enters the country, again in the role of investor. However, the IDA is not an investor like the others—its operations do not fall under FDI. The IDA enters at a higher level. Still, since IDA activities are linked to FDI, three things can possibly happen to the situation portrayed in Figure 4:

- Crowding-In. This is the best thing that can happen. IDA entry encourages more FDI, the demand for permits shifts outward and upward (larger value of k), both B and Q rise. The rise in Q has beneficial micro and macroeconomic effects, contributing to overall development success.
- No change. This is a typical consensus forecast consequence. IDA entry neither encourages nor discourages FDI, and the demand for permits do not change. Since B and Q do not change, there is no contribution to overall development success.
- Crowding-Out. This is the worst thing that can happen. IDA entry discourages FDI, the demand for permits shifts inward and downward (smaller value of k), both B and Q fall. The fall in Q has deleterious micro and macroeconomic effects, detracting from and possibly reversing overall development success.

Once again, the IDA is confronted with a 3-scenario analysis: these occur over and over again, quite naturally, in real-world decisions. To determine which of these 3 scenarios is most likely, and to what extent that scenario is realized, requires a great deal of further data (country-specific, especially), as well as a close analysis of potential FDI. In the best case, IDA entry may even reduce corruption (here modeled by lower value of n), a theme to which we return below.

An important factor in ID A/target recipient relationships is that they are long-lived, 3 years appears to be a minimum, with some lasting 20 years or more. In game theory, long-lived relationships are modeled as repeated games [Gardner, 1995] or as time-dependant supergames [Herr, Gardner and Walker, 1998]. There is a set of famous results for such games, called Folk Theorems—since they were widely known to be true long before proofs appeared in print. A finitely repeated game can model the relationship between an EDA and a target recipient. Let G be such a game. The relevant Folk Theorem for such G says:

Folk Theorem. If G has a good Nash equilibrium and a bad Nash equilibrium, then finitely repeated G has, for any Pareto optimal outcome, a Nash equilibrium outcome nearby.

This would seem to be good news for an IDA. The trouble is, with perverse incentives, as often arise in an EDA/target recipient relationship, we can get the

Perverse Folk Theorem. Suppose the IDA is a passive player in G, while local officials and IDA personnel in country are active players in G. If the interests of the IDA and the active players clash, then a nearly Pareto optimal outcome for active players can be payoff minimizing for the IDA.

To foreshadow our main point here,

5. Repetition of a game with perverse incentives for **an IDA can lead to even worse outcomes than playing the** game **only once.**

To see this, consider the following one-shot game G, which will be played between local officials (player 1) and IDA personnel in-country (player 2):

	2's strategies High	Low
High	(2.4,2.4)	(1,4)
l's strategies		
Low	(4,1)	(1,1)

High and Low refer to effort levels by the two player's respecitvely. The most value in the game G is created by High Effort on the part of both players. We can think of this as stemming from a Principal-Agent Problem. The IDA personnel in-country (player 2) act as principal; local officials (player 1), as agent. The best outcome for IDA personnel—assuming they put forth High Effort, occurs when the local officials put forth High Effort also. However, local officials get even higher payoff by putting forth Low Effort. So perverse incentives are present in G.

G has 3 Nash equilibria:

(Low, High) paying (4,1). At this Nash equilibrium, the local officials put in Low Effort while the IDA personnel in-county put forth High Effort. This outcome is best for local officials. The efficiency of this equilibrium is (4+l)/(4+l) = 100%; a good equilibrium.

(High, Low) paying (1,4). At this Nash equilibrium, the local officials put in High Effort, while the EDA personnel in-country put forth Low Effort. This outcome is best for EDA personnel in-country. The efficiency of this equilibrium is again 100%; another good equilibrium.

(Low, Low) paying (1,1). At this Nash equilibrium, both local officials and EDA personnel in-country put forth Low Effort. The outcome (1,1) pays the least for both players. The efficiency of this equilibrium is (l+l)/(5) = 40%, a bad equilibrium.

Although two of these equilibria achieve 100% efficiency, they divide payoffs very unevenly, with the player putting forth Low effort get the lion's share of the gains

Now suppose the game G is played many times. One obvious way for the two players to interact in this relationship is to alternate between (High, Low) and (Low, High). By playing in this fashion, they average (l+4)/2 = 2.5 each. The only problem with this rotation is if some player should deviate. However, deviation does not pay at the following Nash equilibrium:

(Nash equilibrium). Play rotates between (High, Low) and (Low, High). If either player ever deviates, then the players play (Low,Low) from then on till the end of the game.

This is not just a Nash equilibrium, but also a subgame perfect equilibrium (see Gardner, 1995, chapter 7 for details).

Suppose player 1 puts forth High effort in odd-numbered periods; player 2, in even numbered periods. Suppose player 1 considers deviating in the very first period. Deviation yields no gain, since $1 - 1 = 0$, but a long run loss of -3 every other period, since 1-4 = -3 in subsequent odd-numbered periods. The long run loss overwhelms the short run 0 gain; deviation does not pay. The same holds true for player 2. Hence, we have a Nash equilibrium.

Now we add a third player, EDA home office, which is passive. Player 3 has no strategy, and simply gets a payoff from the game played between players 1 and 2. We represent this as

		2's strategies	
		High	Low
1's strategies	High	(2.4,2.4,3)	(1,4,1)
	Low	(4,1,1)	(1,1,0)

Call this game G+
IDA home office payoff is 0 in the event of Low Effort by both players—this corresponds to not even entering the target recipient.

IDA home office payoff is 1 in the event of Low Effort by exactly one of the players—this corresponds to partially successful development.

IDA home office payoff is 3 in the event of High Effort by both players. This corresponds to successful development.

Here comes the Perverse Folk Theorem. G+ and G have the same active players, and the same set of Nash equilibria. By the Folk Theorem, local officials and in-country IDA officials can achieve the payoffs (2.5,2.5) by playing High Effort every period but the last. Since (2.5,2.5) dominates (2.4,2.4), we hardly expect the local officials and in-country IDA officials to put forth (High, High) efforts. What is good for players 1 and 2 guarantees a payoff of 1—partial development success—for player 3, the IDA. This is an embedded Principal-Agents Problem with a vengeance.

This is also what aid-dependency looks like. The target recipient wants to continue the relationship, as do IDA personnel in country—but IDA home office would very much like better results from the relationship. However, being a passive player, IDA home office does nothing of the kind. [A comparable point is made, in a rather more complicated way, by Pederson (1996) and Murrell (1999)]

We have just seen the baleful effects that a repeated relationship can have on the part of IDA home office, when that home office is a passive player. We now consider how a more active IDA home office (player 3) can affect the aid relationship. To anticipate our result, we show that

6. An Active IDA home office can neutralize the worst effects of the Perverse Folk Theorem by a credible strategy of withdrawal.

Let the matrix G+ correspond to the strategy for player 3 called "passive." Let the matrix below, G++, correspond to the strategy for player 3 called "active."

3's; strategy: active

2's strategies

		High	Low
1's strategies	High	(0,0,0)	(0,0,0)
	Low	(0,0,0)	(0,0,0)

What player 3 has done is zero out the game—all payoffs at zero corresponds to terminating the aid relationship. It is a very blunt instrument, to be sure, but it has the effect—quite beneficial for player 3—of preventing negative payoffs. The following is a Nash equilibrium for the game consisting of matrices G+ and G++:

Players 1 and 2 rotate between (High,Low) and (Low,High) every period. Player 3 plays "passive."

This Nash equilibrium corresponds to the IDA settling for partial development success, so as not to "rock the boat," and yields an average efficiency per period of (1+4+1)/(2.4+2.4+3) = 77%, not especially bad.

Fortunately for the IDA, there are other Nash equilibria—in particular, one which achieves 100% efficiency [of course this is theorists' contrivance, but theoretical efficiencies in the 90's should be our goal, why settle for less]. Here it is:

Players 1 and 2 play High all but the last period, when they play any Nash equilibrium of the one-shot game. Player 3 plays "passive" througout the game. If any player ever deviates, players 1 and 2 play (Low,Low) forever, while player 3 plays "active."

Notice the efficiency of this equilibrium, per play, is (7.2)/(7.2) = 100%, except in the last period. As the number of periods T gets large, the weight on the last period (1/T) vanishes.This equilibrium gains credibility because player 3—the IDA home office—is prepared to shut down the relationship in case of partial development success, when full success is attainable.

So far we have considered a single pair of countries, one represented by the IDA, the other represented by the target recipient. There are also interesting strategic aspects when there are two or more countries represented by ID As.

As we have already pointed out above (#4), IDAs typically encounter corruption in the target recipient. Corruption, which can encompass both CPR problems and Principal-Agent problems, can utterly vitiate all results of development activity. Even worse, it may seem there is nothing the donor countries can do about this baleful situation.

Here is a simple model of the phenomenon. Suppose two ID As, each representing a donor country, face the payoff matrix G+ above. There is a single target recipient, and for each IDA, the interaction inside the target recipient should the IDA enter looks like G+. Given passive IDA's, either donor country can expect the payoff 1—partial development success—from entering, or staying in, the target recipient.

Now suppose that donor country A has entered the target recipient, and decides to improve the situation by getting tough with the target recipient, playing actively. This means A credibly threatens to withdraw, with the payoff consequences given by G++.

What does the target recipient do in a case like this? It turns to the second donor country B, which has not entered the target recipient, and invites B to replace A in the donor/recipient relationship—often with (noncredible) promises of development success. [We heard this repeated in numerous interviews]. This is precisely exercise of an outside opportunity by the target recipient—the outside opportunity being the country not currently operating in the target recipient.

So it would seem the donor countries are stuck, strategically speaking, in partial success equilibria with their attendant aid dependency—and no way out to complete success.

In a situation like this, it is often useful to <u>change the rules of the game.</u> This is precisely what the OECD donor countries did when they ratified the OECD Treaty Against Corruption in 1999. By precommitting themselves not to deal with corrupt regimes, the OECD members essentially ruled out scenarios like the above, where a single corrupt target recipient plays off one donor against another.

Even better from the standpoint of the donors, with this rule change equilibrium of the form (High, High, passive) unless there is a deviation, are restored to viability. Instead of having to settle for partial development success, the donors can demand (and come very close to getting) complete development success. Their interests are best served by crafting the rules of the game in such a way that bad (for them) equilibria are ruled out.

The main point here is

7. **Coordinated commitment on the part of donor country IDAs can forestall the worst effects of the Perverse Folk Theorem.**

To conclude, game theory has demonstrated 7 main points, each of which can inform IDA policy to improve results. These are the following:

1. **The initial conditions in the target recipient often involve perverse incentives, like Tragedy of the Commons.**

2. **Entry by an IDA into such an initial condition does not guarantee success; perverse incentives can intensify with entry.**

3. **A 3-scenario analysis by an IDA can better inform decisions such as the decision to enter.**

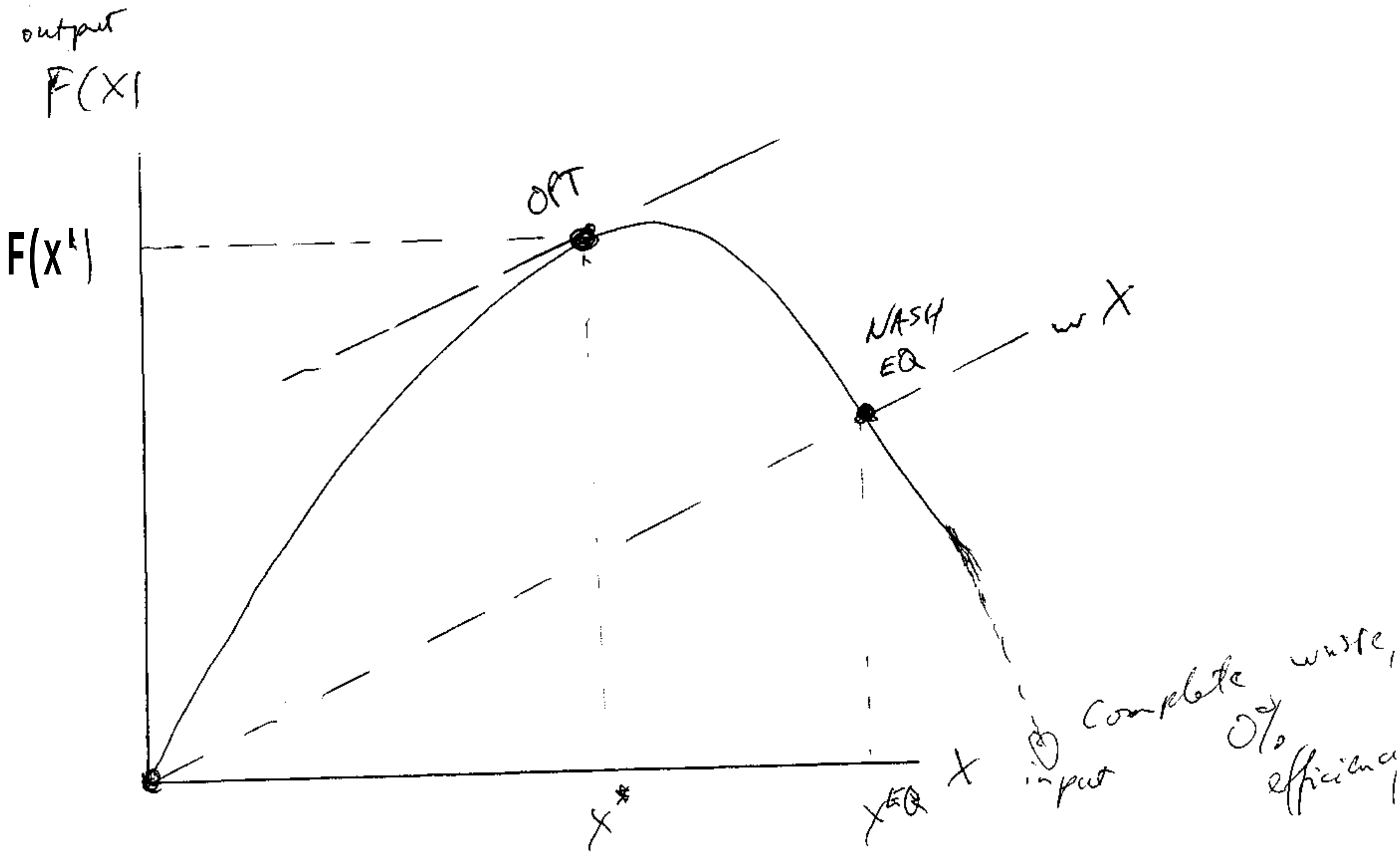
4. **Entry by the IDA at a higher level embeds perverse incentives of a given game into a larger game. Again, success is not guaranteed—but the analysis is more subtle.**

5. **A Perverse Folk Theorem may be at work in repeated aid relationships.**

6. **Passivity on the part of an IDA home office does not pay; credible termination can put an end to aid dependency.**

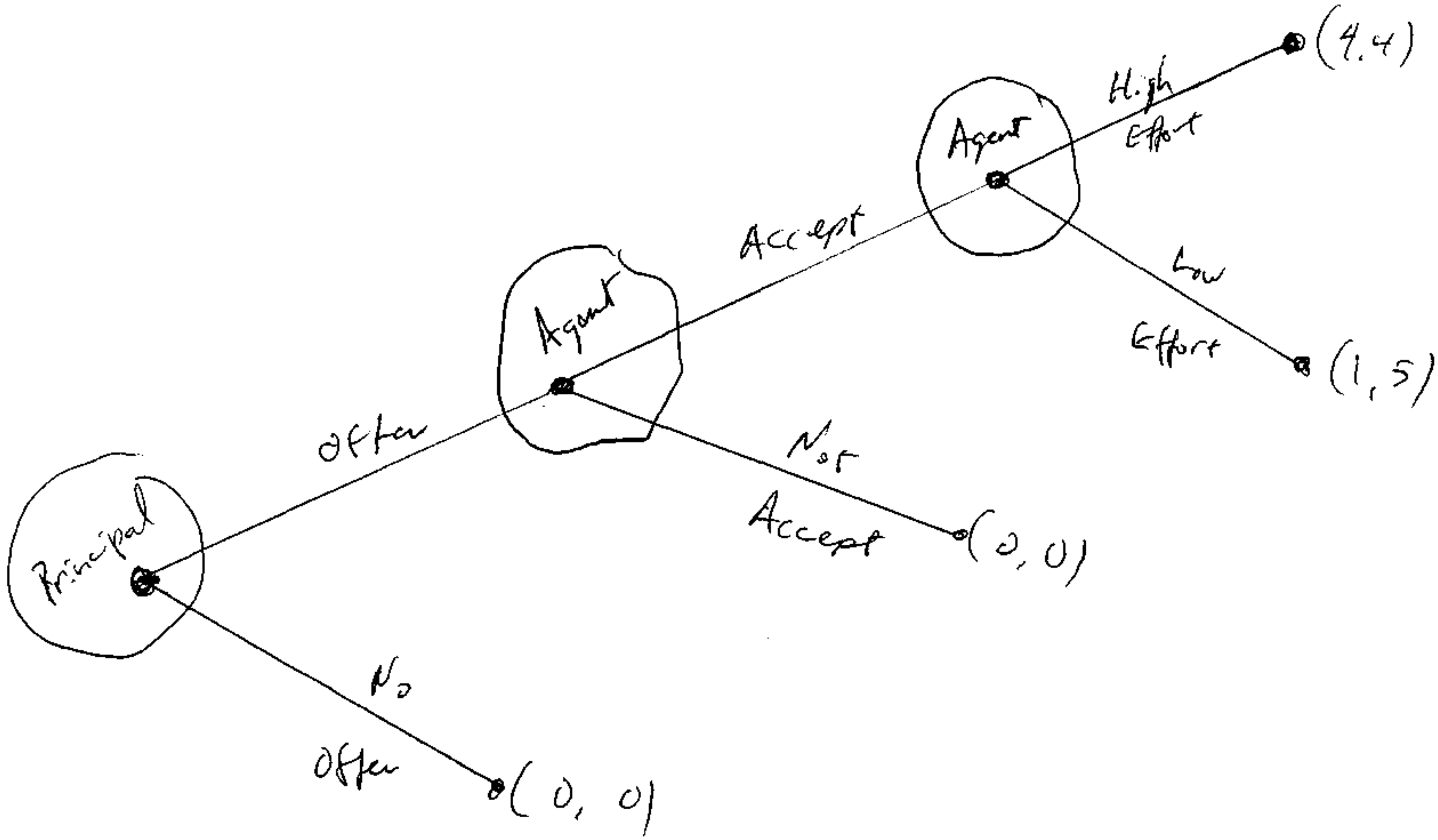
7. **Coordinated commitment on the part of donor country ID As can forestall the worst effects of the Perverse Folk Theorem.**

Figure 1. Tragedy of the Commons



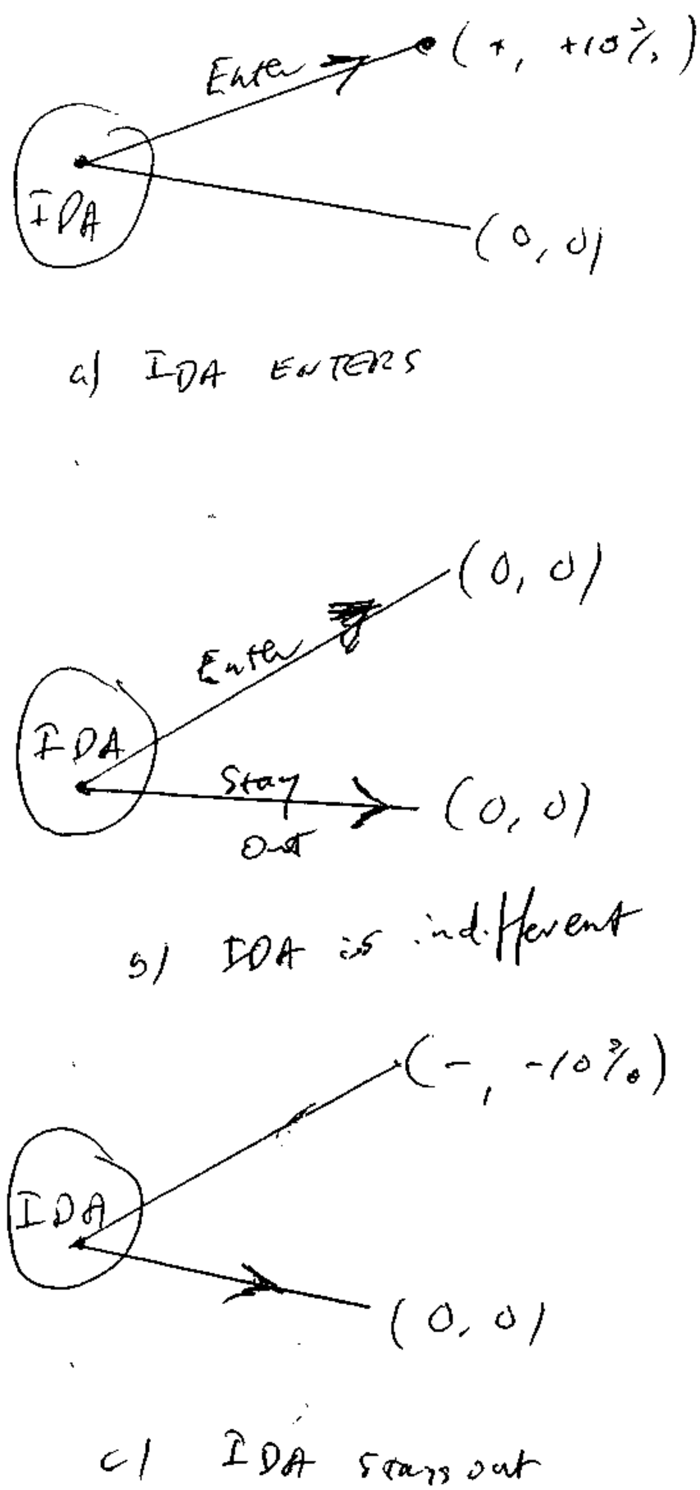
Perverse incentives on a CPR lead to overuse at Nash Equilibrium.

Figure 2. Principal/Agent Problem



High effort is the first-best outcome, but the Agent does best by putting forth Low effort.

Figure 3. The 3-Scenario Format



Entry by the IDA depends on the scenario that best applies.

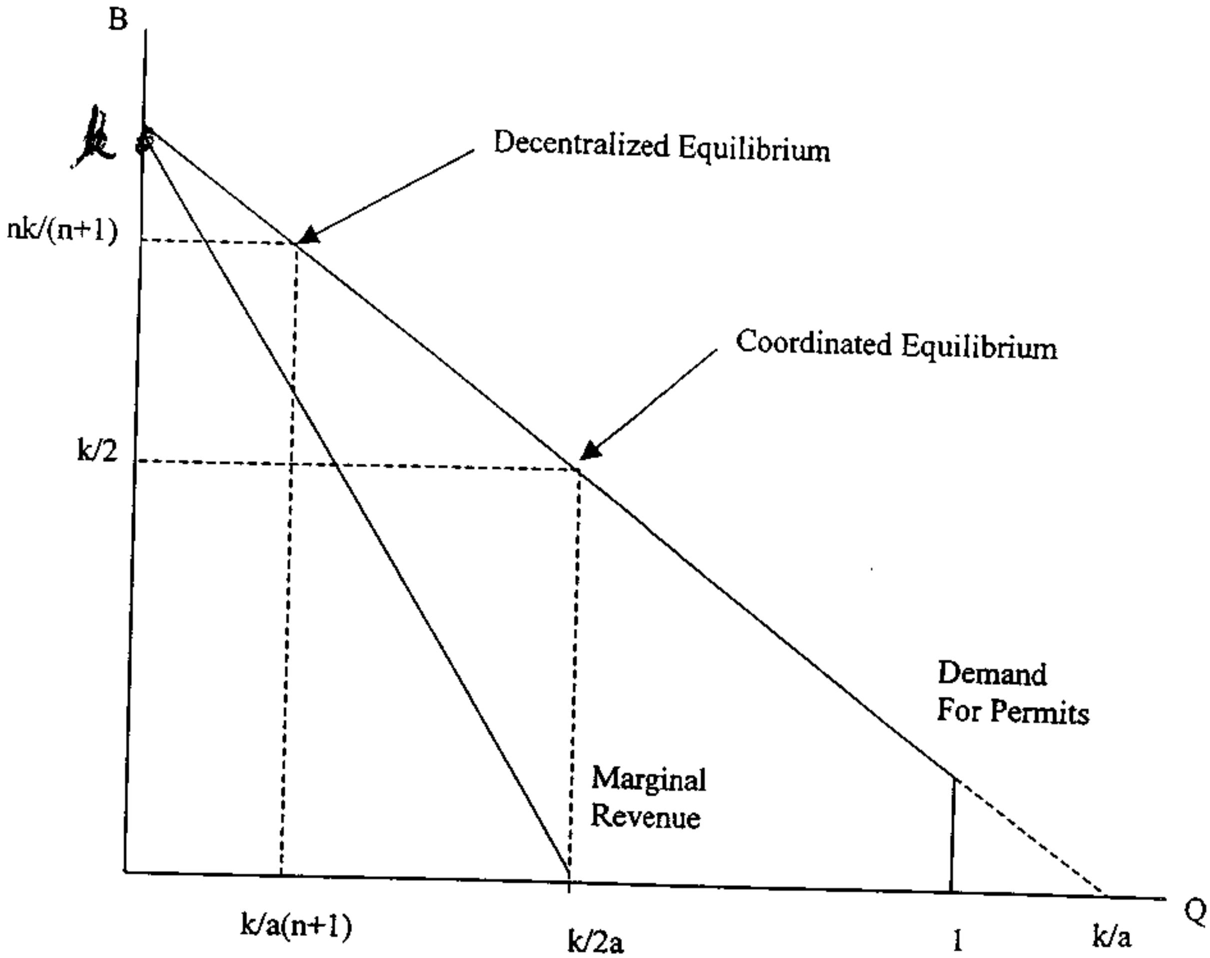


Figure 4 The extent of corruption prior to entry by the IDA.