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Abstract

The limits of transparency as a means of reducing corruption

by Daniel Parra, Manuel Muñoz-Herrera and Luis Palacio*

We use a laboratory experiment to study the impact of transparency on reducing corruption in contexts where embezzlement and bribery can co-occur. These contexts are closely related to grand corruption settings, where different types of corruption occur and allow people in power to take advantage of their position. Transparency is expected to have a positive effect on reducing corruption. However, our results show that transparency decreases embezzlement by roughly 10 percentage points, while it has no significant effect on bribery. The observed differential impact of transparency could be attributed to strategic lying by the resource manager, who acts as if low public investment rates were a consequence of bad luck (low budget) instead of misappropriation. This suggests that the impact of transparency cannot be generalized to all types of corruption when different types co-exist.

Keywords: embezzlement; bribery; grand corruption

JEL classification: C91, D72, D73

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1 Introduction

The detrimental effect of corruption on society commonly transcends direct monetary losses.[1] Its damage is more pronounced upon the most impoverished countries, resulting in the under-provision of necessary infrastructure, drinking water, and education (Ambraseys & Bilham, 2011; Ferraz et al., 2012; Blakeslee, 2018; Beekman et al., 2014). As a government's response, increasing transparency has become the flagship policy for combating corruption. Even if many different particular practices can be classified as corruption,[2] the common belief for policymakers is that transparency has a blanket effect across all forms. However, the evidence in the literature is not clear, in part due to a limitation of scope. Most of the existing work addresses one type of corruptive behavior at a time, mostly, bribery or embezzlement. In this paper, we assess the effectiveness of transparency in a setting that allows for both embezzlement and bribery to co-occur, motivated by the fact that in '*grand corruption'* settings resource managers are likely to use bribery to pave the way to embezzle money from public funds.

The latter point can be illustrated briefly by two examples. The first example is the Odebrecht scandal. This is one of the most prominent cases of corruption in history: around USD 785 million were spent on bribes.[3] The investigations indicate that executives of the Brazilian firm Odebrecht bribed politicians in power to ensure the allocation of public contracts. Once they secured the contracts, they inflated their budgets or created fake contracts, which allowed them to embezzle large sums of money. Presumably, the total embezzled money far exceeded the money used in bribes. However, the lack of transparency makes precise details elusive. The second example is the so-called 'FIFA gate', which revealed how presidents of organizations around the globe embezzled millions of dollars at the expense of FIFA's poorest members, for decades. To facilitate taking money from FIFA's funds, officials of the different football federations were bribed to favor individual candidates when they voted in FIFA presidential elections, when choosing FIFA World Cup hosts, or when granting sponsorship contracts.

[1] Empirical evidence confirms how corruption affects negatively a country's GDP (Mauro, 1995), the composition of government expenditure (Mauro, 1998), the competitive behavior of firms (Ades & Di Tella, 1999), investment rates (Lambsdorff, 2003), inflation rates (Ali & Sassi, 2016), among other things. For a survey on the costs of corruption see Treisman (2000), Aidt (2003), Dreher & Herzfeld (2005), and Arnone & Iliopulos (2007).
[2] For instance, bribery, nepotism, embezzlement, extortion, laundering, cronyism, influence peddling, among others.
[3] See https://www.bbc.com/news/world-latin-america-41109132.

Our main research question asks whether an increase in the level of transparency reduces corruption in a 'grand corruption' scenario similar to the ones presented in the above examples. If transparency indeed reduces corruption, we also ask whether its effect is focalized on embezzlement or bribery, or if it is generalized to both. To address these questions, we design an experimental game labeled the *grand corruption game (GC).* The game includes the main components of the problem mentioned above. In the *GC* game, a resource manager proposes to a group of voters how much to invest in a public good. The exact amount of available resources is unknown to the voters. The resource manager can embezzle money from the endowment, and bribe the voters to get favorable votes. To test for the effect of transparency, we use a between-subjects design with low and high levels of transparency. High transparency means that the voters have a more accurate estimate of the endowment than if transparency were low.

We ran the experimental sessions in Colombia with undergraduate students using the GC game. Our main findings suggest that transparency reduces corruption in general. However, we observe a less prominent feature: when disaggregating corruption into embezzlement and bribery, we observe no significant differences in bribery. That is, regardless of the pie's size, the resource manager spends similar amounts to bribe the voters. In contrast, embezzlement is reduced by almost 10 percentage points when transparency is increased. Our study sheds new insights onto how transparency affects corruption. Moreover, it dives deeper into the generalized argument that increasing transparency reduces corruption regardless of the context and the type.

These results, however, need to be interpreted with caution. We are not claiming that transparency does not work to reduce bribery, but that in a context similar to the *GC* game it may affect embezzlement and not bribery. The observed differential impact of transparency could be attributed to the strategic behavior of the resource manager. In particular, it seems that the resource managers take advantage of the information asymmetries and act as if they had a small endowment. In other words, they act as if the low public investment rates were a consequence of bad luck (low budget) instead of misappropriation. This interpretation is in line with Güth et al., (1996). These authors used a two-level ultimatum game with incomplete information to show that proposers, when endowed with big cakes, act as if they had a small cake in order to keep a bigger piece. A similar result was obtained by Ockenfels & Werner (2012) in a dictator game, supporting the 'hiding behind some small cake' phenomenon. These papers provide evidence that better-informed parties may not be interested in being fair, but in appearing to be fair. An advantage of our design is that we control for the endowment size, which allows resource managers in the treatment with low transparency to act as if they had a small pie.

Our work contributes to the experimental research on corruption, pioneered by Abbink et al. (2002), which isolates bribery (Abbink, 2006; Bobkova & Egbert, 2012) or embezzlement (Abbink & Ellman, 2010; Di Falco et al., 2016; Makowsky & Wang, 2018; Boly & Gillanders, 2018; Attanasi et. al., 2019) to study each particular practice separately. This previous research has been informative because isolation simplifies the analysis of corruption. However, as a consequence of this, an implicit assumption in the literature is that embezzlement and bribery are independent or even substitutes (Fan et al., 2010). It is true that using a *ceteris paribus* assumption and focusing on only one practice can allow for implications that are more specific. However, the incentives of the interaction may change if the two forms of corruption co-occur. In our *GC* game, for instance, the resource manager cannot embezzle without the approval of the voters. Moreover, the voters cannot receive the bribes if the proposal of investment to the public account is not approved. This interaction exemplifies the particular interdependence that may be present in most scenarios in which 'grand corruption' takes place.

The second strand of literature to which we contribute is the one examining transparency. Khadjavi et al., (2015), Di Falco et al. (2016) and Murray et al. (2017) operationalize transparency as complete disclosure on the actions of the resource manager. First, Khadjavi et al., (2015) used a public goods game and found that transparency in actions increases embezzlement in the absence of punishment.[4] Second, Di Falco et al. (2016) used a sequential dictator game and found that transparency reduces embezzlement. Finally, Murray et al. (2017) studied a setting where bilateral alliances could be used to favor partners at the expense of others and found that in some cases transparency can backfire on anti-corruption policies. The backfire effect appears because transparency facilitates the exchange of political favors with others who can be identified as corruptible. We contribute to this line of research by addressing transparency in available resources instead of transparency in actions.

The closest paper to ours is Azfar & Nelson (2007) who found that the more transparency there is, the lower the levels of embezzlement. We also consider different levels of transparency but differentiate from their work by studying settings where more than one form of corruption co-occur

[4] Related studies illustrating how transparency of behavior can be ineffective or even backfire and increase corruption are van de Ven & Villeval (2015) and Gneezy et al. (2018).

(i.e., embezzlement and bribery). Moreover, we have a laboratory experiment where we minimize the personal interactions and the creation of social ties, whereas Azfar & Nelson (2007) have a pen a paper experiment with personal interactions and no rematching of groups. Our findings show that the harder it is to hide embezzled money the less money it is embezzled. However, we also find that the effect cannot be easily generalized to other forms of corruption, such as bribery, because the co-occurrence of the two forms of behavior changes the interaction and the effect of transparency. Therefore, Azfar & Nelson (2007) may have more relation with the resource manager's decisions in NGOs, whereas our work closely relates to *grand corruption* settings.

2 Experimental design

2.1 The grand corruption (GC) game

The GC game is a game with four players. A resource manager is endowed with a set of resources to invest in a public account (i.e., a public good) after the approval of a committee of three voters. The resource manager has exact knowledge of the size of the endowment while the voters only have an estimate about it. The resource manager makes a public proposal of how much to invest in the public account. Then, the three voters vote for or against the proposal, in ignorance of the real size of the pie. If the proposal is approved by a majority rule, it is implemented, and the public account benefits all players. If it is rejected, the resources are lost, and no one gets anything. We allow for corruptive behavior as follows: before the voting stage, the resource manager can make transfers to individual private accounts, to any of the voters (bribery) or himself (embezzlement). After the implementation of the proposal, the resource manager's allocation is screened with a certain probability. If screened and found that the resource manager did not invest all the endowment into the public account, he will lose all his profits.

Specifically, participants interact repeatedly for 10 rounds in groups of four. In each round, there are four stages: (i) competition among players, (ii) proposal about the allocation of the resources, (iii) voting on the proposal, and (iv) inspection of the resource manager's allocation. In the first stage, players compete for the role of resource manager by individually performing an encryption task (Benndorf et al., 2014). The four participants in a group are ranked by their performance from highest to lowest and labeled, accordingly, as players A, B, C, and D. The player with the highest score, player A, is assigned the role of the resource manager. The other three players are assigned the role of voters, and their position in the ranking determines their voting weight. The player with the second-highest score, player B, has 50% of the share of votes, followed by player C with 30%, and player D with 20%. The voting weights mean that the sum of votes from players C and D does not pass the majority threshold. Thus, player B's vote is necessary for the approval of the proposal made by player A.

In the second stage, each group is endowed with an amount ω determined by a random draw. Thus, the endowment does not need to be the same between groups or periods. The value of ω is reported only to the resource manager, player A. Players B, C, and D will only have an estimate of the value of ω. Therefore, the accuracy of this estimate is our measure of transparency, which varies between treatments. After observing ω, player A chooses how much to allocate into the public account P, which is used for the production of the public good. Player A can also allocate resources to different individual private accounts; one for each player: p_A, p_B, p_C, and p_D. The allocation to P is public and observed by all voters, while the allocation to a private account is observed only by the resource manager (player A) and by the account owner. Afterwards, but in ignorance of the amounts allocated to the accounts, voters answer the following *normative* question: *what is the minimum amount that player A should allocate to the public account*? Their answer has no implication for the rest of the game, and due to its normative nature, it was not incentivized. Nevertheless, given that the answer was not binding, we consider there were no reasons for voters not to report their true expected public allocation.

In stage 3, the three voters observe the amount allocated to P, and each voter individually observes the amount allocated to his private account. Then, each player casts his vote: $V_i = v_i w_i$, where $v_i = 1$ if player i votes in favor of the proposal (0 otherwise) and w_i is the weight on the vote assigned to the player according to its ranking. For instance, if player B votes in favor of the proposal then $V_B = 1 \times 0.5$. If the sum of votes in favor constitutes a majority, $\sum V_i > 0.5$, the public good is produced and divided among all four players.[5] Otherwise, it is not produced and no one gets, anything from the public or private accounts.

Stage 4 is an inspection stage used to highlight the illegal nature of private allocations (bribery and embezzlement). With a probability *q=0.2* the allocations made by player A are inspected. If player A allocated the entire endowment to P, nothing happens even if his choices are inspected. However, if player A allocated part of the resources into any of the private accounts and his

[5] We use a setup similar to the standard voluntary contribution mechanism introduced by Andreoni (1988, 1995).

allocation is inspected, player A is punished and loses all his earnings. Voters' earnings are not affected by the inspection. Figure 1 summarizes the four stages of the game.

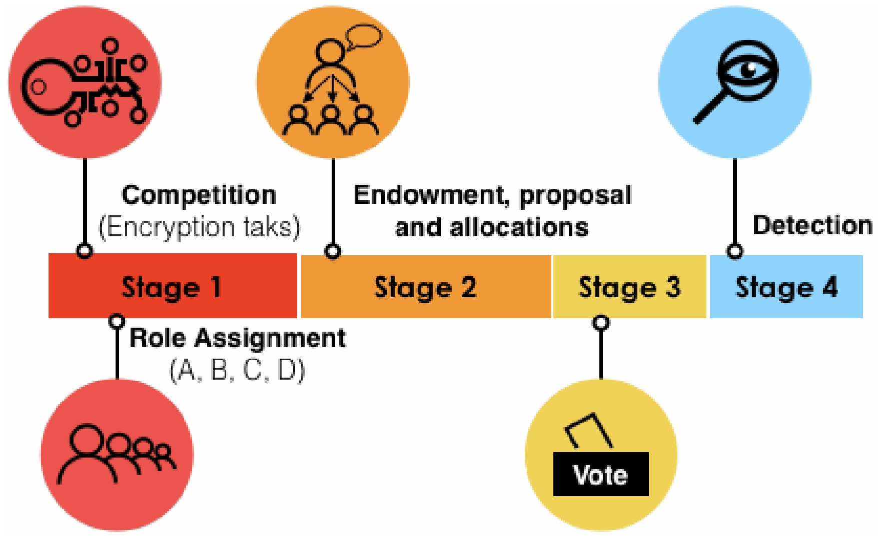


Figure 1. Timeline of the *grand corruption game.*

Regarding the final payoff, if the proposal is approved by a majority of votes, each player earns half of the amount invested in producing the public good, $0.5P$.[6] Otherwise, as mentioned above, each earns zero. Each player also earns twice of what is allocated to his private account. The MPCR of the private accounts is 2 to reflect a differential marginal utility. That is, it represents the fact that the same amount of money has a higher impact on individual wealth than it has on society because it represents a higher share of an individual's income (Abbink et al., 2002).[7]

In addition, players earn a fixed payment of 5000 points, which is independent of the allocations. Finally, as mentioned above, before computing the payoff, there is an inspection of player A's decision with probability $q = 0.2$.[8] If the inspection takes place and the resource manager has not invested all the endowment in the public account, $P < \omega$, he will lose his earnings and will only receive his fixed payment. This probability of detection will not affect the voters' private accounts

[6] This is the standard marginal per capita return (MPCR) used in public goods games (see for example Andreoni 1988; 1995)

[7] This value could not be higher than 2.1 to prevent the possibility that allocating the endowment into private accounts would make the social surplus higher. This is based on the expected utility of the individual assuming an equal sharing of the endowment between private accounts, and taking into the account a probability of being caught of 0.2.

[8] The probability of being captured was first introduced in corruption experiments by Abbink, Irlenbusch, & Renner (2002) in order to model an illegal context. We used such a high probability to show that the effect is present even in environments where controlling authorities are efficient.

or their earnings from the public account. Equation (1) presents the payoffs in the GC game for each player.

$$EU_i = \begin{cases} (1-q)(0.5P + 2p_A) + 5000, & if \;\; i = A, P < \omega, and \sum V_i > 0.5 \\ (0.5P + 2p_i) + 5000, & if \;\; i \neq A, P < \omega, and \sum V_i > 0.5 \\ 0.5P + 5000, & if \quad\quad P = \omega, and \sum V_i > 0.5 \\ 5000, & if \quad \sum V_i \leq 0.5 \;\; \forall\, i \end{cases} \tag{1}$$

Regarding the socially preferred allocation, taking into account the probability of punishment q, the expected value of the social welfare is determined by $W = 2P + 2((1-q)p_A + p_B + p_C + p_D)$, where $P + p_A + p_B + p_C + p_D = \omega$. Therefore, in our game, there are two ways to use ω and maximize the total welfare: either no corruption, so that all the resources are allocated to the public account or complete bribery, so that all the resources are allocated to the voters' private accounts. However, given that in the complete bribery option player A will end up only earning his fixed salary, he will prefer the first option best.

2.2 Experimental design and predictions

Transparency is our treatment variable, which we define as the accuracy of the information that voters have regarding the number of resources available to player A (the endowment) for the production of the public good. We conduct an experiment with two experimental conditions varying the level of transparency: LOW and HIGH. In LOW, players are informed that the endowment's value is between 10k and 30k, whereas, in HIGH, they are informed that the value is between 18k and 22k. The endowment was randomly chosen from a range between 18k and 22k. That is, we vary the level of transparency through the information provided to the voters. In either case, we have a mean-preserving spread of 20k. In both cases, we were careful never to mention any particular distribution for these numbers.

In our game, corruption can take two forms: embezzlement and bribery. Embezzlement occurs when player A transfers resources to his private account and bribery occurs when he transfers resources to any of the voters' private accounts. Importantly, our game can measure the impact of corruption on the provision of the public good; this closely resembles what happens in the real world. As stated before, our treatment variable is used to test whether transparency can influence player A's decision to allocate to the public account rather than allocating to private accounts. That is, we want to assess changes in the resource manager's behavior as a consequence of voters being better informed about the amount to be distributed.

Given that in our design the lack of transparency is interpreted as the ease of hiding corruption, we expect corrupt behavior to increase in LOW compared to HIGH. The reason is that in HIGH, it will be evident that if the public account does not have at least 18k, the resource manager is diverting money to private accounts, whereas in LOW the lower value is 10k. Therefore, a resource manager can misuse more resources without being directly perceived as doing something wrong. In particular, the total level of corruption in this game is the sum of the embezzled money and money spent on bribes. Hence, this effect can be tested by looking at the total amount allocated to the private accounts (including A's).

> *Hypothesis 1: The higher the level of transparency, the lower the number of resources diverted from the public account (total corruption).*

If Hypothesis 1 cannot be rejected, the standard intuition is supported, and transparency can be a useful tool to reduce corruption. Such a result, however, would inform us about the magnitude of corrupt behavior but would lack clarity on the distribution of private transfers. That is, we would still need more information to disentangle how it affects embezzlement compared to bribery. Our experimental design allows us to separate the effect of transparency on embezzlement and bribery. We generate hypotheses on the specific forms of corruption as follows:

> *Hypothesis 2: The higher the level of transparency, the fewer the resources embezzled by the resource manager.*

Hypothesis 2 suggests that player A will embezzle more when transparency is low because it is easier to put money in his private account without it being evident to others that he is doing something wrong. Thus, we expect transparency to decrease embezzlement. Such a finding would be consistent with the experimental literature studying embezzlement (see Azfar & Nelson, 2007; Di Falco et al., 2016). We also generate a hypothesis on the effect of transparency on bribery:

> *Hypothesis 3: The higher the level of transparency, the fewer the resources used for bribery by the resource manager.*

In addition to allocating resources into his private account, player A can bribe voters by allocating resources to the voters' private accounts. The motives for allocating money to bribes may differ from those motivating embezzlement. Arguably, embezzlement is driven mainly by self-interest because the money will give direct utility to player A, and no benefit to any other player in the group. Bribery, on the other hand, gives no monetary benefits to player A or any other player but the owner of the private account. If we regard inequality aversion as an explanation for bribery, the best way to reduce inequality would be to allocate all the resources to the public account, because allocating 25% of the pie to each private account implies that the resource manager has a 0.2 probability of ending up with a payoff of zero. Thus, the primary motivation to bribe —in the GC game— is to influence player B's, C's or D's vote in favor of the proposal. Therefore, hypothesis 3 predicts that bribery will decrease when transparency is high.

2.3 Procedures

We ran the experiment in Colombia at the EMAR-LAB of the Industrial University of Santander. Participants were all undergraduate students from different fields. A total of 80 students participated in four sessions with 20 participants each. Each participant participated in only one of the two treatments (HIGH or LOW transparency) and earned an average payout of USD 6.[9] The instructions were context-free to avoid roleplay biases. The game was played for ten periods. In each period players were randomly matched in groups of four, and their roles were assigned according to the ranking of scores from the encryption task in that period. During the experiment, we use all the values in thousands, with each point being equivalent to one Colombian Peso. This procedure was used to simplify the understanding of payoffs for participants, given that none of the subjects had ever participated in an economic experiment. At the end of each session, participants were paid for a randomly selected period out of the ten they played to avoid income effects. Each participant had a different paid period allocated according to a lottery in which each period had the same probability of being chosen.

[9] This is approximately half a daily salary for a student at the university.

3 Results

Table 1 reports the average and the standard deviation for the main variables for both LOW and HIGH transparency. In the last column, we report the difference between LOW and HIGH and its level of significance. The variables are reported as proportions of the endowment player A received in each group. Aggregate corruption is generated as the number of resources allocated to all private accounts divided by the total endowment. For instance, 52.7% of the endowment was allocated into private accounts (Aggregate Corruption) in the LOW treatment. The Embezzlement variable reports the share of the endowment that player A allocates to her private account. Bribery shows the share of the endowment allocated to all the voters' private accounts. Bribe for B, Bribe for C, and Bribe for D are the breakdown of bribery per voter.[10] Finally, public account reports the proportion of the endowment allocated to produce the public good. From now on, unless otherwise indicated, we will present the variables as a proportion of the endowment to ease the interpretation, given that the endowment varied between 18k and 22k in each period.

Table 1 presents evidence confirming that a higher share of the endowment is spent on corruption when transparency is lower ($p < .10$).[11] Our design also allows us to disaggregate the impact of transparency on the two types of corruption studied when they co-exist. In that sense, Table 1 also suggests that this significant effect is driven by the differences in the proportion of resources embezzled ($p < .05$), whereas the difference in bribes is not significant ($p < .10$). Given that we have a game with ten repetitions and a random matching protocol, we need to control for potential spillovers across subjects. To address this issue, and any potential interdependence of observations, we use regression models to control for experience and correct standard errors by clustering at the individual level.

[10] Notice that Public Account + Embezzlement + Bribery = Public Account + Aggregated Corruption =1, and Bribery = Bribe to B + Bribe to C + Bribe to D.

[11] Notice that the p-value of aggregated corruption is the same as the public account. The reason is straightforward: the public account is just 1 minus the aggregated corruption.

Table 1. Mean of main variables by treatment

	LOW	HIGH	Difference
Aggregated Corruption	0.527	0.387	0.140*
	[0.371]	[0.318]	
Embezzlement	0.259	0.164	0.095**
	[0.190]	[0.140]	
Bribery	0.268	0.223	0.045*
	[0.241]	[0.207]	
Bribe for B	0.111	0.109	0.002
	[0.093]	[0.98]	
Bribe for C	0.095	0.063	0.032*
	[0.087]	[0.073]	
Bribe for D	0.062	0.051	0.011
	[0.081]	[0.077]	
Public Account	0.473	0.613	-0.140
	[0.371]	[0. 317]	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard deviations are shown in brackets. The significance of the difference was calculated using clustering at the subject level, by an OLS regression with the variable of interest as the dependent variable and the treatment dummy as the independent variable.

In Table 2 we present an OLS regression[12] with *Aggregated Corruption* as the dependent variable. The covariates are a treatment dummy using LOW as the reference group, a discrete variable for the period, and the resource manager's score on the encryption task (Effort). We correct the standard errors by clustering at the individual level[13] in order to adjust the significance of the tests by allowing dependence between observations. Column (1) presents the regression with only the treatment variable as a regressor, which can be understood merely as a t-test for the treatment variable. We find a weakly significant effect at a 10% level. In column (2), we report a model where we control for experience (Period) and the level of effort exerted by player A in the current period. This result shows that transparency reduces corruption by approximately 15 percentage points.

[12] We use OLS instead of using a panel data model because the role of resource manager changes each period, which results in few observations for players being resource managers.

[13] When clustering by session the results are the same and the significance is strengthened. We do not report these results here.

Table 2. Transparency and Corruption

	(1)	(2)	(3) Period 1-5	(4) Period 6-10
High Transparency=1	-0.140*	-0.149*	-0.0350	-0.264***
	[0.0795]	[0.0775]	[0.0944]	[0.0885]
Period		0.00472	-0.00691	0.0123
		[0.0104]	[0.0230]	[0.0223]
Effort		-0.0407	-0.0346	-0.0484
		[0.0333]	[0.0300]	[0.0441]
Constant	0.527***	0.934***	0.848***	1.015**
	[0.0631]	[0.326]	[0.285]	[0.489]
N	200	200	100	100

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Columns (1) and (2) display the estimated coefficients from an OLS regression with Aggregated Corruption as the dependent variable. Column (3) presents the same regression only for periods 1 to 5 and Column (4) presents it for periods 6 to 10. Standard errors corrected for clustering at the subject level are presented in brackets.

It is likely that the average effect of transparency on corruption across periods is not significant because the resource manager's decision is complex and demanding. If that were the case, the effect of low transparency on corruptive behavior should become weaker in the last periods of play due to experience. Figure 2 gives a sense of the evolution of aggregated corruption using period by period data and shows how a significant gap opens between treatments after period five.14 This is confirmed by the regression models reported in Table 2 columns (3) and (4), which indicate that in periods 6 to 10 high transparency reduces corruption by 26.4 percentage points compared to low transparency; this effect is significant at a 0.01 level. Our evidence in favor of Hypothesis 1 is summarized in Result 1.

Result 1. *Corruption decreases when the level of transparency is high, and the effect is strengthened over time.*

[14] Notice that in period 6 there is a big drop on the average rate of corruption in treatment HIGH. This is due to the fact that 70% of the resource managers decide to allocate all the endowment to the public account. However, in the following periods the proportion was not that high.

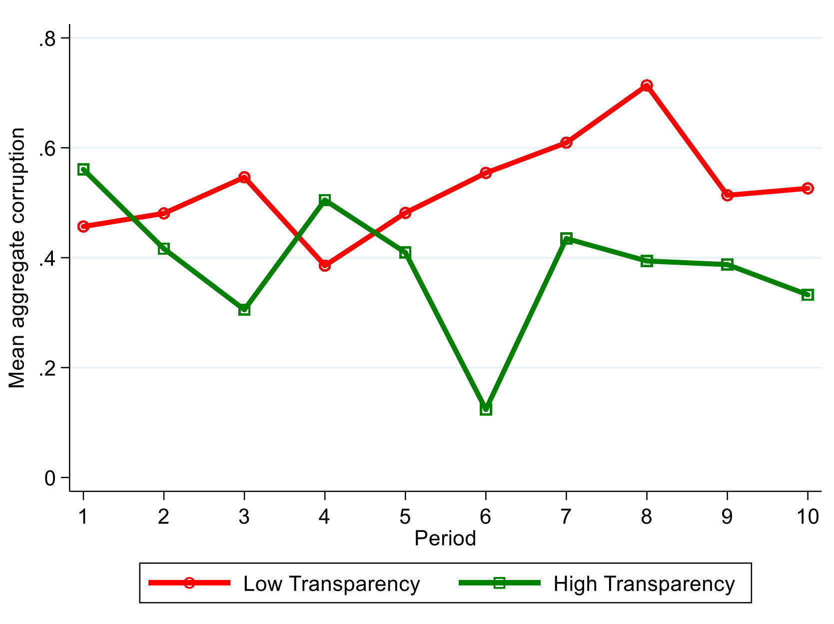
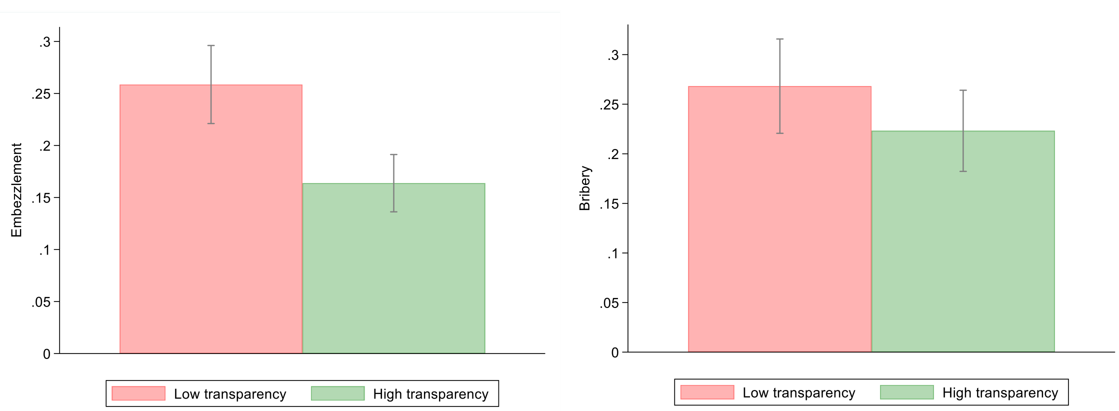


Figure 2. Evolution of aggregate corruption over time.

Thus far, we have argued that lower levels of transparency promote corruption. We now look into how this effect takes place by disentangling the separate impact of transparency on embezzlement and bribery. Figure 3 uses information from Table 1 to compare the impact of different levels of transparency on both types of corrupt behavior. Figure 3 illustrates that the difference between treatments is larger for embezzlement ($p < .05$) than for bribery ($p > .10$).



(a) Embezzlement

(b) Bribery

Figure 3. The average rate of embezzlement and bribery, as a proportion of the endowment, by levels of transparency.

Note, however, that such differences between treatments should be taken with caution given the potential dependencies between the observations. Therefore, in Table 3 we present an OLS regression with errors corrected by clustering at the individual level. In Columns (1) and (2) we have as a dependent variable the proportion of the endowment that was embezzled by the resource manager in percentages. In these columns, we can observe that the coefficient for HIGH is negative and significant at a 5% level. In particular, we see that embezzlement is about 10 percentage points lower in HIGH, supporting Hypothesis 2.

Table 3. The impact of the level of transparency on bribery and embezzlement

	Embezzlement		Bribery	
	(1)	(2)	(3)	(4)
High Transparency=1	-9.482**	-9.902**	-4.504	-4.979
	[3.862]	[3.725]	[5.439]	[5.360]
Effort		-1.907		-2.161
		[1.603]		[2.126]
Period		0.484		-0.0119
		[0.478]		[0.642]
Constant	25.86***	43.49***	26.82***	49.89**
	[3.320]	[15.19]	[4.465]	[21.36]
N	200	200	200	200

* p < 0.10, ** p < 0.05, *** p < 0.01

Note: Columns (1) and (2) display the estimated coefficients from an OLS regression with the proportion of the endowment (in percentage) spent on embezzlement as the dependent variable. Columns (3) and (4) present the estimated coefficients from an OLS regression with the proportion of the endowment spent on bribery (in percentage) as the dependent variable. Standard errors corrected by clustering at the subject level are presented in brackets.

Result 2. *Embezzlement decreases when the level of transparency is high.*

In columns (3) and (4) of Table 3, we present the same regressions as in columns (1) and (2), using as the dependent variable the percentage of the endowment allocated to the voters' private accounts. The money spent on bribes cannot be statistically differentiated between treatments, see in the coefficient for High Transparency in columns (3) and (4).[15] Thus, our evidence does not

[15] It could be argued that this null effect could be a consequence of lack of power. However, for a t-test to be positive, with the values provided in Table 1 and a power of 0.8, the size of the number of resource managers taking this decision should be at least 309. Therefore, the likelihood that a laboratory experiment found a significant difference is low.

provide support in favor of Hypothesis 3. Moreover, integrating Result 2 and Result 3, we observe that it is the number of resources embezzled and not the used to pay bribes what drives the effect of the different levels of transparency on corrupt behavior.

Result 3. *There is no significant reduction in bribery when the level of transparency is high.*

Finally, to conclude this results section, we look at the decisions of how to vote and the rates of approval of the proposal. Column 1 in Table 4 displays the marginal effects of a Probit regression with the approval of the proposal as the dependent variable (1 if approved and 0 if not). Given that voters only know an estimate of the size of the endowment, we use the variables Public Account, Bribe for B, Bribe for C, and Bribe for D, in absolute terms instead than as proportional to the endowment. However, given that the values are in thousands (recall that budgets ranged between 18k and 22k); we use the variables in thousands to ease the interpretation.[16]

First, we observe in the column *Total* that the level of transparency does not affect the approval rates. The probability that the proposal is approved only increases when the allocation to the public account increases ($p < .05$). However, the impact of increasing the resources allocated to the public account is small, and in 89% of the cases, a proposal was approved. This is summarized in Result 4.

Result 4. *Transparency reduces corruption; therefore it promotes public good provision. However, it does not affect the approval of the proposal made by the resource manager.*

Result 4 is better understood by regressions B, C, and D in Table 4 where the dependent variable is the vote of players B, C, or D, respectively (1 in favor 0 against). Note that none of the included covariates influences player B's voting decision. This is due to player B always getting large private transfers, independently of the level of transparency, which makes his share coming from the public account less appealing and thus, less influential on his vote. Indeed, in our data, player B's votes against the proposal are only 8.5% of the total votes. On the other hand, we observe that voters C and D are influenced by both the public good allocation and the bribes, although they are more sensitive to bribes.

[16] For instance, instead of having a value of 11340 we use 11.34, which simplifies notation.

Table 4. Determinants of approval and voting in favor of the proposal

	Approval	Voting decision		
	Total	B	C	D
High Transparency=1	-0.0736	-0.0720	0.0163	-0.115*
	[0.0505]	[0.0456]	[0.0612]	[0.0682]
Public account	0.0173**	0.00677	0.0225***	0.0282***
	[0.0074]	[0.0074]	[0.0077]	[0.0067]
Bribe for B	0.0157	0.0208		
	[0.0288]	[0.0190]		
Bribe for C	0.0245		0.105***	
	[0.0235]		[0.0263]	
Bribe for D	0.0270			0.0963***
	[0.0185]			[0.0261]
Period	0.00604	-0.00439	0.0175**	0.0110*
	[0.0084]	[0.0061]	[0.0084]	[0.0062]
Difference between Public allocation and Fair allocation		-18.01	-66.00	-104.0
		[61.46]	[73.96]	[80.85]
N	200	200	200	200

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Column Total presents the estimated marginal effects from a Probit regression where the dependent variable is the approval of the proposal (0 for not approved 1 for approved). Columns (B), (C) and (D) display the estimated coefficients from the estimated marginal effects from a Probit regression where the dependent variable is the vote of B, C, and D respectively. Standard errors corrected by clustering at the subject level are presented in brackets.

Finally, we look at the elicitation of the normative minimum acceptable allocation and compare it to the actual allocation choice. That is, we analyze the effect of the difference between the voter's minimum acceptable allocation and the resource manager's allocation on a voter's vote. In Table 4, we see that even though the sign is negative, as expected, the coefficient is not significant. However, in Figure 4, we observe that the distribution of the difference varies between treatments (Kolmogorov-Smirnov test, $p < .000$). Notably, in HIGH the difference between the reported minimum acceptable offer and the real public allocation is normally distributed around zero, whereas in LOW the distribution is biased to the right. Altogether, the results of Table 4 and Figure 4 suggest that when the level of transparency is high, the resource managers pretend to be less corrupt by allocating to the public account quantities around the normative expectation. On the other hand, when the level of transparency is low, resource managers deviate more from the expected allocation of the voters. Despite this, the votes result in high rates of approval of the proposal even when the level of transparency is low.

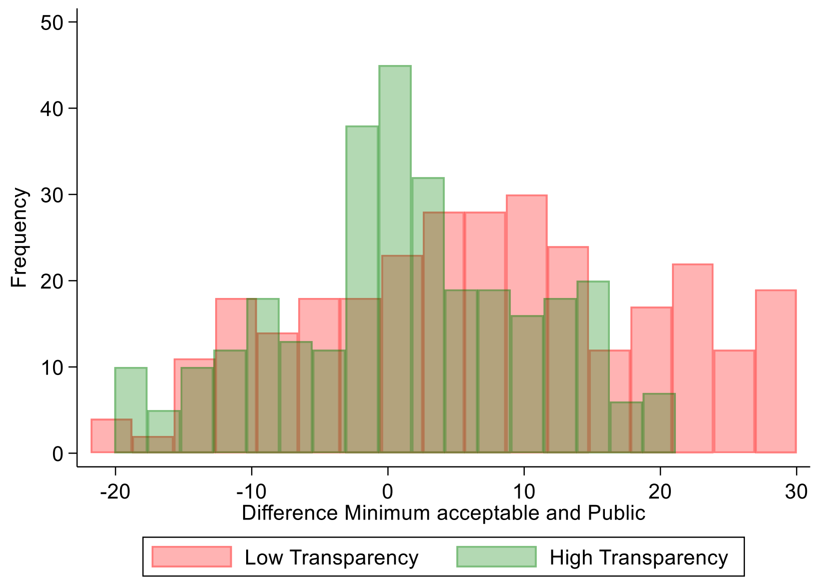


Figure 4. Histograms of the difference between the minimum acceptable offer and the public allocation by treatment

4 Discussion and Conclusion

Previous experimental research on corruption has been oblivious to the possibility that a combination of embezzlement and bribery changes the incentives of public officials when it comes to corruptive behavior. Nevertheless, some events worldwide have shed light into the potential interaction of these two different types of corruption, suggesting that the co-occurrence of different forms of corruption (e.g., *grand corruption* settings) matter and its study is of utmost importance. In our article, we assess the effect of different levels of transparency on corruption, in a setting where both embezzlement and bribery can co-occur. The game for the experiment was inspired by real contexts where bribery is used, by resource managers, as a tool to get others to "close their eyes" and allow them to embezzle. Our findings speak in favor of the idea that transparency can decrease corruption, and its effect becomes stronger in the long-run. Nevertheless, it raises a point of caution when claiming that transparency reduces corruption in the same way both when corrupt behavior occurs in isolation or when different forms of corruption co-exist.

Our main finding shows that while high levels of transparency decrease the number of resources embezzled, there are no additional effects on the number of resources used to bribe. This, in turn, implies that despite transparency being a vital instrument to decrease embezzlement, its impact cannot be generalized to all types of corruption; especially in contexts where a various forms of corruption co-exist. We are in no way arguing that transparency cannot decrease bribery. Instead, we show that in certain settings, the effect may be focalized to one form of corruption and not necessarily extended to others.

A possible explanation comes from the idea that the resource managers can take advantage, when transparency is low, and pretend they were endowed with fewer resources. Thus, instead of arguing that bribery does not decrease when transparency increases, it may be that it does not increase when transparency decreases. Put another way, embezzlers take advantage of the low levels of transparency to deceive even their partners in crime. Therefore, resources managers may be bribing as if they had a small pie, regardless of the size of their endowment, but they may be embezzling as a function of the size of their pie.

Our evidence also suggests some caution in stating that transparency deters embezzlement. Instead, we argue that it has a moderating effect and it may actually decrease the amount embezzled but not the act of embezzling itself. Further research can consider what other instruments may accompany transparency to produce a stronger combined effect on all types of co-occurring corrupt behaviors. This is further highlighted by the fact that, in our study, the resource manager's proposal is approved in most instances regardless of how evident corruption is, highlighting how important it may be to have measures that keep voters accountable. The main explanation, in our setup, is that resource managers and voters have interdependent incentives for creating the public good. Even if our results suggest that it is of high priority to increase the levels of transparency in the management of public funds, for instance through Blockchain systems,[17] it should be considered that transparency might be a necessary but not a sufficient condition to deter corruption.

[17] Broadly speaking, a Blockchain is an immutable public digital ledger. Once someone records some information, it cannot be changed.

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Appendix A: Instructions

(Original in Spanish)

1. Welcome

You are participating in a study on economic decision-making. Please read the instructions carefully, because they will explain how to earn money. Any communication between you and other participants will be carried out through the computers. Please do not talk or communicate with other participants in any other way. If you have any questions, please raise your hand and one of us will help you.

Your participation in the study is anonymous. This means that your identity will not be revealed to others, nor will the identity of others be revealed to you. During this study, you will earn points. The points you earn will depend both on your decisions and on the decisions of the other participants. There are no correct or incorrect answers in this study. Do not think that we expect concrete behavior on your part.

You will participate in this study for 10 periods. One of the periods will be randomly selected by the computer. The points of this period will be the points with which your payments will be calculated. At the end of the study each point will be equal to one Colombian Peso. That is, if you earn 5 thousand points your profit will be 5 thousand COP in cash.

2. The decisions

You will participate in a group of 4 people. One of the members of the group will be denominated as player A and the other 3 will be players C (C1, C2, and C3). Roles are assigned depending on a competition. The player with the highest number of hits will be player A for that period and the other 3 will be players C, ordered C1, C2 and C3 according to the number of hits. In case of obtaining the same number of hits the computer will choose randomly between the tied ones.

In each period player A will receive a number of points and he will make a proposal to the players C. Players C will decide whether to approve or reject the proposal of player A. If the proposal is approved, the points will be assigned according to what has been agreed. If the proposal is rejected players will not receive what is proposed by player A.

The interaction will be repeated for 10 periods. In each period, the groups will be formed at random. That is to say that there is a very low probability of being part of a group with the same people in two different periods.

Below we explain in detail the competition, the decisions and how the payoff of each player are calculated.

3. Stage 1: Competition

Each period is performed a competition of encryption. The task is to encode combinations of letters (words) into numbers. For every word that you locate correctly you will get a hit. The duration of the competition is 120 seconds.

Three capital letters will always be a "word." Below each letter is a blue box where you must include the corresponding numbers. The encryption code is found in a table below the corresponding letter.

Whenever you want to enter a value please click on the blue box below the first capital letter. Important Tip: Please note that after entering the three-digit number you can easily switch to the next blue box using the tab key on your keyboard.

Once you have entered the three values corresponding to the 3 letters press the button "Next Word". The computer then checks if all capital letters have been correctly encoded. Only then, the word will be counted as correctly resolved and a new word will appear on your screen at random.

The player with the highest number of hits in this competition will be chosen player A. The others will be players C1, C2, and C3, sorted according to the number of hits. The number of hits of players C will be important when voting for or against player A's proposal.

4. Stage 2: Player A's proposal

Player A will receive a number of points, between 18000 and 22000, which only he will know exactly. With these points, he should make a proposal to C players about how much to invest in the group account.

Before giving the proposal to players C, player A can decide how to use these points and he has 2 ways to do so: (i) a personal account of each player, (ii) a group account. Here's what happens with the points depending on the account to which they are assigned:

<u>The personal account of each player:</u> in total there are 4 personal accounts, one for player A and one for each player C. Each participant will receive double the points assigned in his personal account.

<u>The group account:</u> All participants will receive half of the assigned points in the group account, including player A.

In other words, player A will decide how many points to assign to (i) his personal account, (ii) the account of player C1, (iii) the account of player C2, and (iv) the account of player C3. Points that are not assigned in any of these accounts will be placed directly in the group account.

Only player A will know exactly how many points there are initially and how much is assigned to personal accounts. Each player C will only know the points assigned to his personal account and to the group account. Below are two examples of player A.'s decision.

Example 1: Player A receives a total of 21000 points and decides to assign 0 points in personal accounts. Then, the proposal that players C receive is that player A assigns 21000 points in the group account.

Example 2: Player A receives a total of 21000 points and decides to assign 5000 points in his personal account, 3000 points in the C1 account and 0 points in the accounts of the other players C. Then, the proposal that the players C2 and C3 receive is that player A assigns 13000 points in the group account and 0 points in his personal accounts. Player C1 receives the same proposal except that player A has assigned 3000 points in his personal account.

While Player A makes the proposal, players C should answer the following question: How much do you think is the minimum value that Player A should invest in the group account? The answer you give will have no consequences later.

5. Stage 3: Voting of players C

At this stage players C receive the proposal of player A. This means that each player C will know how many points he intends to allocate to the group account and how many points to his personal account. However, C players do not know how many points were allocated in the personal accounts of other players, only know that the starting amount is between 18000 and 22000.

The decision of the C players is to vote for or against the proposal. If the proposal is approved, then the assignment of points will be carried out. If rejected, the starting points cannot be used. The way a proposal is approved or rejected will be explained below.

Each player C is organized by his successes in the competition stage, determining whether he is C1, C2 or C3. In this way, player C1 will have 50 votes, C2 will have 30 votes and C3 will have 20 votes. The proposal is approved if more than half of the votes are in favor. Otherwise the proposal is rejected. Here are two examples:

Example 1: Player A proposes to allocate 21000 points in the group account. If player C1 and player C2 vote in favor and C3 against, there will be 80 votes in favor (more than half) and 20 against. Therefore the proposal is approved.

Example 2: Player A proposes to allocate 15000 points in the group account. If player C1 votes against and players C2 and C3 in favor, there will be 50 votes against and 50 votes in favor (no more than half). Therefore the proposal is rejected.

Please note that the proposal will be rejected if at least two C players vote against.

6. Stage 4: Profits

Players will receive the points of the period chosen by the computer. These points depend on the allocation of resources and the approval of the proposal. In addition, everyone receives a pay per attendance equal to 5000 points, regardless of the decisions made.

If the proposal is approved, players get points from the group account and their personal account, in addition to the payment for attending. In other words, you will receive half the points of the group account plus double the points of your personal account, and also the payment for attending.

If the proposal is rejected, the initial amount will be lost. Therefore, the players' profit will be only the payment to attend, 5000 points. The following is explained in detail with two examples:

Example 1: Player A gets 21000 points and proposes to assign them completely in the group account, nothing in personal accounts. If the proposal is approved the win of all players will be 15500 points ((0.5 x 21000) + 0 + 5000 = 10500 + 5000). If the proposal is rejected the win of all players will be 5000 points.

Example 2: Player A gets 21000 points and proposes to allocate 13000 to the group account. He also assigns 5000 points to his personal account and 3000 points to the personal account of C1. If the proposal is approved the points will be:

Player A’s profit: (0.5 x 13000) + (2 x 5000) + 5000 = 6500 + 10000 + 5000 = 21500 points.

Player C1’s profit: (0.5 x 13000) + (2 x 3000) + 5000 = 6500 + 6000 + 5000 = 17500 points.

Player C2 and C3’s profit: (0.5 x 13000) + 0 + 5000 = 6500 + 0 + 5000 = 11500 points.

If the proposal is rejected players will receive only 5000 points to attend.

7. Review of the proposal

Player A's proposal may be revised. The review works as follows: the computer chooses a random number between 1 and 100. If the number chosen is between 1 and 20 the decisions of player A will be reviewed. If the number chosen is between 21 and 100 decisions will not be reviewed.

Player A will be sanctioned if the proposal is reviewed and has not allocated all initial points to the group account. The penalty is the loss of points he has earned in that period, except for his payment for attending. In no case will the players C be affected, as the penalty applies only to player A.

Below we illustrate with two examples, assuming that the proposal is revised:

Example 1: Player A receives 21000 starting points and proposes to allocate them completely to the group account. In this case player A would not receive penalty.

Example 2: Player A proposes to allocate 13000 points to the group account and has received 21000 points at the start of the period. That is, he has assigned 8000 points in personal accounts. Therefore, player A will lose the points assigned to the accounts, he would only earn his payment for attending. Players C will not be affected as the penalty applies only to player A.

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