



Measuring corruption in the field using behavioral games [☆]

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ABSTRACT

Corruption is often harmful for economic development, yet it is difficult to measure due to its illicit nature. We propose a novel corruption game to characterize the interaction between actual political leaders and citizens, and implement it in Northern Mozambique. Contrary to the game-theoretic prediction, both leaders and citizens engage in corruption. Importantly, corruption in the game is correlated with real-world corruption by leaders: citizens send bribes to leaders whom we observe appropriating community money. In corrupt behavior, we identify an important trust dimension captured by a standard trust game.

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Corruption is considered to be harmful for economic development (Bhargava, 2005), with micro-level evidence confirming its detrimental effects in areas such as the provision of public goods (Reinikka and Svensson, 2004; Bertrand et al., 2007; Reinikka and Svensson, 2011; Ferraz et al., 2012) and firm efficiency (Fisman and Svensson, 2007; Sequeira and Djankov, 2014).¹ On the macro side, empirical evidence is inconclusive (Mauro, 1995; Svensson, 2005). Due to its illicit nature, how to best measure the magnitude and nature of corruption remains not only a central focus of the literature in political economy, but also an open question. All instruments used to measure corruption, from perception-based and

¹ Little evidence highlights corruption as beneficial (Huntington, 2017; Méon and Weill, 2010). Olken and Pande (2012) provide a comprehensive review on the topic.

survey measures, to audit studies, present disadvantages (Sequeira, 2012).² In particular, while audit studies can reveal the extent of missing resources, they are unable to shed light on the mechanisms of corruption at the local level, i.e., the ones that characterize the interaction between citizens and the public sector in everyday situations (Justesen and Bjørnskov, 2014).

This paper advances the literature by studying the culture of corruption at the local level through a novel lab-in-the-field experiment. We introduce a neutrally-labeled game featuring citizens competing to be chosen for a financially valuable opportunity granted by the actual political leader at the village level. Citizens must choose between a personal investment or a bribe to the leader. The leader keeps all bribes and chooses one citizen after observing the anonymous decisions. The chosen citizen is then rewarded.

This design innovates by combining two important features. First, because it is always in the best interest of the leader to choose the individual who made the greatest personal investment, the game leads to a subgame-perfect Nash equilibrium (SPNE) in which no citizen gives any bribes. With the exception of the archetypal game of Abbink et al. (2002), the majority of lab or lab-in-the-field studies of corruption involve equilibria with partial or full corruption.³ Second, in common with Gneezy et al. (2019), the game moves away from the two-player trust game paradigm of the conventional corruption game, and is therefore better equipped to capture group dynamics.

We implement our lab-in-the-field experiment with citizens and local political leaders in 206 communities in Northern Mozambique. Mozambique, one of the poorest countries in the world (UNDP, 2020), is considered as “partly free” in terms of democratic rights (Freedom House, 2020), and is ranked 149th out of 180 countries on 2020 Transparency International’s Corruption Perceptions Index. The local leaders (village chiefs or *chefes de aldeia*) are the official political representatives of their communities, and they were empowered as part of the decentralization process implemented in Mozambique in the 1990s (West and Kloeck-Jenson, 1999). Discretionary power, combined with a lack of competitive political forces, present favorable conditions for corruption to arise, involving rent-seeking and nepotism, and increased collusion between citizens and leaders to siphon off government funds (Basurto et al., 2020; Ferraz and Finan, 2011; Shleifer and Vishny, 1993; Véron et al., 2006). As decentralization is closely linked to corruption when accountability is low (Fisman and Gatti, 2002; Fan et al., 2009; Jacoby et al., 2021; Lessmann and Markwardt, 2010), this setting is particularly relevant for many low- and middle-income nations which have significantly reformed their political structures towards greater autonomy of local political leaders (Bardhan and Mookherjee, 2006; Ribot and Oyono, 2012).

Despite the stark theoretical predictions of our corruption game, both citizens and leaders engage in corrupt transactions. Ninety-one percent of citizens send a strictly positive bribe to the leader, and 39% of leaders do not choose the profit-maximizing choice of selecting the person with the highest private investment. This results in a significant transfer from citizens to

their leaders: citizens earn about two-thirds of their expected (equilibrium) payoff, but leaders earn over five times theirs.

We establish a clear link between behavior in the game and corrupt behavior observed outside of the game by looking at the interaction between citizens and real political leaders in an incentivized setting. Finding an ideal external measure of corruption is not straightforward in our context because it should relate to explicit engagement in a corrupt activity, but also not be subject to self-reporting bias. For our study, we unobtrusively measured village leaders’ appropriation of funds earmarked for their community using a structured community activity (Casey et al., 2012). During the game, citizens send significantly more bribes to leaders who are observed appropriating these funds, providing evidence that the lab-in-the-field experiment captures real corruption dynamics within these communities. This provides novel direct evidence on the external validity of individual behavior in a corruption game.⁴

Finally, employing survey questions and a standard trust game played between citizens and local leaders, we show a strong correlation between trust and behavior in the corruption game. This is in line with the reciprocal nature of corruption, as an individual pays a bribe in expectation that the act will be reciprocated (Abbink and Hennig-Schmidt, 2006). While Gneezy et al. (2019) observe only a minor role for reciprocity among non-connected participants, we find that 39% of leaders go against their self-interest in the corruption game and reciprocate citizens’ bribes. Citizen giving in the trust game is also predictive of leaders’ observed appropriation. Incentivized trust games may measure particular forms of financial trust and reciprocity that can enable greater corruption. Linking trust and corrupt behavior in and outside the lab presents a further novel contribution of this study.

1. Context and sampling

Corruption is particularly relevant in the presence of natural resource wealth. Together, they could lead to the natural resource curse and civil conflict (Auty, 1993; Treisman, 2000; Collier and Hoeffler, 2004; Ross, 2004). These concerns are particularly salient in our context: the Cabo Delgado province in Mozambique, where one of the largest off-shore reserves of liquefied natural gas (LNG) in the world was recently discovered (Frühauf, 2014).

Cabo Delgado is the northernmost province of Mozambique, a low-income country, ranking 7th from the bottom worldwide in terms of GDP per capita (US\$1,247, PPP current international \$, The World Bank (2017)) and on a decreasing trend in terms of voice and accountability (Freedom House, 2020; UNDP, 2020). Mozambique has had a tumultuous history of conflict since the 1960s, from its war of independence from Portugal to a civil war. Although the war formally ended in 1992, violence has resurged in recent years. Cabo Delgado province is primarily rural, with a total of 1.8 million inhabitants, and within the country it ranks lowest in human development (INE, 2015a).

Like many countries in Africa, Mozambique underwent a decentralization process in the 1990s that resulted in the creation of newly empowered political leaders at the community level (West

² Earlier measurements focused on perception indexes based on surveys of individuals, experts or businesses, which may suffer from reporting bias. More recently, audit studies have relied on the accuracy of public records to capture corruption (see, e.g., Olken (2006); Ferraz and Finan (2008); Ferraz and Finan (2011); Niehaus and Sukhtankar (2013)).

³ See, e.g., Frank and Schulze (2000); Schulze and Frank (2003); Alatas et al. (2009a); Alatas et al. (2009b); Barr and Serra (2009); Cameron et al. (2009); Armantier and Boly (2013); Banerjee (2016a); Banerjee (2016b); Guerra and Zhuravleva (2021). Abbink and Serra (2012) and Armantier and Boly (2012) provide summaries of the literature on lab experiments studying corruption. The game of Abbink et al. (2002) is also used by Abbink (2004); Abbink and Hennig-Schmidt (2006); Van Veldhuizen (2013).

⁴ Though it compares different participants, the work of Armantier and Boly (2013) shows evidence of the external validity of corruption experiments through their finding of similar treatment effects in the lab and the field in Burkina Faso and Canada. Additionally, Barr et al. (2009) relate corrupt behavior in their experiment to the experience of their population of interest, but the focus is on how different treatments alter corrupt behavior within the game, rather than relating it to external behavior. Banerjee (2016b) intentionally over-pays subjects in a corruption lab game and shows a slight positive correlation between failure to report the over-payment and in-game behavior. Related work on the external validity of behavior in the lab includes work on dishonesty (Dai et al., 2018; Hanna and Wang, 2017; List, 2009; Potters and Stoop, 2016; Rustagi and Kroell, 2022), and collective action (Beekman et al., 2014; Kosfeld and Rustagi, 2015).

and Kloeck-Jenson, 1999). The main authority is to resolve issues of land disputes, enforce justice, and be consulted before the implementation of rural development or aid programs in the community. While leaders are in theory tasked with the dual role of representing their communities and acting as authority figures for the state, the reality leans much closer to the latter (Buur et al., 2005). There is no systematic formal democratic process for electing local leaders in rural villages: the selection must be in accordance with the traditional rules of the respective community, and the state has the final say over the appointment (Buur et al., 2005).

Our study involves a representative set of communities in the province, each led by a local leader. We randomly selected 206 communities from the list of all 454 polling stations in the province, stratified on urban, semi-urban, and rural areas. Of the 206, 169 communities (80%) were located in rural areas. This sample was part of a larger field experiment on the provision of information about the discovery of natural gas in the province, with further details provided in Armand et al. (2020).⁵

Local leaders are clearly-identified in the community, thus we have a total of 206 participating leaders. In addition, selection of citizens to participate in the study was the product of physical random walks within the communities. In each house, heads of households were selected to participate. In each community, 10 individuals participated in the games, for a total of 2060 participating citizens. Panel A in Table 1 presents descriptive statistics for both citizens and leaders. The majority of citizens is male, with an average age of 46 years, with primary education only (65%), and of Muslim religion (56%). Leaders are predominantly male (98%), more educated and with more assets relative to citizens, and have been in power on average for 10 years. In terms of religion, the distribution among leaders is comparable to the one of citizens.

2. The corruption game

The game encompasses 11 participants, including 10 citizens and the local leader, but it can be easily adapted for any number of citizens ≥ 2 . The game script is provided in Appendix A. Each citizen receives an endowment of 10 tokens worth 10 Meticais (MT) each, for a total of 100 MT (US\$1.5). The total endowment corresponds to approximately two-thirds of daily income (INE, 2015b). Each citizen must choose how many tokens to send to the leader (which we refer to as a *bribe*), with the remaining units being kept for oneself (which we refer to as *private investment*). The leader's only action is to choose one citizen after observing the allocation chosen by all of them, without observing their identity.

In terms of payoffs, the leader keeps the bribes from *all* citizens, independent of which citizen they chose. Citizens not chosen by

⁵ Different variations of information provision were delivered after randomly allocating communities in three groups. In a *control group*, communities did not receive any information module. In a *leader treatment group*, the information module delivered to the leaders only, while in a *community treatment group*, the information module was provided to both the leaders and the local community. The behavioral measurements presented in Section 2 were conducted from August to November 2017, after the completion of interventions in Armand et al. (2020). While interventions were randomized and do not pose a threat to our analysis, we control for treatment indicators in all specifications including community characteristics as control variables (see Section 3.1).

⁶ Citizens deposited their bribes in small purses, which were brought to a separate enumerator who recorded them privately on a tablet. A software aggregated the information and the tablet was brought to the leader who was presented with the options in the form of an anonymous ordered list. When the leader selected an amount that was sent by multiple citizens, the software randomly selected one of them for payment. After citizens made their decisions, they were also asked for their incentivized belief about the size of the private investment that would be chosen by the leader.

the leader keep their private investment. In contrast, the citizen chosen by the leader receives a bonus of 300 MT (US\$4.5), but the entirety of their private investment accrues to the leader.⁶

The leader receives all units sent as bribes from all citizens, plus the private investment of the selected citizen. The dominant strategy of the leader is thus to choose the citizen who made the largest private investment. This format is analogous to a setting in which the leader is incentivized to select the most qualified entrepreneur. Knowing the leader's behavior, citizens' best responses are to send no bribes, and allocate their full endowment to their private investment. The simplicity of the game is intentional to guarantee understanding in contexts with low literacy.

The main theoretical feature of this game, characterized by a subgame-perfect Nash equilibrium (SPNE) in which no citizen gives any bribes, is shared by the game of Abbink et al. (2002). They present a neutrally-framed lab experiment resembling a modified trust game in which reciprocation is interpreted as returning the favor from a bribe. Our game is instead designed to capture group dynamics, while moving away from the trust game paradigm. Also related is the game of Gneezy et al. (2019), who study how bribes affect the judgment of individuals with discretionary power. In their experiment, two individuals compete to be selected by a referee, who, depending on the treatment, can either accept only the bribe of the individual they choose as the winner, or can accept both bribes and choose the winner at their discretion. An important difference with our design and this latter treatment is that leaders in our game are incentivized to always choose the lowest bribe, whereas referees in Gneezy et al. (2019) are financially indifferent, leading to multiple equilibria. Their focus on selfish versus reciprocal motives in corrupt decisions with anonymous populations is different from, but complementary, to our interest in studying potentially corrupt relationships among connected individuals.⁷

Our game uses neutral terminology, leaving it free of strong norms about socially appropriate behaviors.⁸ We use the terms *corrupt behavior* and *bribes* to help elucidate the mapping from game behavior to real community dynamics. An alternative interpretation of the game is one of rent-seeking, in which citizens seek to accrue rents from the leader by paying bribes rather than engaging in a productive activity. This distinction can get blurred because rent-seeking is sometimes referred to as a form of corruption (Rose-Ackerman, 1999). Previous experiments on rent-seeking have typically studied the contest model of Tullock (1980).⁹ Our game shares some similarities as citizens also compete to be chosen by the leader in rent-seeking games (Lambdsdorff, 2002). However, rather than an exogenous rule with expenditures monotonically increasing the probability of earning the fixed prize, it is the leader who has complete autonomy to allocate the prize. While both rent-seeking and corruption are typically assumed to generate deadweight losses, we excluded this feature from our design to minimize complexity. Following the results of Abbink et al. (2002), we hypothesized that deadweight losses would not significantly alter behavior.

While we conducted a one-shot version of the game with our participants, our interest is not purely with in-game decisions

⁷ In addition to the benefits of ruling out profit-maximization as a motive for engaging in corruption, a further methodological advantage over the game of Gneezy et al. (2019) is that we do not require the use of context-specific real effort tasks (such as writing jokes or tasting fruit). The simple and standard format of our game makes it easy to be conducted in various settings. See Appendix A.1 for game scripts.

⁸ Decisions in the game were described literally by either keeping the money or sending it to the leader. We confirmed during piloting that there were no negative associations with giving tokens to the leader.

⁹ In these experiments individuals tend to over-compete relative to the Nash prediction (Sheremeta, 2018). These games are rarely linked to corruption, and behavior appears to be driven by preferences for winning competitions or by bounded rationality (Lim et al., 2014).

Table 1
Descriptive statistics.

| | Mean | Std. dev. | 1st | Percentiles | N |
|---|--------|-----------|--------|-------------|------|
| | (1) | (2) | (3) | 99th (4) | (5) |
| A. Demographics | | | | | |
| <i>Citizens</i> | | | | | |
| Female | 0.28 | 0.45 | 0.00 | 1.00 | 2052 |
| Age | 45.94 | 15.71 | 20.00 | 85.00 | 2052 |
| Primary education | 0.65 | 0.48 | 0.00 | 1.00 | 2052 |
| Secondary or higher education | 0.12 | 0.33 | 0.00 | 1.00 | 2052 |
| Muslim | 0.56 | 0.50 | 0.00 | 1.00 | 2052 |
| Macua ethnic group | 0.63 | 0.48 | 0.00 | 1.00 | 2052 |
| Household members | 5.97 | 2.90 | 1.00 | 14.00 | 2052 |
| In monogamous relationship | 0.74 | 0.44 | 0.00 | 1.00 | 2052 |
| Wealth index | 0.28 | 0.14 | 0.07 | 0.60 | 2052 |
| Raven's test score | 5.01 | 2.36 | 0.00 | 10.00 | 2052 |
| <i>Leaders</i> | | | | | |
| Female | 0.02 | 0.15 | 0.00 | 1.00 | 206 |
| Age | 55.46 | 9.86 | 32.00 | 77.00 | 206 |
| Primary education | 0.75 | 0.43 | 0.00 | 1.00 | 206 |
| Secondary or higher education | 0.20 | 0.40 | 0.00 | 1.00 | 206 |
| Muslim | 0.58 | 0.49 | 0.00 | 1.00 | 206 |
| Macua ethnic group | 0.66 | 0.48 | 0.00 | 1.00 | 206 |
| Household members | 6.54 | 3.34 | 2.00 | 17.00 | 206 |
| In monogamous relationship | 0.78 | 0.42 | 0.00 | 1.00 | 206 |
| Wealth index | 0.39 | 0.13 | 0.13 | 0.67 | 206 |
| Number of years in power | 9.81 | 8.92 | 1.00 | 40.00 | 206 |
| B. Behavioral and survey attitudes | | | | | |
| <i>Citizens</i> | | | | | |
| Corruption game: bribe sent to leader | 4.22 | 2.49 | 0.00 | 10.00 | 2060 |
| Corruption game: payoff | 81.41 | 77.13 | 0.00 | 310.00 | 2060 |
| Accommodates bribes | 0.21 | 0.41 | 0.00 | 1.00 | 2042 |
| Amount sent in trust game | 4.15 | 2.26 | 0.00 | 10.00 | 2060 |
| High trust in leaders | 0.63 | 0.48 | 0.00 | 1.00 | 2052 |
| <i>Leaders</i> | | | | | |
| Corruption game: bribe chosen by leader | 2.60 | 2.62 | 0.00 | 10.00 | 206 |
| Corruption game: payoff | 496.31 | 124.83 | 230.00 | 820.00 | 206 |
| Appropriation | 0.27 | 0.29 | 0.00 | 1.00 | 205 |
| Share returned in trust game | 0.37 | 0.16 | 0.00 | 0.84 | 206 |
| Accountability | 1.51 | 0.76 | 0.00 | 2.00 | 205 |
| Accommodates bribes | 0.14 | 0.35 | 0.00 | 1.00 | 206 |

Note. Summary statistics of demographic, as well as behavioral and survey attitudes for citizens and leaders. Demographics are obtained from surveys. There are 8 cases for which we do not have survey data for the participants in the games. Variables for citizens' demographics present missing values ranging from 0 to 0.7% of observations, depending on the variable. For these variables, we impute missing values with the median value in the community. The wealth index is computed as the average of 15 indicator variables for whether the household owns a radio, a television, a bicycle, a motorbike, a car, a fishing boat, a fishing net, an electric or gas oven, an oven for bread, a typical coal oven, a fridge, a bed, a table, a cell phone, and a watch. The index is rescaled to be between 0 (lowest) and 1 (highest). Behavioral and survey attitudes are defined as follows: *bribe sent to the leader* and *payoff* are the number of tokens sent by the citizen to the leader in the corruption game and the citizen's final payoff; *accommodates bribes* is a survey measure defined as an indicator variable equal to 1 if the respondent (the citizen or the leader) reports agreeing that the best way to overcome problems is to pay bribes, and 0 otherwise; *amount sent in trust game* is the amount sent by the citizen to the leader in the trust game; *high trust in leaders* is a survey measure defined as an indicator variable equal to 1 if the citizen reports trusting the leaders in their community "a lot" (highest of four options), and 0 otherwise; *bribe chosen by the leader* and *payoff* are the number of tokens sent by the citizen that is chosen by the leader in the corruption game and the leader's final payoff; *appropriation* is the proportion of community funds that is observed as being appropriated by the leader in the incentivized structured community activity; *share returned in the trust game* is the proportion returned by the leader in the trust game; *accountability* is a survey measure indicating whether the leader reports agreeing that the community supports accountability and takes values 0 (disagree), 1 (neither agree nor disagree), and 2 (agree). Details about the games and the variables are provided in Section 2. The scripts of the games are provided in Appendix A.

per se, but relates to how these decisions reflect the real dynamics between citizens and leaders. Due to the leader's central authority in their community, they are involved in many interactions with ordinary citizens. If citizens and leaders view the game as being similar to real life interactions, they may approach the game with the mentality that these interactions are repeated (Cardenas et al., 2005). In repeated interactions leaders may wish to cultivate a reputation of corruptibility using the language of Ryvkin and Serra (2012). Leaders are able to increase their long-term earnings through a culture of corruption, which more than offsets the immediate losses from selecting less productive citizens. Therefore, in the infinitely repeated version of the game, there are multiple equilibria with corruption (see Appendix B.1 for a discussion). For example, there exists an equilibrium in which three citizens send maximum bribes of 100 MT each, while all other citizens send zero. Assuming the leader's strategy is to reward whoever sends

the largest bribe, then each of these citizens receives an expected payoff of 100 MT, with the non-corrupt citizens also receiving their private investment of 100 MT. The leader thus earns a per-period payoff of 300 MT. By cultivating a reputation of corruption in repeated interactions, the leader earns three times their static equilibrium payoff (the theoretical upper-bound), while citizens earn five-sixths of their analogous static expected payoff of 120 MT (Appendix B.1). Total welfare is identical, but the distribution is substantially more unequal in the equilibrium with corruption. Relating private investments to productive activities, the citizens being selected are no longer the most qualified.

2.1. Additional measurements

We supplement information about behavior in the corruption game with additional survey and behavioral measurements, sum-

marized in this section. Additional information about these measurements can be found in Armand et al. (2020). Panel B in Table 1 presents descriptive statistics for these variables.

Survey measures. We have available survey measures about citizens, leaders, and the community. These were collected in three separate questionnaires. The household questionnaire was answered by the household head and included questions on the demographic traits of the respondent and his/her household, trust, public goods provision, assets, exposure to crime, as well as a Raven's test to proxy cognitive ability. The leader questionnaire had a similar structure. The community survey was completed by an individual (or group) which was knowledgeable about the community. For citizens, the main variables of interest are the self-reported attitudes in favor of bribes and trust in leaders. For leaders, the main variable of interest is on their views about whether accountability is supported by community.¹⁰

Behavioral measurements. We implemented a real-life behavioral measurement of the leader's corruption, often classified as a structured community activity (Casey et al., 2012). We observed whether leaders appropriated funds that had been set aside to cover refreshments and snacks for their citizens. Leaders were privately given 400 MT (US\$6) and asked to purchase refreshments and snacks for community meetings. The size of these meetings was fixed across villages. Quantities and types of food items purchased were observed and recorded by enumerators during the meetings, and the cost of each item was inquired at the nearest store. Of the 400 MT, we observe actual expenditure by leaders, with the remainder recorded as *appropriation*. The vast majority of leaders (80%) appropriated a strictly positive amount of funds, while 14% were recorded as spending the exact amount.¹¹ Overall, appropriation was 27% on average, with 9% of leaders appropriating the full value. The remaining leaders who appropriated a positive amount typically did so by buying lower quantities of goods, noting that there was little variation in the price of goods across villages.

In addition, we conducted a variant of the classic trust game (Berg et al., 1995) between leaders and citizens. The trust game involved the same participants as in the corruption game. Each citizen received an endowment of 100 MT in the form of 10 tokens worth 10 MT each; leaders did not receive any endowment. Citizens had to decide to keep this income for themselves or send a portion to the leader. The funds sent to the leader were tripled and the leader had to decide how much to give back to the citizens. For the leader's decision, we used the strategy method: for every possible positive amount sent from 1 to 10 tokens (which became 3 to 30), the leader was asked how much he/she would like to send back. This was used to implement the outcome for each citizen, while the leader was paid for one random citizen's decision. The main variable of interest for citizens is the amount sent, while for leaders it is the share returned (averaged across the 10 conditional responses).¹² The average citizen gave 4.15 out of 10 tokens, while leaders returned on average 4.66 tokens (37%) when faced with a citizen who gave 4.15 (becoming 12.45) tokens.

¹⁰ For attitudes in favor of bribes, the survey question reads as follows: "Do you agree that the best way to overcome problems is to pay bribes?". For trust in leaders, the survey question reads as follows: "How much do you trust the leader in your village?". The survey question asked to measure accountability among leaders reads as follows: "Do you agree that the community in your village supports accountability for your decisions as leader?".

¹¹ Six percent of leaders were recorded as spending more than the amount they were given, with a median amount over-spent of 10%. We re-coded these values as zero. Our results are robust to this transformation.

¹² We conducted three behavioral games with citizens: the corruption game, the trust game, and the public goods game. The order was randomized; results are robust to controlling for order. Outcomes were not revealed until after all games had been conducted. We do not focus on the public goods game because it does not involve the leader.

3. Results

In the corruption game, citizens sent on average 4.22 tokens as bribes to the leader (Panel B in Table 1). This substantially deviates from the prediction of zero corruption. Compared to the trust game, which involves similar dynamics and equilibrium predictions but does not involve competition among participants, citizens send slightly more tokens in the corruption game. Leaders' behavior is instead closer to the SPNE prediction: on average, leaders select a citizen who sent a bribe of 2.60 tokens. Consistent with these behaviors, leaders payoffs are extremely high (496 MT or US \$7.5). In contrast, unlike giving in the trust game, bribery in the corruption game is a losing proposition. Citizens earned on average 81 MT (US\$1.2), significantly less than their endowment of 100 MT.¹³ Leaders earn *five times* their one-shot theoretically predicted payoff, while citizens earn less than two-thirds of theirs. If we consider the leader's maximum equilibrium payoff in case the game were infinitely repeated, the leader still earns 67% more than the theoretical upper bound of 300 MT.

Fig. 1 presents the behavior in the corruption game in more detail by looking at distributions. Denoting the size of the bribe sent by a citizen to the leader as $b \in [0, 10]$, just under 9% of citizens send the predicted amount of $b = 0$ (highlighted by darker shading in Panel A). In contrast, 30% of leaders chose a citizen who sent $b = 0$. This underestimates the number of leaders choosing the SPNE action, as some leaders may not have had the option to choose it if no citizen sent $b = 0$. This situation happened in 50% of the communities. In total, 61% of leaders chose the SPNE action by selecting the minimum bribe available (highlighted by darker shading in Panel B), while 39% of leaders go against their direct material interest.

Citizens tend to overestimate the likelihood that leaders will choose individuals who send positive bribes and/or underestimate the extent of bribery by others. To verify this result, we examine (incentivized) data on beliefs about the level of the bribe the leader would choose. The vast majority of citizens projected that intermediate levels of tokens would be selected by the leader: the average belief is 4.6 tokens, similar to the average bribe sent. Only 13% of citizens selected one of the extremes of 0 or 10.

3.1. Citizens' and leaders' behavior inside and outside the lab

Within the game, corruption depends on both citizens' willingness to engage in corruption by sending bribes, and leaders' willingness to engage in and reward corruption. We first assess the aggregate relationship between behavior in the corruption game and two key measures of leaders' preferences: corrupt behavior, as measured by appropriation, and trust game reciprocation. Fig. 2 shows (unconditional) non-linear relationships between citizens' and leaders' behavior in the corruption game and leaders' appropriation outside the game (Panel A), and between citizens' and leaders' behavior in the corruption game and leader's reciprocation in the trust game (Panel B). This provides a first step to understanding who engages in corruption and whether bribery in the corruption game arises for all leaders or only for leaders at the extremes of both corrupt behavior and reciprocation in the trust game.

We observe a positive association between corruption game behavior and leaders' appropriation and reciprocity; this is true for the corruption game behavior of both citizens and leaders. In terms of appropriation, behavior in the corruption game by both

¹³ Potential payoffs ranged from 0 to 310. Beyond the maximum payoff of the game of 300 MT, a bonus of 10 MT could be earned if the citizen had correct beliefs about the leader's decision. See Appendix A for the scripts.

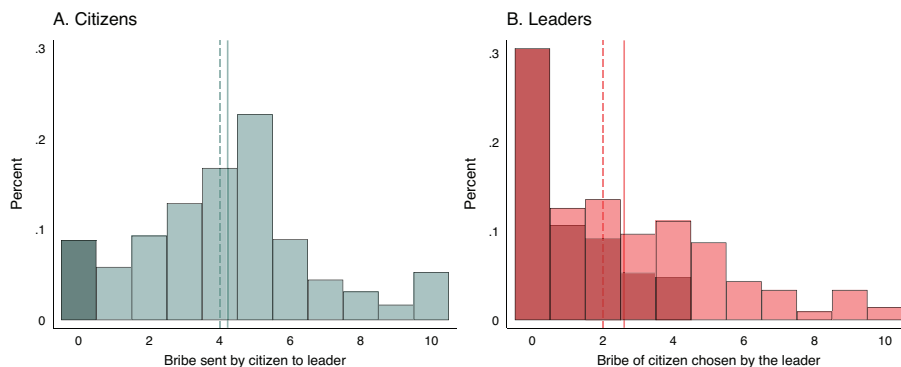


Fig. 1. Bribery in the corruption game. *Note.* Panel A shows the distribution of the number of tokens sent by citizens to the leader as bribe ($N = 2060$). Panel B shows the distribution of the number of tokens sent by citizens as bribes restricting to individuals chosen by leaders ($N = 206$). The share choosing the SPNE actions is reported with darker shading. The vertical lines indicate the sample mean (solid line) and the median (dashed line). Details about the game are provided in Section 2. The scripts are provided in Appendix A.1.

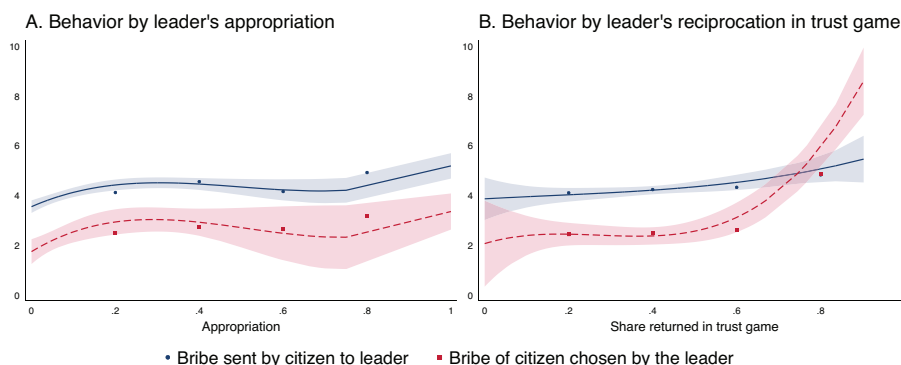


Fig. 2. Behavior in the corruption game, by leaders' corrupt behavior and reciprocation. *Note.* Panel A shows a cubic fit between citizen's and leader's behavior in the corruption game and appropriation, i.e., the proportion of community funds that is observed as being appropriated by the leader in the incentivized structured community activity. Panel B shows a cubic fit between citizen's and leader's behavior in the corruption game and the share returned by the leader in the trust game. *Bribe sent by citizen to leader* is the number of tokens sent by citizens to the leader as bribe in the corruption game, ranging from 0 (citizen gave no bribe) to a maximum of 10. *Bribe of citizen chosen by the leader* is the number of tokens sent by citizens as bribes restricting to individuals chosen by leaders, ranging from 0 (citizen chosen gave no bribe) to a maximum of 10. Details about the game are provided in Section 2. Confidence intervals are built assuming a 90% confidence level and assuming standard errors clustered at the community level in Panel A and robust standard errors in Panel B. Point and squares are averages of the corresponding variables computed in equally spaced intervals of the horizontal axis.

citizens and leaders is relatively flat in the central part of the distribution, while it is steeper at the extremes. Bribery in the corruption game tends to be smaller for leaders that appropriate little, and much larger for leaders that appropriate most of the funds. While the relationship between bribery by citizens is linear in the leader's reciprocation in the trust game, the relationship between the bribe chosen by the leader and its reciprocation is mainly driven by leaders who return a very large share in the trust game.

To delve deeper into these relationships, Table 2 presents OLS regressions of the bribe sent by the citizen to the leader on attitudes and behavior gathered outside the game. We refer to measures of citizens' attitudes and behavior outside the game as *citizen variables*, and to measures of leaders' attitudes and behavior outside the game as *leader variables*.

Column (1) presents a specification without controls, column (2) adds controls for citizens' characteristics, and column (3) adds controls for leaders' characteristics. Citizens' and leaders' characteristics include gender, age, education, religion, ethnicity, household size, marital status and wealth. Citizens' controls also include a measure of cognitive ability proxied by the Raven's test score (Raven, 1936). Leaders' controls also include the leaders' time in power. Column (4) adds controls for community characteristics, which include an infrastructure index, a natural resource index,

community size (measured by the number of tables in the polling station), district fixed effects, and indicator variables for the treatment groups and the randomization strata studied in Armand et al. (2020). Finally, column (5) introduces community fixed effects, which absorb the leader variables. Results are robust to a wide variety of alternative specifications (Appendix B.2), and to conditioning on the aforementioned treatment groups (Appendix B.3).

Regarding the determinants of citizen bribery in the corruption game, contrary to expectations, citizens' accommodating attitudes toward paying bribes are not associated with bribery in the game. On the contrary, trust game giving is positively associated with sending bribes, significant at the 1% level. The magnitude is large: every additional token sent by citizens to their leaders in the trust game being associated with approximately one-third of an additional token given in bribes. The same is not true for the survey measure of trust (Section 3.2).¹⁴

¹⁴ Incentivized and survey measures of trust are positively related, but this relationship is only marginally significant (Appendix B.4). Most demographic variables are not significantly related to bribe decisions (Appendix B.5). An exception is gender: female citizens are more likely to send bribes (significant at the 10% level). In addition, we do not find a significant relationship between citizens' trust in their leader and their own willingness to accommodate bribes. Appendix B.6 investigates heterogeneous effects by citizens' degree of connectedness to the leader, as well as whether the leader is established or not.

Table 2
Behavior in the corruption game.

| | Dep. variable: bribe sent by citizen to leader | | | | |
|------------------------------|--|---------------------|---------------------|---------------------|---------------------|
| | (1) | (2) | (3) | (4) | (5) |
| A. Citizen variables | | | | | |
| Accommodates bribes | -0.054 (0.135) | -0.032 (0.139) | -0.038 (0.140) | -0.017 (0.131) | 0.057 (0.147) |
| Amount sent in trust game | 0.324*** (0.032) | 0.321*** (0.031) | 0.316*** (0.032) | 0.303*** (0.032) | 0.257*** (0.036) |
| High trust in leaders | -0.048 (0.106) | -0.010 (0.108) | 0.005 (0.107) | 0.016 (0.111) | -0.073 (0.116) |
| B. Leader variables | | | | | |
| Appropriation | 0.990*** (0.276) | 0.911*** (0.275) | 0.897*** (0.269) | 0.820*** (0.305) | |
| Share returned in trust game | 1.149** (0.512) | 0.986* (0.503) | 0.859* (0.507) | 0.869* (0.494) | |
| Accountability | -0.268** (0.110) | -0.258** (0.105) | -0.275** (0.110) | -0.237** (0.106) | |
| Observations | 2022 | 2022 | 2022 | 2022 | 2022 |
| R ² | 0.131 | 0.139 | 0.149 | 0.163 | 0.320 |
| Citizen controls | - | Yes | Yes | Yes | Yes |
| Leader controls | - | - | Yes | Yes | - |
| Community controls | - | - | - | Yes | - |
| Community fixed effects | - | - | - | - | Yes |

Note. Results based on OLS regressions at citizen level. Statistical significance at * 0.1; ** 0.05; *** 0.01. Standard errors clustered at community level. The dependent variable is the number of tokens sent by the citizen to the leader as bribe in the corruption game, ranging from 0 (citizen gave no bribe) to a maximum of 10. Details about the game and the variables are provided in Section 2. In Panel A, *citizen variables* refer to independent variables pertaining to citizen behavior or survey measures and are defined as follows: *accommodates bribes* is a survey measure defined as an indicator variable equal to 1 if the citizen reports agreeing that the best way to overcome problems is to pay bribes, and 0 otherwise; *amount sent in trust game* is the amount sent by the citizen to the leader in the trust game; *high trust in leaders* is a survey measure defined as an indicator variable equal to 1 if the citizen reports trusting leaders “a lot” (highest of four options), and 0 otherwise. In Panel B, *leader variables* refer to independent variables pertaining to leader behavior or survey measures and are defined as follows: *appropriation* is the proportion of community funds that is observed as being appropriated by the leader in the incentivized structured community activity; *share returned in the trust game* is the proportion returned by the leader in the trust game; *accountability* is a survey measure indicating whether the leader reports agreeing that the community supports accountability and takes values 0 (disagree), 1 (neither agree nor disagree), and 2 (agree). Further details on citizen and leader variables can be found in Section 2.1, while the full list of controls is provided in Section 3.1. The number of observations differs from the total number of participants in the corruption game ($N = 2060$) due to missing data in the independent variables.

While focusing on how leaders’ attitudes and behavior outside the game affect citizens’ bribe decisions in the game, we observe three main results. First, citizen bribery in the game is associated with the extent to which leaders engage in actual corruption. Leaders’ appropriation of community funds is positive and significantly associated with citizen bribery. Column (4) shows that moving from no to full appropriation increases the bribe by 0.820, which corresponds to an increase of 19% as compared to the average bribe size.¹⁵ This suggests that citizens are, on average, able to perceive how corrupt their leaders are, and consequently send more bribes to more corrupt leaders. Second, citizen bribery in the game is associated with trust game behavior of leaders: citizens send significantly more bribes to leaders who return more in the trust game, suggesting that expectation of reciprocation (trustworthiness) is an important factor in bribery decisions. The magnitude is comparable to the effect of the proportion appropriated. Third, citizens send significantly fewer bribes to leaders who believe accountability is supported by their community.

While we showed that citizens condition their bribe sending behavior on leaders’ characteristics, we now ask whether these characteristics analogously predict leaders’ choices. In our setting, this analysis is more complex, owing to the fact that the choice set of leaders is determined by the citizens themselves. As citizens send more bribes to more corrupt leaders, this raises an issue for identification in the case of leader behavior in the game. We treat this analysis as more exploratory, and present the corresponding regressions in Appendix B.8.

Appendix Table B7 presents village-level regressions using the bribe chosen by the leader as dependent variable and leader vari-

ables as independent variables, including alternative sets of control variables. We find significant relationships between leaders’ bribe choice and leader appropriation, trust game behavior, and accountability attitudes – analogous to those in Table 2. Given the concern that these relationships may be endogenous to the options presented by citizens, Appendix B.8 further discusses specifications that restrict the sample to the subset of leaders who selected an intermediate bribe (suggestive that the bribe chosen reflected these leaders’ preferences). Though exploratory, these specifications suggest that leaders’ characteristics may similarly influence both citizen and leader choices.¹⁶

3.2. Trust and corruption

The previous findings highlight a relationship between corrupt behavior and trust game behavior, for both citizens and leaders. Appendix B.9 summarizes behavior in the trust game and shows that citizens’ behavior predicts their leaders’ corruption. This relationship can have potential consequences in the communities, as corruption is associated with higher crime and lower public good provision (Appendix B.10). This suggests that trust games in certain contexts may involve a “dark-side” which could enable corrupt transactions. While corrupt behavior is widely perceived as harmful for development, trust is often viewed as enhancing investment and growth (Zak and Knack, 2001). Paradoxically, cor-

¹⁶ In an alternative approach, we study whether the bribe selected by the leader depends on the bribe sent by the citizens, and how this relationship differs depending on the leader’s characteristics. We estimate specifications in which we use a dummy variable for whether the bribe sent by the citizen is selected by the leader as dependent variable, and the bribe sent by citizen interacted with leader characteristics as independent variables. Appendix Table B9 shows that, conditional on community fixed effects, the bribe sent by the citizen is significant, but among interaction terms, only the interaction with the share returned by the leader in the trust game is significantly different from zero.

¹⁵ In Appendix B.7 we show that conditioning regressions on self-reported leader’s attitudes towards corruption does not alter the results. There, we further include an investigation of potential alternative relationships with available secondary measures of corruption.

rupt acts can require a high degree of reciprocal affect-based trust (Rose-Ackerman, 2001; Finan and Schechter, 2012). Previous literature has studied the relationship between trust and corruption, noting both that political corruption can decrease trust (Anderson and Tverdova, 2003), and low generalized trust may enable corruption (Uslaner, 2005). While Finan and Schechter (2012) show that politicians broadly target reciprocal voters in vote-buying, we find that citizens send more bribes to specific leaders who are more reciprocal.

By contrast, we do not find any significant association using the self-reported measure of trust in leaders, which holds true whether or not we control for trust game behavior (Appendix B.2). Behavior in the corruption game is also more robustly associated with leaders' appropriation as compared with trust game behavior. Citizens send significantly more in the trust game to leaders that appropriate more outside the game and have more corrupt attitudes (Appendix Table B10). These associations are diminished by conditioning on behavior in the corruption game, while they continue to be significant for leaders' appropriation. These results are in line with the literature highlighting differences between survey and incentivized measures of trust. Survey measures might be capturing different dimensions of trust, such as "trustworthiness" or expectations about others' behavior (Glaeser et al., 2000; Sapienza et al., 2013), while sender behavior in the trust game may also be motivated by other considerations, such as risk-aversion or altruism (Cox, 2004; Schechter, 2007).

4. Conclusion

This paper introduces a novel corruption game in a setting in which citizens play with their actual political leaders. The game is simple to implement and understand: the SPNE predicts that there will be no corruption in any one-shot game. However, this prediction is not borne out in the data. In addition, citizens' bribery in the game is strongly predicted by their leader's corrupt behavior, measured by a behavioral observation of appropriation of community funds. Most importantly, beyond the variation we document in leaders' propensity to engage in corrupt behavior, is our key result that citizens are correctly able to anticipate it within the context of the game. The resulting outcome is a large transfer of wealth from citizens to their leaders, with leaders earning five-times their equilibrium predicted payoff.

We also record a novel important relationship between one dimension of trust and corruption, suggesting that the type of reciprocity measured by the trust game can also enable corruption. This finding also highlights a potential warning for social scientists using trust games. Because survey measures of trust are not positively associated with corruption, diversifying the measurement of trust can address these concerns. While the literature on trust has typically focused on its positive benefits, our results suggest that they may also capture corrupt relationships.

Sensitive measures of corrupt behavior by leaders can be captured through simple and appropriately designed lab-in-the-field games. This is critical for measuring and understanding corruption at the local level, particularly in areas with low levels of transparency and less developed institutions, where traditional survey methods may fundamentally suffer from reporting bias. While we highlight negative associations between corruption and community outcomes, the extent to which such corruption is harmful for local development remains an important unanswered question.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.jpubeco.2022.104799>.

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