

The Carrot and the Stick: Using Game Theory to Minimize Corruption in Guatemala

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ABSTRACT

After I helped construct a school in Guatemala, I found their educational system might be corrupt. I used game theory, or the study of strategic interdependence, to analyze this issue. Each actor anticipates the other's reactions and acts accordingly. Payoff matrices, 2-by-2 grids in which one actor's options are listed across the top of the boxes and the second actor's options are listed by the left side of the boxes, helped simplify this complex situation into a workable model that shows individual incentives and actions as well as the collective best action for societal welfare. If the first player makes "x" choice rather than "y" choice, is the second player incentivized to make "a" or "b" choice? Conversely, if the first player makes "y" choice, is the second player incentivized to make "a" or "b" choice? If, for a particular choice, no player can do better by unilaterally changing its decision, it is a Nash equilibrium. Ideally, the government won't receive a bribe, and the parents will send their children to volunteer. The penalty if the local government gets caught accepting a bribe plays an important role; interestingly, increasing the government's goodwill amongst the local population through the school-building process would also lead to the ideal outcome. Further, simultaneously increasing both the penalty from accepting a bribe, as well as the goodwill to the government from school-building, produces the optimal outcome. I call this the "carrot and the stick" approach, and it may prove quite effective in ending corruption entirely.

Introduction

Guatemala's educational system is in crisis. Plagued by both corruption and inefficacy, Guatemala lags behind. Guatemala's education spending is meager. The country spends 2.8% of its GDP on education. By comparison, the United Kingdom spends 5.5% of its GDP on education, France spends 5.4%, and the United States spends 5.0%. Even compared with its neighbors El Salvador and Honduras, Guatemala's funding for education is paltry. El Salvador and Honduras spent 3.8% and 6.0% of their GDP on education respectively ("List of Countries - Spending on Education"). More broadly, according to the World Bank, the average Latin American country spends relatively twice as much on education, at 4.5% of their GDP, than Guatemala ("Government Expenditure"). Because less than half of Guatemala's sparse education funding goes to public primary schools, it is fair to conclude that they are underfunded.

Resulting from this lack of funding, there is a lack of primary education infrastructure in Guatemala. Although six years of primary school are free and compulsory, the average amount of schooling in Guatemala is 4.1 years or the equivalent of American third grade. This is because more than half of Guatemalans live below the poverty line, so it is hard for families to afford the extra costs of primary school, such as books, supplies, transportation, and uniforms ("Education in Guatemala"). As a result, 245,000 children between the ages of 7 and 12 do not attend school at all (Galicia). The lack of resources is worse for the indigenous in Guatemala. Although 25.5% are illiterate nationwide, up to 60% of the indigenous are illiterate. The effects are magnified by gender disparity as well. Only 39% of Mayan, or indigenous, females are literate, compared with 77% Ladino, or non-indigenous, females; only 68% of Mayan males are literate, compared with 87% Ladino males ("Education in Guatemala"). Many children cannot attend school. Even when they do, the available schools are run-down and lack sufficient resources.

Voluntourism

Given the scarcity of educational resources, I helped construct an elementary school in Quiché, Guatemala, with a non-governmental organization in 2019. During this trip, I observed the schools' inferior construction, even the new one we helped build. The three-room schoolhouses had metal tin roofs with holes and electrical sockets beneath these holes. The walls were concrete, but there were no doors. The schools lacked working sinks and toilets. Finally, there was a lack of accessibility to these run-down schools as many students had to walk up to five miles to school on a difficult and potentially dangerous path.

Towards the end of the trip, the town turned out for a dedication ceremony of the new school. The exact amount the NGO donated in cash to build the school was listed as 105,936.40 quetzals. This is approximately \$13,779.57, a year later in today's dollars, which is not entirely fair. The amount was closer to \$16,500 in 2019 at the time of the trip, because of the declining value of Guatemalan currency in the year that has passed. Because each volunteer paid \$3,500 to go on the trip, and there were thirty volunteers on my half of the project, I worried why more of our money was not going directly to the project. Furthermore, I worried about what would happen when our NGO left Guatemala.

After I returned home from volunteering in Guatemala, I began researching my private concerns online. While criticisms of mission trips are widespread, the criticism most pertinent to my experience was the allegation that mission trips were "voluntourism." Voluntourism, in the way I did it, where a group of unskilled volunteers head abroad for a two-week stint, is unhelpful to the very community it claims to serve. Voluntourism, though fueled by noble intentions, is based on "perverse economics" (Rosenberg). Instead of hiring skilled locals to work, costing the organization money, they use volunteers who pay to be there, raising money. So, the fundamental business model of voluntourist organizations hurts the community. Guatemala has profound wealth inequality (as does the United States). The poorest 10% of Guatemala own less than 1% of the country's wealth, with the richest 10% owning 50% ("Guatemala - Poverty"). Thus, the jobs we shoddily completed could have been done much more effectively, and with greater return for the community, by locals. While we did serve the community by building a three-room schoolhouse, the voluntourist process was an expensive and inefficient way to do so. Instead of paying for the room, board, and food for thirty young American voluntourists, and the security guards perpetually stationed outside of our hotel, the money could have been donated directly to the community. Moreover, Guatemala has a weak currency exchange rate; our money would have gone much further if directly donated. Regrettably, voluntourist organizations put the short-term experiences of the volunteers over the well-being of the community.

Corruption in Guatemala

Besides educational inefficacy, Guatemala is plagued by corruption. To mitigate this problem, the United Nations backed an autonomous anti-corruption commission in Guatemala, or the International Commission against Impunity in Guatemala, or CICIG in 2007. The Commission would carry out its own investigations and then hand over the cases to local prosecutors (Green). The CICIG was started after Guatemala's 36-year civil war from 1960-1996, in which the military held power and many citizens were killed or displaced from their homes. The CICIG is part of an ongoing effort to increase democracy in Guatemala ("Guatemala: Political"). Support for the Commission was widespread. Seventy percent of the Guatemalan people approved of the work of the CICIG (Green). Within the United States, which provided most of the funding for the CICIG, support for the Commission was bipartisan (Velásquez).

Though support among the public was high, Guatemalan officials disliked the law. The Commission was shut down in 2019 when President Jimmy Morales retaliated against the investigation of himself and his family for accepting illegal campaign funds (Green). The CICIG's mission was to act as a "complementary prosecutor," and recommend public policies to fight against criminal groups ("CICIG (International)"). It is telling that Morales took this duty as a threat to his power. The current president of Guatemala, Alejandro Giammattei, is also a critic of the now-defunct CICIG (O'Boyle). Corruption is indeed pervasive in Guatemala's government. Although the Penal Code

criminalizes bribery, embezzlement and extortion, government officials “engage in corruption with impunity.” Bribery and gifts are standard practices (“Guatemala Corruption”). On September 1, 2015, President Otto Pérez Molina was impeached and imprisoned on corruption charges for taking bribes from companies trying to import products into the country (Romo and Botelho). The graft reaches the highest levels of Guatemalan politics.

However, corruption is “perhaps most widespread” at the local level, as of 2016. The current decentralization of power in Guatemala has led to mayors of municipalities to have greater power over budgets and security forces. There are now local criminal empires. It is easy for criminality to infiltrate local governments. There is an ability to “[co-opt] officials within their limited sphere of influence” (Lohmuller). So, there is corruption at the local level which may affect how much money gets from the national government to the municipality and then to local school construction and maintenance. In Guatemala, there is a “perception of universal corruption” and that “corruption exists today at the municipal level.” The citizens know that “substantial funds” come from the state government and from NGOs. “Absent transparency, many people in the community now try to calculate how much the community development projects should cost and estimate how much the mayor receives. When they perceive a difference, they accuse the mayor of stealing” (Hawkins et al. 73).

Because of this, there is a high perception of corruption in Guatemala. Regardless of whether local corruption can be proved to exist in this particular region, the perception of widespread corruption has a deleterious effect on Guatemalan society. The Corruption Perceived Index rates countries by perceived levels of public sector corruption using expert assessments and opinion surveys. Corruption, defined as “the misuse of public power for private benefit,” on a scale of 100 (very clean) to 0 (very corrupt). The 2019 CPI ranked 180 countries on a scale of 100 (very clean) to 0 (very corrupt). For context, Denmark scored the highest at 87, the United Kingdom scored 77, and the United States scored 69. Guatemala ranked 146 out of 180 countries, with a score of 26. Even the perception of corruption has adverse economic effects on the country. For every 1-point increase in CPI, in which a country is perceived as becoming less corrupt, there is a 1.7% increase in GDP. Moreover, there is additional foreign investment in the country as CPI increases, considered to be a “power law dependence,” or exponentially more investment (“Corruption Perceptions”). Given that Guatemala is thus incentivized to limit corruption, I was curious as to why this keeps happening.

Game Theory Perspective

Game theory is the study of strategic interdependence, or when one actor’s actions affect the other’s. Thus, when making decisions, the actors have to anticipate each other’s reactions and act accordingly. Payoff matrices, 2-by-2 grids in which one actor’s options are listed across the top of the boxes and the second actor’s options are listed by the left side of the boxes, allow us to simplify complex situations into workable models (Spaniel). Actual problems, like NGOs filling an institutional educational void in Guatemala, are too complex to understand. With an effective game theory model, however, we can understand the individual incentives and actions as well as the collective best action for societal welfare. Game theory is also a mathematical method to make sure assumptions imply conclusions. In the Guatemala example, we are attempting to prove that mission trips incentivize the government to avoid fixing their own societal problems.

In a model, the analysis goes as follows. If one player makes “x” choice versus “y” choice, is the other player incentivized to make “a” or “b” choice? Conversely, if the first player makes “y” choice, is the other player incentivized to make “a” or “b” choice? A Nash equilibrium is the set of strategies in which no player has an incentive to change their strategy based on what the other person is doing.

The Model

We consider a game between a parent (S) who evaluates whether to send their child on the volunteering trip and the local government (G) which can choose to either participate in corruption or not. We assess each player's payoffs

under situations where G's corruption is caught and when it is not caught. While S does not know the actions of G or if the corruption will be caught, they can evaluate the probability of the corruption being caught (p) or not ($1-p$) based on news reports, existing monitoring, and judicial organizations. Note that the corruption in this scenario is a bribe taken by G from the NGO or other related parties. S does not directly get involved in this corruption or bribe the local government.

We define u as the utility or payoff for S if they send their child on this volunteering trip. This utility can be thought of as personal satisfaction, bragging rights, or potential benefit towards college applications. The payoff for G that arises due to the goodwill generated from the school building project is defined as z . The bribe amount taken by G is defined as b . Note that this bribe amount is specific to the involvement of the NGO and volunteers. G may participate in other corrupt activities with unrelated parties and that is not the focus of this game. The loss of utility for G if foreign volunteers do not show up is c . If G participates in corruption related to the volunteering program and gets caught, y is the loss of face or penalty. The loss of utility for S as a result of being part of the corruption scandal is defined as v .

Scenario 1: Local Government Corruption is Not Caught:

In this setting, if G indulges in corruption, it is not caught and does not face any adverse consequences. Here, if S decides to send their child on the trip and G takes a bribe, the payoff for G is $z+b$. The payoff for S is u . If S decides not to send their child on the trip, then the payoff for G is $z-c$ irrespective of the actions of G as the school is assumed to be built in both cases and G loses its incremental bribe due to the involvement of the NGO. Since the corruption is not caught, there is no penalty associated with G's payoff. In this scenario, S's payoff is 0 since they do not participate in the trip. Finally, if G does not take any bribe, then the payoff for G and S are z and u respectively. Table 1 represents the payoff matrix when G's corruption is not caught.

Table 1: Payoff Matrix When Corruption is Not Caught (probability = $1-p$)

		Player 2: Parent of Student Volunteer	
		Send	Do Not Send
Player 1: Local Government	Bribe	$z+b, u$	$z-c, 0$
	No Bribe	z, u	$z-c, 0$

Scenario 2: Local Government Corruption is Caught:

In this setting, if G indulges in corruption, it is caught, and G faces a penalty of y . Hence, irrespective of S's actions, if G indulges in corruption, their payoff is $-y$. Note that we assume that if caught taking a bribe, the government gets zero goodwill. Here, S has a payoff of $-v$ if they send their child on the trip and 0 if they do not. If G does not indulge in corruption, their payoff is z if S sends their child and $z-c$ if S does not send their child on the trip. In this case, S's payoff if they send their child is u and 0 if they do not. Table 2 represents the payoff matrix when G's corruption is caught.

Table 2: Payoff Matrix When Corruption Is Caught (probability = p)

		Player 2: Parent of Student Volunteer	
		Send	Do Not Send
Player 1: Local Government	Bribe	-y, -v	-y, 0
	No Bribe	z, u	z-c, 0

Final payoff matrix and analysis:

Since the probability of the corruption being caught is p, we can multiply the payoffs for G and S in Table 1 by 1-p and the payoffs in Table 2 by p to arrive at the final payoff matrix (see Table 3 below) for the game between G and S.

Table 3: Final Payoff Matrix

		Player 2 – Parent of Student Volunteer	
		Send	Do Not Send
Player 1 Local Government	Bribe	$(p)(-y) + (1-p)(z+b),$ $p(-v) + (1-p)u$	$-py + (1-p)(z-c),$ 0
	No Bribe	z, u	z-c, 0

From a policy and societal benefit perspective, the ideal outcome for this game is no bribe for G and send for S. For this outcome to be the Nash equilibrium for this game, assuming S decides to choose send, G must be better off choosing no bribe irrespective of the actions of S. Hence, we need:

$$z > (p)(-y) + (1 - p)(z + b) \tag{1}$$

Simplifying equation (1) leads to the condition $p > \frac{b}{y+z+b}$. Similarly, if G chooses the no bribe condition, for S to be better off choosing Send, we must have $u > 0$, which is satisfied. Hence, $p > \frac{b}{y+z+b}$ is the only required condition needed for no bribe/send to be the Nash equilibrium.

Next, we consider if any of the other three decision pairs can form a Nash equilibrium. First, we consider the bribe/send outcome. Here, if S decides to send, G will be better off (from arguments above) to take a bribe only if $p < \frac{b}{y+z+b}$. On the other hand, given G's decision to take a bribe, S will be better off with send if:

$$(p)(-v) + (1 - p)u > 0 \tag{2}$$

Equation (2) implies that $p < \frac{u}{u+v}$. Given that we have two conditions on the probability of getting caught, depending on the values of the variables, we can have three possible scenarios: 1) $\frac{b}{y+z+b} < \frac{u}{u+v}$, 2) $\frac{b}{y+z+b} > \frac{u}{u+v}$ and 3) $\frac{b}{y+z+b} = \frac{u}{u+v}$. Next, we investigate each scenario separately to identify the incentives for each player.

Scenario 1: $\frac{b}{y+z+b} < \frac{u}{u+v}$

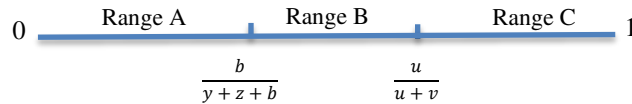


Figure 1: Range of p Under Scenario 1

Here, as shown in figure (1), there are three possible ranges for the probability to get caught that are important to consider.

Range A: $p \leq \frac{b}{y+z+b}$

In this case, if $p < \frac{b}{y+z+b} < \frac{u}{u+v}$, neither G nor S have an incentive to change their decision and hence the bribe/send decision pair is a Nash equilibrium. In the case where $p = \frac{b}{y+z+b}$, G's payoffs are equivalent under the bribe and no-bribe decisions, and since S will still choose send, the bribe/send outcome would be a weak Nash equilibrium.

Range B: $\frac{b}{y+z+b} < p \leq \frac{u}{u+v}$

In this scenario, since $p > \frac{b}{y+z+b}$, G has an incentive to switch to no bribe and hence the bribe/send outcome is not a Nash equilibrium.

Range C: $p > \frac{u}{u+v}$

In this range, both G and S have an incentive to switch and hence the bribe/send outcome cannot be a Nash equilibrium. In summary, the only scenario that can make the bribe/send decision a Nash equilibrium in scenario 1 is $p \leq \frac{b}{y+z+b}$.

Scenario 2: $\frac{b}{y+z+b} > \frac{u}{u+v}$

Here, as shown in figure (2), there are three possible ranges for the probability to get caught that are important to consider.

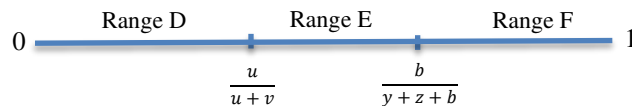


Figure 2: Range of p Under Scenario 2

Range D: $p \leq \frac{u}{u+v}$

In this range, since $p < \frac{u}{u+v} < \frac{b}{y+z+b}$, both G and S do not have an incentive to deviate and the bribe/send outcome is a Nash equilibrium. When $p = \frac{u}{u+v}$, S's payoffs are identical under send and do not send and hence the bribe/send outcome is a weak Nash equilibrium.

Range E: $\frac{u}{u+v} < p \leq \frac{b}{y+z+b}$

In this range, S has an incentive to deviate and choose do not send and hence the bribe/send outcome is not a Nash equilibrium.

Range F: $p > \frac{b}{y+z+b}$

In this range, both S and G have an incentive to deviate and hence the bribe/send outcome is not a Nash equilibrium.

Scenario 3: $\frac{b}{y+z+b} = \frac{u}{u+v}$

In this scenario, if $p < \frac{b}{y+z+b}$, then both S and G have no incentive to deviate and hence the bribe/send outcome is a Nash equilibrium. If $p = \frac{b}{y+z+b} = \frac{u}{u+v}$, then both S and G have equivalent incentives to bribe/no bribe and send/do not send respectively. Hence the bribe/send outcome is a weak Nash equilibrium. If $p > \frac{b}{y+z+b}$, then as argued in the previous scenarios, bribe/send outcome cannot be a Nash equilibrium.

Next, we consider the bribe/do not send decision pair. Here, G always has an incentive to switch to no bribe and hence the bribe/do not send decision pair cannot be a Nash equilibrium. Similarly, we can see from table (3) that under the no bribe/do not send pair, S always has an incentive to switch and hence this also cannot be a Nash equilibrium. Hence, we can see from the above discussion that as long as $p > \frac{b}{y+z+b}$, we are able to achieve the societally ideal outcome of no bribe/send as a Nash equilibrium.

As we can see from the equation $p > \frac{b}{y+z+b}$, larger goodwill or larger penalty are going to make the threshold probability smaller. Increasing penalties will lead to a lower need for monitoring as will increasing the goodwill. In some cases, increasing penalties may not be a viable option and this research shows that creating and promoting greater goodwill for the local government as a result of these school projects is a critical tool in combating corruption.

Discussion

The societally ideal outcome is the government not receiving a bribe, and the parents choosing to send their children to volunteer. Through game theory analysis, we investigated how to facilitate this societally ideal outcome. We learned that both the penalty faced by the local government if caught receiving a bribe, as well as the goodwill earned by the government through the school-building process, must be increased. We call this the “carrot and the stick” approach.

First, the Guatemalan central government should increase the penalty if local governments are caught taking bribes. The U.S. government can assist in this process by funding CICIG, the now-defunct administrative body that investigates and brings potential corruption cases to the Guatemalan prosecutor. Increased international scrutiny is more possible with a new, less nationalistic U.S. presidential administration. This process may become self-funded as an increased penalty would pay for robust judicial scrutiny.

Second, the Guatemalan central government must facilitate community building so that the local government can earn more goodwill. The Guatemalan central government can do this by offering the following three benefits to local governments: tax breaks, additional and complete funding for school construction, and favorable media attention. Alternatively, there are partnerships for the central and local governments to undertake together. If there is an educational vacuum in a particular district, the central government can take over educational infrastructure construction, creating local employment opportunities. These jobs would result in increased goodwill by the locals as a result of the local and central government partnership. The NGO’s also have a role to play in furthering the goodwill for the government by better highlighting and marketing the projects. Further, any meaningful attempt at improving the well-

being of Guatemala must address the historical issues at play. Guatemala's endemic poverty and corruption is caused by the ongoing effects of Spanish colonization and American neo-colonialism, in which our government backed dictators and incited military coups. While many are very pessimistic about mission trips, I feel honored by the volunteering I did, though it is a fraction of what is needed. We were able to help construct a school that will actually increase educational access in a remote and rural part of the world. Though mission trips are incentivized to continue on multiple levels, they are simply not equipped to make systemic change.

The game theory model used in this paper can be extended to a dynamic game over a long period versus the static game used in this paper. Other stakeholders could also be included in a dynamic game such as: the central government, the U.S. federal government, the student volunteers, and the students in Guatemala. We look forward to investigating such scenarios in the future.

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