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ORIGINAL ARTICLE

Transparency, wages, and the separation of powers: An experimental analysis of corruption

Omar Azfar · William Robert Nelson Jr

Abstract We conducted an experimental analysis of the causes of corruption, varying the ease of hiding corrupt gains, officials' wages, and the method of choosing the law enforcement officer. Voters rarely re-elect chief executives found to be corrupt and tend to choose presidents who had good luck. Directly elected law enforcement officers work more vigilantly at exposing corruption than those who are appointed. Increasing government wages and increasing the difficulty of hiding corrupt gains both reduce corruption.

1 Introduction

Corruption has taken center stage in the study of developing, and increasingly, developed economies. Numerous accounts show that corruption discourages investment, retards growth, distorts expenditure priorities, encourages protectionism, and undermines service delivery. Today corruption is thought by many to be the primary cause of underdevelopment.[1]

Work on the causes of corruption suggests that democracy, culture, and wealth all influence the amount of corruption (Treisman, 2000). However, studies of the institutional causes of corruption have been limited by the fact that the relevant institutions vary mostly across countries.

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[1] Shleifer and Vishny (1993) provide the classic theoretical discussion of how corruption undermines economic activity. Mauro (1995) and Knack and Keefer (1995) offer empirical accounts of the cross-country relationship between corruption and growth. The literature on corruption is reviewed by Bardhan (1997) and Azfar (2002a).

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Cross-country regressions thus suffer from omitted variable bias, simultaneity bias, and selection bias. Also, there may not be enough institutional variation across countries to examine some interesting hypotheses. Thus, the existing literature provides insufficient guidance to prospective reformers. We hope that in some small way our experimental results will help guide reformers where real world data have been unable to demonstrate clear causal patterns.

Our approach, following Klitgaard (Klitgaard, 1988; Klitgaard, Maclean-Abarora, & Parris, 2000) is to regard corruption as a crime of calculation, not passion. Accordingly, the incidence of corruption will be predicted by the economic theory of crime developed by Gary Becker, Isaac Ehrlich, and others (some classic references are Becker, 1968; Ehrlich, 1973; Ehrlich & Becker, 1972). Corruption should depend on the probabilistic costs and benefits of being corrupt.

In this paper, corruption is defined as "the abuse of office for personal gain" in which an official (the agent), who is difficult for the principal to monitor, engages in some sort of malfeasance for personal enrichment (Klitgaard, Maclean-Abarora, & Parris, 2000; Bardhan, 1997).

Klitgaard defines the institutional conditions under which corruption will exist as follows:

"Corruption = Discretion + Monopoly – Accountability."

Our focus is on the last term – accountability. Accountability consists of the costs and probabilities of being caught, both of which we vary experimentally. The cost of being caught rises with the benefits of being in office. Therefore, higher wages should discourage corruption. The probability of being caught is likely to depend both on the ease of detecting corruption (transparency) and on the incentives faced by the law enforcement officer (separation of powers). Thus, we deconstruct accountability into transparency, wages, and the separation of powers.

Our salient findings are:

1. Voters are unlikely to re-elect executives found to be corrupt.
2. Increasing government wages reduces corruption.
3. Increasing the difficulty of hiding corrupt gains decreases corruption.
4. Directly elected attorneys general work more vigilantly at exposing corruption than do appointed attorneys general.

Each of these findings has important real world parallels and implications.

The paper is organized is the following way. Section 2 explains the Experimental Design and Section 3 introduces the Results. Section 4 is the Discussion of results and real world parallels and Section 5 is the Conclusion.

2 Experimental design

2.1 The game

We designed the corruption game ("the game") so that incentives faced by the players mimic those facing voters, attorneys general, and executives in the real world. The game involves eight players who at different times may play the role of voters, attorneys general, and executives. The basic idea of the game is the following. An executive is determined by popular vote. The attorney general is either appointed by the executive or selected in a separate, simultaneous election. The executive rolls a die to see how many valuable tiles he receives. The executive chooses how many valuable tiles to keep for himself and how many to distribute to the voters. The attorney general then may attempt to expose to the voters valuable tiles that the executive kept for himself rather than distributing them to the voters.

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Finally, the executive stands for reelection. The written instructions that were given to the participants are presented in Appendix A. The visual instructions are in Appendix B.

Three treatment variables are used to test the effects of accountability on corruption.

1. The attorney general is either elected or appointed.
2. The wages of the executive and the attorney general are either high or low.
3. The difficulty of hiding corruption is low, moderate or high.

The experiment proceeds as follows. Candidates are assigned participant numbers from 1 to 8. The game begins when three of the eight participants are selected to be candidates for executive according to three rolls of an eight-sided die. (In the elected attorney general treatment the same three are candidates for attorney general.) The die is rolled until three different participants' numbers come up. These three are the candidates. The other five players are voters.

Each candidate gives a 15-second campaign speech. The speeches are given in the order that the candidates' numbers were rolled. The speeches were included in the design to provide something on which the voters could base their votes. The speeches allowed the candidates to state what they planned to do if elected. The talk was not entirely "cheap" because the games involve multiple rounds and some of the participants' choices were at least partially verifiable. For example, the number of tiles turned by an attorney general became known to all. Thus candidates could establish a reputation for being trustworthy.

After the speeches, voters each cast a secret ballot by writing the number(s) of the participant(s) they want to be executive (and possibly attorney general) on a piece of paper. The ballots are collected, the votes are tallied, and the winner(s) are announced. Ties are broken by the roll of a six-sided die, with each player having been assigned three numbers. The executive sits at the head of the table and unconditionally earns $30 in the low-wage treatment and $60 in the high-wage treatment. In the appointment version, the executive selects any of the other seven players to be her attorney general. In the elected attorney general version, voters simultaneously vote for both the executive and the attorney general. The winner of the executive election is the executive and the winner of the attorney general election is the attorney general. If the same candidate wins both elections, she becomes the executive and the runner up in the attorney general election becomes the attorney general.

The executive then rolls a six-sided die and receives the same number of valuable tiles as the number rolled. (The randomness of the roll is comparable to randomness of business cycles over which an executive has incomplete if any control. Whether the economy is in an expansion or recession affects the amount of money the executive has available to allocate.) These valuable tiles are mixed with the appropriate number of worthless tiles to total 10, 14, or 22 (The number of total tiles determines the difficulty of exposing corruption.). All tiles are placed face up in a box that only the executive can see into. The executive has full information regarding his tiles but no other players know the executive's roll. The executive decides how many valuable tiles to keep and how many to distribute to the voters. (The losing candidate[s] earn money in the same way as the voters and is referred to as a voter[s] in payment contexts.) The executive makes her allocation decision by stacking the six tiles she wants distributed to the six voters. The experimenter, without allowing the other players to see tiles' identities, then places the six stacked tiles into an opaque bag. The voters do not know how many valuable tiles are in the bag or have been kept by the president.

Before the voters draw tiles from the bag, the attorney general can expose corruption by selecting tiles held by the executive, making their identity known to all. The attorney general can sequentially select up to four tiles, and can observe whether each selected tile is valuable or blank before deciding whether he wants to flip over another tile. The attorney general can flip the first two tiles at no charge. The third tile flipped costs the attorney general $5 and the

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fourth costs $10. The attorney general receives $20 in the low-wage and $40 in the high-wage version. All money remaining, after turning all desired tiles, is the attorney general's earnings for the round (i.e., if he decides to flip over 3 tiles in the low wage version, his earnings are $20 − $5 = $15).

Each valuable tile that is distributed to the voters is worth $30 to the voter that draws it from the bag. Each valuable tile that the executive keeps, but that the attorney general does not expose, is worth $15 to the president. If exposed, a tile is worth nothing. Accordingly, corruption causes a dead weight loss of 50 percent if not exposed and 100 percent if exposed.

After the attorney general has turned all desired tiles, the bag containing the tiles that the executive allocated to the voters is carried around. Each voter blindly draws a tile from the bag. Each voter learns the identity of the tile personally drawn, but voters are not told the identities of the tiles drawn by other voters. Some information is probably communicated though voters' reactions to their draw. But, even if all the drawn tiles' identities become public knowledge, the voters' knowledge of an executive's probity increases with the number of tiles turned by the attorney general, as revenues are stochastic.[2]

After voters finish drawing tiles, that round is finished and the next round begins. The executive and attorney general are automatically candidates. The third candidate is selected by rolling a six-sided die and counting off the rolled number clockwise from the executive. The three candidates give 15-second presentations in this order: previous round's executive, previous round's attorney general, and randomly selected candidate. Voters then cast their ballots. After six rounds of the first game are completed, the executive and attorney general are not automatically candidates in the first round of the second game. Rather, three candidates are randomly chosen using an eight sided die as in the first game.

By backwards induction, a Nash equilibrium of the game is for the executive to keep all the valuable tiles, for the attorney general to not expend any money turning tiles, and for the voters to vote in whatever way minimizes personal effort. So long as the game has a known endpoint this equilibrium does not vary with the number of rounds the game is played. In equilibrium, in the appointment game the choice of attorney general is also irrelevant, for all attorneys general will play the same strategy.

2.2 The experiment

Four sessions were run with each of the following total number of tiles – 10, 14, and 22. During each session participants played two six-round corruption games. Sessions with each number of tiles varied according to the wage rate and whether the appointed or elected attorney general game was played first (see Table 1). The wage rate did not change intra-session. Inter-session, the wage rate was changed in the instructions, so participants were not made aware that wage rates varied among the sessions. Whether the appointment or election game was played first could have affected behavior, so sessions were arranged to control for this possibility. For each number of blank tiles, there were four session formations: low-wage elected attorney general first, low-wage appointed attorney general first, high-wage elected attorney general first, and high-wage appointed attorney general first. The order in which these four session variations were run varied across the sessions with different numbers of tiles. The first four sessions involved 10 tiles, the second four sessions 14 tiles, and the third four sessions 22 tiles. Sessions were run with an ascending numbers of tiles, because we did

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[2]The one exception is if the executive rolls a six and distributes all six tiles. If this information becomes public, probity is assured.

Table 1 Experimental variations wages and tiles only vary inter-session; election and appointment vary intra-session

	10 tiles	14 tiles	22 tiles
Low wage			
Executive = $40	Elected first, then appointed	Elected first, then appointed	Elected first, then appointed
AG = $20,	Appointed first, then elected	Appointed first, then elected	Appointed first, then elected
High wage			
Executive = $60	Elected first, then appointed	Elected first, then appointed	Elected first, then appointed
AG = $40	Appointed first, then elected	Appointed first, then elected	Appointed first, then elected

Table 2 Summary statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Experimental variations					
Tiles for hiding take	144	9.33	5.00	4	16
Attorney general directly elected	144	0.5	0.501	0	1
Wage	144	0.5	0.501	0	1
Idiosyncratic variations and dependent variables					
Revenue (dice roll)	144	3.631	1.611	1	6
Re-elect executive	144	0.319	0.467	0	1
Attorney general's vigilance (tiles flipped over)	144	2.625	0.967	0	4
Executive corruption (valuable tiles kept by executive)	144	0.458	0.974	0	6
Demographic variables					
Gender N = group size * #sessions = 96	96	0.578	0.497	0	1
Major N = group size * #sessions = 96	96	0.343	0.476	0	1
Nationality N = group size * #sessions = 96	96	0.677	0.475	0	1
Executive's gender	144	0.520	0.497	0	1
Executive's major (Economics = 1)	144	0.388	0.489	0	1
Executive's nationality (US = 1)	144	0.729	0.445	0	1
Attorney general's gender	144	0.555	0.498	0	1
Attorney general's major (Econ = 1)	144	0.354	0.479	0	1
Attorney general's nationality (US = 1)	144	0.666	0.473	0	1

Executive corruption (valuable tiles kept by executive: means)			
	10 tiles	14 tiles	22 tiles
Low wages	0.208	0.541	1.125
High wages	0.250	0.291	0.333

Attorney general's vigilance (tiles flipped over: means)			
	10 tiles	14 tiles	22 tiles
Low wages	2.41	3.16	2.54
High wages	2.25	2.79	2.58

not know how many tiles should be used before running the experiment. Our results are only meaningful if the executives (at least occasionally) act corruptly and if the attorneys general (at least occasionally) monitor. We increased the number of tiles to get a significant amount of corruption. Theory predicts that corruption will correlate with the number of tiles, as we found that it did (see Table 2).

As previously stated, each session consisted of two six-round corruption games. Performance-based pay was based on participants' earnings in one of these twelve rounds. This pay round was randomly and openly determined in front of the participants by first

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flipping a coin to choose which game (appointed or elected attorney general), and then rolling a six-sided die to choose the round. Participants were paid based on a randomly selected round rather than cumulative earnings to minimize income effects. Of course, participants were aware that performance-based earnings would be determined in this manner. Payments were calculated and placed in envelopes as the participants filled out three forms: a receipt verifying payment, a demographic questionnaire, and a list of general questions regarding the experiment.

3 Results

We ran 12 sessions, with 8 players in each; thus 96 people participated in the experiment. All participants were University at Buffalo undergraduate students. Each received $5 for arriving on time and on average they earned approximately $25 more in performance based pay. All payments were made at the end of the session. Sessions lasted just under two hours. Participants were from a variety of majors, including but not limited to business, economics, pharmacy, psychology, and engineering. Participants were solicited and scheduled via email.

Tables 2 and 3 contain the means and the distributions of the various response categories. Our participants re-elected the executive about 1/3 of the time but only rarely elected an

Table 3 Frequency distributions

Tiles turned by attorney general	Freq.	Percent	Cum.%
0	4	2.78	2.78
1	8	5.56	8.33
2	56	38.89	47.22
3	46	31.94	79.17
4	30	20.83	100
Total	144	100	

Tiles turned by attorney general	Attorney general elected	Attorney general appointed
0	1	3
1	1	7
2	27	29
3	27	19
4	16	14
Total	72	72

Valuable tiles exposed	Freq.	Percent	Cum.%
0	127	88.19	88.19
1	14	9.72	97.92
2	3	2.08	100
Total	144	100	
Executive corruption (tiles kept)			
0	106	73.61	73.61
1	22	15.28	88.88
2	10	6.94	95.83
3	3	2.08	97.91
4	1	0.69	98.61
5	1	0.69	99.30
6	1	0.69	100
Total	144	100	

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executive exposed as corrupt. Attorneys general were generally quite vigilant. They neglected to undertake the two free flips less than 1/10 of the time. In the majority of instances, the attorneys general undertook at least one costly flip, and many flipped all four tiles, which was the most they were permitted. Most executives stole nothing from the public purse. Those who expropriated public funds typically stole small amounts. The mean amount of expropriation was 0.46, which was about 1/8 of the average revenues of 3.6.

The corruption game involves three stages of play in each round:

1.1. An executive is elected by the citizens.
1.2. The executive rolls a die. The value of the roll determines the number of valuable tiles received. She then decides which tiles to keep for herself and which tiles to give to the votes.
1.3. Next, the attorney general decides how many tiles to flip over according to a rising cost schedule. The public then observes how many tiles the attorney general flips over and how many of the flipped tiles are valuable. The six tiles are distributed among the voters.
2.1. The executive comes up for re-election. The citizens vote. Another executive is elected.

In accordance with the precepts of game theory, we start by examining the last move first.
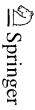
3.1 Re-election of the executive

Citizens get information regarding the honesty of the executive from two sources: income received and evidence of corruption as exposed by the attorney general. Two predictions are that exposed corruption makes re-election less likely and higher incomes make re-election more likely.

Our results support both of these theoretical predictions (see Table 4). We estimated the probability of re-election using three estimation methods: OLS, probit, and random effects. We also performed a fourth regression, which includes dummies for all rounds, not just the theoretically important one at round 7. (In round 7, the first round with the new institution for choosing the attorney general, all three candidates are randomly chosen, making it less likely that the executive will be up for re-election, and therefore less likely she will be re-elected.) We used group random effects to control for group characteristics, as groups may develop internal dynamics that make all the observations in one group different from others. Group random effects were not significant and the random effects regressions are identical to the OLS regression.

We find that voters are indeed less likely to re-elect executives who have been shown to be corrupt. The base probability of re-election is about 32%, but of the 14 times an executive was exposed as corrupt, the person was only re-elected once. This result is significant at 1% in the OLS and random effects regressions and remains significant at 5% in the probit/probit random effects estimations and in the OLS/random effects estimation where we use dummies for all rounds (see Table 4). The effect of exposed corruption on re-election is not small: An executive exposed of corruption is 25 percentage points less likely to be re-elected, a large decline compared to the average reelection probability of 32%. This has obvious, real world parallels, as anecdotal accounts suggest that voters disapprove of and vote out governments exposed as corrupt.

Higher revenues, as determined by the number that the executive rolls, make reelection more likely. The effect is significant at 1% in the OLS, probit, and random effects estimations. The magnitude of the coefficient also suggests that luck is important. Rolling a 6 rather than a 1 increases the probability of re-election by 35 percentage points – more than the mean probability of re-election. If we include dummies for all periods, rather than just

Table 4 Re-election of the executive

Dependent variable	Dummy for re-election of executive Std. dev. = 0.467				
Estimation method	OLS	Probit	Random effects (group)	Probit random effects	Random effects (group) with round dummies
Experimental variations	3.1	3.2	3.3	3.4	3.5
Ease of hiding corruption (number of empty tiles)	−0.009 (1.15)	−0.03 (1.29)	−0.009 (1.15)	−0.03 (1.29)	−0.009 (1.12)
Wages	−0.101 (1.27)	−0.35 (1.33)	−0.101 (1.27)	−0.35 (1.33)	−0.097 (1.22)
Attorney general directly elected	0.201* (2.56)	0.623* (2.44)	0.201* (2.56)	0.623* (2.44)	0.205** (2.59)
Idiosyncratic variations					
Exposed corruption lagged (valuable tiles exposed)	−0.252** (2.57)	−1.30* (2.32)	−0.252** (2.57)	−1.30* (2.32)	−0.213* (2.10)
Attorney general vigilance lagged (number of tiles flipped over)	0.001 (0.01)	0.016 (0.11)	0.001 (0.01)	0.016 (0.11)	−0.022 (0.49)
Revenue lagged (number rolled)	0.070** (2.86)	0.227** (2.75)	0.070** (2.86)	0.227** (2.75)	0.060* (2.26)
Demographic variables					
Executive's gender (Female dummy)	−0.108 (1.30)	−0.322 (−1.19)	−0.108 (1.30)	−0.322 (−1.19)	−0.081 (0.94)
Executive's major (Economics dummy)	1.45 (1.64)	0.475 (1.65)	1.45 (1.64)	0.475 (1.65)	0.115 (1.27)
Executive's nationality (US dummy)	0.079 (0.86)	0.241 (0.78)	0.079 (0.86)	0.241 (0.78)	0.084 (0.90)
Dynamic variables					
Round 7	−0.143 (1.06)		−0.143 (1.06)		Round dummies
N	132	132	132	132	132
Adj R^2	0.15				
Log likelihood		−68.4		−68.4	
R^2 within			0.211		0.27
R^2 between			0.25		0.23
R^2 overall			0.22		0.27
$P > \chi^2/F$	0.0007	0.0002	0.0002	0.0045	0.0022

There is no first round and the round 2 dummy is insignificant. The round 12 dummy is also insignificant. Including round 2 or round 12 dummies makes no real difference in the results of interest. t stats below coefficients

**sig at 1%, *sig at 5% +sig at 10%

the theoretically important dummy for period 7, the significance of revenues falls to 5% ($t = 2.26$), and the coefficient declines a little from 0.07 to 0.06.

Voters appear to vote not so much on the basis of their own revenues as on the sum of voters' revenues. We stacked the data and regressed lagged income on voting for reelection at the individual level. Lagged income had a positive, but insignificant effect on reelection, despite a large sample size (results available upon request). While they were not told group revenues, play was face to face and players generally made no effort to hide their glee or disappointment. We deliberately did not make play anonymous (by making players face away from each other, etc.) because we thought that an ability to informally share information on revenues was a better match with real world circumstances, where citizens are often aware of how well the economy in general is doing.

We controlled for three demographic variables: the gender, nationality and major of the candidate. These demographic variables may make the re-election of a particular demographic group more likely, but we found no such effects. One would expect the Round 7 dummy for reelection to be negative because the incumbent was not automatically a candidate. The direction of the coefficient was correct, but insignificant.

3.2 Vigilance of the attorney general

Having determined that our participants, as voters, used information on exposed corruption when re-electing the executive, we turn to the determinants of vigilance on the part of the attorney general. Participants appeared quite vigilant as attorneys general. There were only 12 instances of not undertaking the two free flips. In the majority of instances, the attorneys general undertook at least one costly flip, and a significant number (30/144) undertook all four flips (see Table 3). We observed that many attorneys general stopped choosing costly flips once corruption was exposed, but we did not record the order of valuable and empty tiles flipped, so we cannot make any clear demonstration of this strategy.[3]

Theory suggests (Persson, Roland, & Tabellini, 2000) that independently elected attorneys general will be more vigilant at exposing corruption than those who are appointed. This is indeed the case (see Tables 3 and 5 and Figure 1). The regressions suggest that directly elected attorneys general turn more tiles (at 5%) in each of the four test specifications – OLS, ordered probit, random effects, and random effects – with all period dummies. These results are also economically significant. In terms of magnitude, the coefficient of 0.35 is equal to 1/3 of the standard deviation of the dependent variable. Because each group played rounds with appointed and elected attorneys general, it was possible to estimate the effect of direct election on the attorneys' general vigilance, even when controlling for group fixed effects. We found that the effect remained significant ($t = 2$–2, $P = 0.024$; results available upon request).

Not undertaking the two free flips may be the clearest evidence of laxity on the part of the attorney general. As we can see in Table 3, of the 12 instances when attorneys general did not undertake the 2 free flips, 10 occur when the attorney general was appointed. We estimated the probability of undertaking at least the two free flips, using a probit. Directly elected attorneys general are more likely to undertake at least the two free flips at the 1% significance level (see Table 5, the probit regression labeled 4.5).

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[3]The lack of a partial correlation between the number of tiles turned and the number of valuable tiles turned, controlling for how much the executive keeps, suggests that many players may be following this strategy (results available upon request).

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Table 5 Attorney general's vigilance

Dependent variable Estimation method	Number of tiles flipped over Std. dev. = 0.967				Dummy for at least two tiles flipped
	OLS	Ordered probit	Random effects (group)	Random effects (group) round dummies	Probit
Experimental variations	4.1	4.2	4.3	4.4	4.5
Ease of hiding corruption (log of number of empty tiles)	0.103 (0.71)	0.134 (0.79)	0.095 (0.31)	0.112 (0.37)	−0.512 (1.58)
Wages	−0.129 (−0.82)	−0.143 (0.78)	−0.126 (0.37)	−0.132 (0.39)	−0.233 (0.58)
Attorney general directly elected	0.354* (2.24)	0.434* (2.30)	0.344* (2.43)	0.337* (2.33)	1.21** (2.56)
Idiosyncratic variations					
Revenue (number rolled)	0.122* (2.55)	0.144* (2.50)	0.107 (2.44)	0.083 (1.72)	0.391** (2.83)
Demographic variables					
Attorney General's gender (Female dummy)	0.213 (1.29)	0.241 (1.25)	0.192 (1.22)	0.191 (1.16)	−0.346 (0.82)
Attorney General's major (Economics dummy)	−0.137 (0.70)	−0.166 (0.72)	−0.179 (0.83)	−0.127 (−0.57)	−1.00* (2.27)
Attorney General's nationality (US dummy)	0.124 (0.67)	0.172 (0.79)	0.082 (0.46)	0.071 (0.37)	0.118 (0.26)
Dynamic variables					
Round 1	−0.538[+] (1.87)	−0.66[+] (1.95)	−0.521* (2.03)	Round dummies	−0.85 (1.40)
Round 6	−0.392 (1.38)	−0.46 (1.39)	−0.405 (1.57)		−0.19 (0.27)
Round 12	−0.659* (2.34)	−0.78* (2.30)	−0.657** (−2.61)		−0.85 (1.39)
N	144	144	144	144	144
Adj R^2	0.10				
Log likelihood		−178			−29
R^2 within			0.16	0.20	
R^2 between			0.15	0.14	
R^2 overall			0.16	0.18	
$P > \chi^2/F$	0.009	0.009	0.004	0.037	0.006

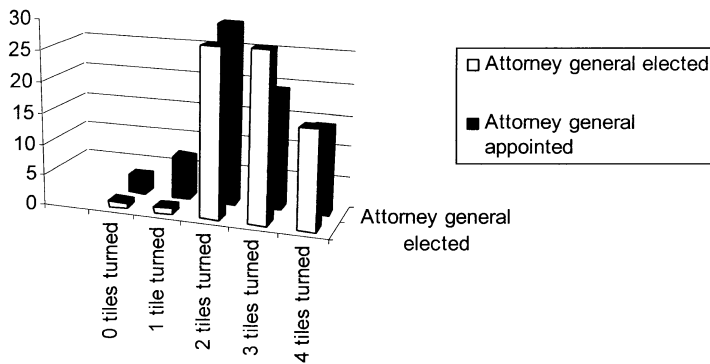t stats below coefficients

**sig at 1%, *sig at 5%, [+]sig at 10%

Fig. 1 Attorney general's vigilance: tiles turned by attorney general

In contrast to our expectations, wages had no perceptible effect on the attorneys' general vigilance. Increasing wages may induce attorneys general to be more vigilant for two reasons. First, the value of being reelected as attorney general or being promoted to executive is higher, so more wealth should be expended as attorney general in hope of reelection. Second, well-paid attorneys general may feel a greater sense of duty to investigate. Neither of these hypotheses received any empirical support.

In all of the regressions, we controlled for the gender, nationality, and major of the attorney general but found that these demographic variables had no significant effect on the attorneys' general vigilance. The only exception was when the indicator variable for at least two free flips was used as the dependent variable. In this case, the economist major dummy became significant. Economists were less likely to turn over the two free tiles. (Since it was not unlikely that one or two of the coefficients on the demographic variables in the many regressions we estimated would be significant, we do not want to over-interpret this finding.)

There appear to be two dynamic effects: a learning effect and a last-round effect. Attorneys general are less vigilant in the first round, possibly because the participants have not quite understood the game yet. The 6th and especially 12th rounds show last round effects. In the 12th round, there is little reason for the attorney general to expose corruption, as voters can do nothing to punish the executive for corruption or reward the attorney general for vigilance. In the 6th round also, the likelihood that the executive or attorney general will be up for re-election is lower (because all candidates will be randomly chosen in the next round), which reduces the incentives for the attorney general to expose corruption. This also has relevance for real world debates about term limits, which we will discuss in the next sub-section.

Intriguingly, the size of the executives' roll affects the vigilance of the attorney general. Despite being secret by design, higher rolls inspire greater vigilance. Perhaps some hint in the facial expression of the executive gave away a high roll. (It is difficult to tell, but the result might be driven by rolling sixes.) We are not overly troubled by this result because it also has real-world parallels. The executive has a clear incentive not to reveal a high roll and the attorney general could not see the die. The inability of experimental executives to conceal their good fortune reminds us of such human flaws in real world executives.

We also investigated whether voters reward an attorney general's vigilance by re-electing him or promoting him to executive. The coefficient has the expected sign but is not nearly significant (results available upon request).
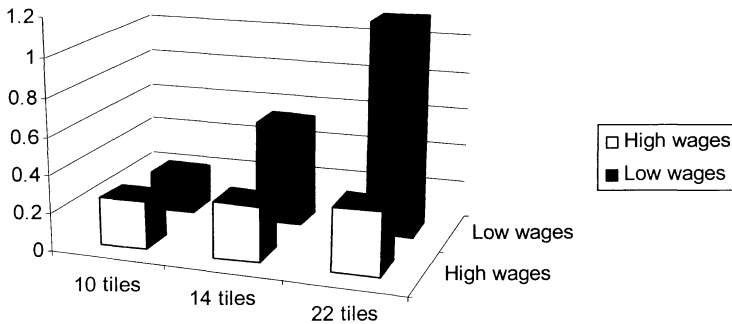
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Fig. 2 Executive corruption: tiles kept by executive

3.3 Executive corruption

We now turn to the level of executive corruption. As mentioned above, executive corruption is defined as the number of valuable tiles the executive keeps for himself. Most executives were honest, stealing nothing from the public purse. When they did steal, they typically stole small amounts. In the 144 rounds, a 4, 5, or 6 was rolled 79 times. However, in only 3 rounds did that executive keep 4 or more tiles (see Table 3). Theory predicts that higher government wages, the difficulty of hiding corrupt gains, and the direct election of the attorney general should be negatively related to the level of corruption. The data show clear evidence of the first two predictions, but not the third (see Table 6).

The determinants of executive corruption were estimated using ordinary least squares (OLS), ordered probits, and random effects estimators. Idiosyncratic group effects are not significant and the random effects regression is identical to OLS.

Higher government wages clearly discourage corruption; the effect is significant at 5% in the OLS regression and becomes significant at 1% in the ordered probit estimation. The magnitude of the effect suggests that it is important; the coefficient of 0.34 on the wage dummy is larger than 1/3 of the standard deviation of the dependent variable. Higher wages reduce corruption, if exposed corruption is likely to lead to dismissal of the executive (see Figure 2).

The ease of hiding corruption, or lack of transparency, is proxied by the total number of tiles. The number of tiles also has the predicted effect on corruption, though the effect is a little less clear. It is easily significant at 5% in the OLS (and therefore random effects) regression, but only significant at 10% in the ordered probit estimation.[4] The magnitude of the coefficient suggests that changing the number of tiles from 10 to 22 has an impact equal to 1/2 the standard deviation of the dependent variable. It is worth noting that, as we might expect theoretically, transparency appears to have a non-linear effect captured by the logarithmic transformation. As the number of tiles rises, voters might rely more on their own incomes and less on the increasingly unlikely event of exposed corruption when deciding whether or not to re-elect the executive.[5] (There is not enough data to resolve this issue when using the re-election regression.) Empirically, the difference between having 10 or 14 tiles total appears larger than the difference between having 14 or 22 tiles.

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[4] Abbink, Irlenbusch, and Elke (2002) also find in a different context that increasing transparency reduces corruption.

[5] This assumes that the extent of corruption rises less than proportionately with the number of tiles.

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Table 6 Executive corruption

Dependent variable Estimation method	No. of valuable tiles kept by the executive Std. dev. = 0.97			
	OLS	Ordered probit	Random effects (group)	Random effects (group) round dummies
Experimental variations	5.1	5.2	5.3	5.4
Ease of hiding corruption (number of empty tiles)	0.326* (2.29)	0.396+ (1.80)	0.326* (2.29)	0.329* (2.26)
Wages	−0.354* (2.27)	−0.633** (2.63)	−0.354* (2.27)	−0.364* (2.30)
Attorney general directly elected	0.058 (0.38)	−0.168 (0.70)	0.058 (0.38)	0.060 (0.39)
Idiosyncratic variations				
Revenue (number rolled)	0.101 (2.15)	0.074 (1.02)	0.101 (2.15)	0.133* (2.55)
Re-elected executive	−0.225 (1.29)	−0.650 (2.12)	−0.225 (1.29)	−0.213 (1.14)
Demographic variables				
Executive's gender (female dummy)	0.099 (1.23)	0.256 (1.02)	0.099 (1.23)	0.135 (0.80)
Executive's major (economics dummy)	−0.040 (0.22)	−0.197 (0.67)	−0.040 (0.22)	0.001 (0.01)
Executive's nationality (US dummy)	−0.149 (0.84)	−0.393 (1.52)	−0.149 (0.84)	−0.142 (0.78)
Dynamic variables				
Round 1	0.795** (2.84)	0.944** (2.66)	0.795** (2.84)	Round dummies
Round 6	0.438** (1.61)	0.329 (0.77)	0.438** (1.61)	
Round 12	0.476 (1.75)	0.557 (1.38)	0.476 (1.75)	
N	144	144	144	144
Adj R^2	0.15			
Log likelihood		−109		
R^2 within			0.18	0.20
R^2 between			0.42	0.45
R^2 overall			0.22	0.24
$P > \chi^2/F$	0.0003	0.0003	0.0001	0.0026

t stats below coefficients

**sig at 1%, *sig at 5%, +sig at 10%

The direct election of the attorney general has no perceptible effect on the level of corruption. This is a bit surprising given that the direct election increases vigilance. One possible explanation is that, while direct elections increase vigilance, many players are unaware of this, and thus executives play as if election versus appointment is irrelevant. If participants play the game for more rounds, they might learn about the election effect and act less corruptly when the attorney general is elected. Treisman's (2000) finding that only several decades of continuous democracy make a serious dent in corruption may also suggest that longer play is required before the impact of political institutions on the level of corruption becomes apparent.

Revenue, the number of valuable tiles the executive receives, has an effect on how many tiles the executive keeps (but the effect is not significant in the ordered probit estimations). This result can be interpreted as support for the notion that more discretion – proxied by the revenues the executive has control over – leads to more corruption. It should be acknowledged that the result is hardly surprising, as to some extent this would simply be true by construction. An executive determined to steal as much as possible would only be able to steal 1 tile if she rolled a 1.

We might have expected re-elected executives to be more honest, but could find no decisive evidence of this in the data. (The coefficient on reelected executive has the right sign but is only significant in the ordered probit estimation.) The demographic variables are insignificant. Gender, major, and nationality have no perceptible effects.

As in the regressions on the attorneys general vigilance, there are apparent dynamic effects in the 1st, 6th, and 12th rounds. Executives are more corrupt in the first round, perhaps because they have not quite understood the game yet. They are more corrupt in the 6th and 12th rounds, probably because of final round effects. Only the first round effect is clearly significant, but the 6th and 12th round effects are individually marginally significant and jointly significant in the OLS and random effects estimations.

The final round effect also has real-world parallels. Many electoral systems have term limits. The results here suggest that executives may be more corrupt in the last period they are allowed to be in office. A president with no prospect of re-election might steal all he can, while he can. We cannot, however, say anything about the aggregate effect of term limits, which might reduce the political collusion that sometimes occurs when a person stays in power for many decades. Our participants, as voters, appear reluctant to persistently re-elect officials even if they are apparently (and sometimes actually) honest. (We think this reluctance is not driven by a combination of altruism and income effects, which we were careful to eliminate by paying players on a randomly selected round rather than giving them cumulative winnings. We think the reluctance might be driven by a preference for equality of opportunity, which we are examining in other experiments.)

4 Discussion of results and real world parallels

4.1 Transparency and corruption

Increasing transparency is thought by many to be the most effective means of reducing corruption. The rhetoric of the World Bank, the United Nations, and bilateral donors is replete with calls for increased transparency in public life to reduce corruption in the public sectors of developing countries.

The links between transparency and corruption are difficult to draw with real-world data because of overlapping definitions, reverse causality, and omitted variables. The main purpose of experimental work is to create an environment free of these concerns. Corruption and

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transparency in our game are clearly defined and do not overlap in definition. Our main results are based on how different participant behaviors are correlated with changes in the experiment environment, and we controlled the environment. Therefore conclusions we draw do not suffer from questions of reverse causality. The experimental design is also "rectangular," i.e., changes in the experimental environment are not correlated with each other (see Table 1 for an illustration). Hence, omitted variable problems are not serious.

    We define corruption as the number of valuable tiles that an executive steals. Wage payments to the executive are high enough that she "shouldn't" keep public funds for herself out of a sense of fairness. (In the low-wage treatment, the executive makes $30, which is equal to the maximum possible earnings of a voter. The expected income from being a voter is $17.50 if the executive is not corrupt.) There is also a large, explicit distortion cost to keeping public funds (the tiles are worth $30 to the citizens but only $15 to the executive).[6] Thus it is fair to call the executive keeping tiles for herself a wasteful "abuse of office for personal gain" or an instance of corruption.

    Transparency is defined as the inverse of the total number of tiles that the executive receives. Since the attorney general can only flip over a limited number of tiles according to a rising cost schedule, increasing the total number of empty tiles reduces the transparency of the system. Real-world parallels for reducing the number of empty tiles mixed up with the valuable ones are standardizing accounting systems and requiring public officials to regularly declare their assets. These changes would make it easier for law enforcement officers to expose corruption, just as reducing the number of tiles makes it easier to expose corruption in this experiment.

    In this experiment, transparency of the system is defined as the probability with which random checks on the executive's wealth yield evidence of corruption. Several real-world parallels are reported in Klitgaard's (1988) classic "Controlling Corruption," where he describes the successful anti-corruption programs in Hong Kong, Singapore, and the Philippines. In all three cases, improbable amounts of wealth were used as the basis for initiating investigations. In Hong Kong and Singapore, the law was amended to allow for disciplinary action on the basis of unexplained riches, i.e., in the presence of unexplained riches the burden of proof was transferred onto the accused. Random and surprise wealth checks were also used to good effect in all three countries.

    More broadly, Klitgaard reports that many of the successful anti-corruption policies that were adopted in Hong Kong, Singapore, the Philippines, and La Paz (Bolivia) can be thought of as increasing the probability of exposure.[7] These include: improving accounting and audit systems, checking on bank accounts, hiring undercover agents, using reports from the media and public, and providing incentives for officials to report bribes.

    Survey results from West Java, Indonesia also suggest that increases in transparency reduce corruption. Public officials ranked "the regular declaration of assets of public sector employees" and "more coverage by the media" highly in terms of their potential to reduce corruption. Each is a method of increasing transparency (Azfar, 2002b).

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[6] Corruption can create many distortion costs. Mauro (1998) has shown that corruption distorts government expenditure priorities. Murphy, Shleifer, and Vishny (1993) argue that it distorts the allocation of talent. Kaufmann and Wei (1999) have shown that businessmen who pay more bribes spend more not less time with bureaucrats. Lee and Azfar (2002) show that initially corrupt countries are less likely to reduce tariffs.

[7] Reforms in La Paz, Bolivia were introduced at the municipal level by Mayor Maclean Abarora.

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4.2 Wages and corruption

The second variable in our experiment is the wages of the executive and attorney general. Increasing the wages should have two effects on the level of corruption. First is an income effect. A wealthy official has less to gain in utility terms from being corrupt.[8] Second, and probably more importantly, is an incentive effect. The possible loss of a relatively well-paying executive position may limit corruption. In our experiment, voters can punish visibly corrupt executives and thus provide incentives for executive honesty. Again, Klitggard's accounts contain several real-world examples of the importance of wage reform in an anti-corruption strategy. The successful anti-corruption efforts in Hong Kong, Singapore, the Phillipines, and La Paz, included both increasing the pay, and making promotions and retirement benefits contingent on good, honest work (Klitgaard, 1988; Klitgaard, Maclean-Abarora, & Parris, 2000).

There is a continuing debate about the importance of wage reform in reducing corruption. Some anecdotal accounts suggest that government wages affect corruption. A devaluation that dramatically lowered real wages of government officials in Cameroon was reportedly followed by a sharp increase in corruption (http://www.oecd.org/pdf/M00025000/M00025403.pdf). However, statistical evidence on the question appears mixed. While Weder and van Rijkehem (2001) find that higher government wages are related to lower levels of corruption, others (Lederman, Loyaza, and Soares, 2002: Rauch and Evans, 2000) state that this result is not robust.

Even if the partial correlations between government wages and corruption are statistically significant, they may not allow any clear inferences, because government wages may be correlated with other measures of good governance – like the ability to collect taxes or keep public employment at sensible levels. Therefore, any correlation between government wages and corruption may be spurious or driven by reverse causality. Our experimental results are free of these concerns and show that higher wages lead to less corruption.

4.3 The separation of powers and corruption

The third treatment variable is the means of appointing or electing the attorney general. In almost all countries, the attorney general is appointed by the executive and – to put it politely – has weak incentives to investigate the executive branch of government. This situation is exacerbated by the legal constraints on private lawsuits in cases involving criminal charges. These constraints effectively allow the attorney general to decide whether a corruption case will be filed.

Arguments that the separation of powers can help break such collusion and/or reduce corruption date back to Locke, Montesquie, and the framers of the U.S. Constitution. These arguments have recently been formalized by Persson, Roland, and Tabelini (1997, 2000) and Laffont and Meleu (2001). The specific form of the separation of powers considered here is the direct election of the attorney general. Direct elections for attorneys general are prevalent in the United States (44 out of 50 states have directly elected attorneys general). Klitgaard

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[8]Our own view (shared by Klitgaard) is that this effect is likely to be small in practice. It is worth noting that some of the arguments linking higher wages to less corruption (or crime in general) rely on income effects as well as incentive effects (Ehrlich, 1973; Ehrlich and Becker, 1972). In experimental settings, payments are typically too small to create serious income effects, so we suspect our results are driven by the incentive effects based on a reluctance to lose a lucrative "executive position," though we cannot rule out fairness considerations, etc.

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argues that separation of powers in the form of external oversight by the ICAC on the police department in Hong Kong and by CPIB on the Excise and Customs Department in Singapore was important in making anticorruption efforts effective.[9]

There is little real world statistical evidence linking the direct election of the attorney general with the level of corruption because there are very few (possibly no) directly elected attorneys general at the national level in the world. There are 44 directly elected attorneys general in the 50 American states, and therefore only 6 who are not elected. In any case, the poor quality of corruption data in the United States makes it very difficult to conduct such an examination in a believable manner.[10]

5 Conclusion

We conducted a laboratory experiment varying the ease of detecting corruption, the wages of officials, and the method of electing or selecting the law enforcement officer. We found that voters rarely re-elect chief executives found to be corrupt, and that they reward presidents who had good luck by re-electing them. Directly elected law enforcement officers work more vigilantly at exposing corruption than those that are appointed. In particular, it appears that elected attorneys general collude less often with the executive. As predicted by the economic theory of crime, increasing both government wages and the ease of detecting corruption reduce corruption.

Investigating the causes of corruption with real world data is difficult because of overlapping definitions, reverse causality, selection bias, and omitted variables. The main purpose of experimental work is to create an environment free of these concerns. Corruption and transparency in our game are clearly defined and do not overlap in definition. Our main results of interest are based on how participants' different behaviors correlate with changes in the experimental environment.

Experimental data do suffer from a lack of environmental validity. Laboratory incentives imperfectly mimic real world situations and the stakes are usually much lower. Yet such results can make important contributions, especially if real world institutions do not provide opportunities for conventional empirical analyses. Take an analogous case in the life sciences. Smoking correlates with the incidence of lung cancer. However, the correlation in itself does not provide persuasive evidence that smoking causes cancer because smokers lead relatively unhealthy lifestyles. It is unethical to organize randomized interventions that endanger human lives to resolve this question.[11] Scientists often produce evidence of cellular damage to lung cells when mixed with carbon monoxide in vitro, and of the incidence of cancer among mice randomly exposed to cigarette smoke. These results incrementally produce a more persuasive case that smoking causes cancer. It is only when these various forms of

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[9]ICAC is Hong Kong's "Independent Commission Against Corruption," which reported directly to the governor, and CPIB is Singapore's "Corrupt Practices Investigation Bureau," upon which ICAC was in part modeled.

[10]One "corruption" variable, "the number of white collar convictions," obviously combines the level of corruption and the effectiveness of investigations. Another, based on a survey of newspaper reporters, has many states ranked by one single reporter and some not ranked at all – these data are described in Fisman and Gatti (2000).

[11]Randomized experiments are conducted on humans to determine the efficacy of medicines after it has been determined that the implicit risks of the experiment are substantially lower than the benefits. However, no research proposal that sought to examine the cause of a lethal ailment by randomly exposing human subjects to the conjectured cause would pass muster at the Institutional Review Board of any major university.

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evidence have been collected and all point in the same direction that a persuasive case can be made for the view that smoking causes cancer. And it is only such persuasive evidence that convinces even the narrow interests that benefit from selling cigarettes that it is futile to argue that smoking is safe. Narrow interests that benefit from corruption are similarly influential. Similarly, persuasive evidence is needed in order to support the effectiveness of various reforms, like regular declaration of assets by public officials, if such laws are to be enacted. Experimental results such as ours provide one of many forms of evidence that can make this case.

This paper may shift the burden of proof regarding the effectiveness of corruption reforms. Hong and Plott (1982) conducted an experiment that found forcing prices to be posted led to higher prices. They argued that this evidence shifted the burden of proof towards those that argued that forcing prices to be posted was pro-competitive. We might similarly argue that the burden of proof on the causes of corruption has been shifted. The onus to provide evidence that electing attorneys general will not increase their vigilance and evidence that increasing wages and transparency will not reduce corruption is now on others.

Appendix A: General game instructions

Thank you for participating in this experiment. Please do not communicate with your fellow participants during the experiment unless told by the experimenter that communicating is allowed.

Participants will interact in two situations during today's experimental session. Each situation will be repeated six times. Each time a situation is repeated is referred to as a round. Eight subjects will participate in each situation. The two situations will be very similar. The common rules, participant roles, tile values etc. will be explained in this section. The rules that are specific to each situation will be explained in separate instructions. These specific instructions will be read immediately before participation in each situation begins.

The following story is illustrative of both situations. Imagine that the eight participants in each group are the citizens of a country. Citizens vote to determine who among them will be president and who will be the attorney general. Once selected, the president has the opportunity to act corruptly by personally keeping money rather than distributing it to the voters. The attorney general then has the opportunity to expose this presidential corruption, but investigating the president costs the attorney general money. Each situation is repeated six times. In each round, a new election will be held to select the president and attorney general. The difference between each of the situations is how the votes determine who becomes the president and attorney general. (Any tie votes will be broken using a random process.) Voting rules will be explained immediately before you participate in each situation.

All of the situations involve the steps listed below. All die roles, decisions, and draws will be documented by the experimenter and used to calculate participants' earnings.

1. Three participants are chosen as candidates according to the roles of an eight-sided die cast by the experimenter.
2. Each candidate speaks for 15 seconds on why he/she would make a good public official.
3. The five voters (all of the participants that are not candidates) anonymously vote.
4. Votes are counted. The president and attorney general are determined (exactly how will be explained immediately before each situation begins).

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5. At this point all participants know who is the president, who is the attorney general, and who are the 6 voters.

6. The president receives a $60.00 salary. Voters receive no salary.

7. The president receives four "0" tiles (worth nothing). Then the president rolls a six-sided die to determine the number $ tiles he receives. He receives the same number of $ tiles as the number he rolls. Each $ tile is worth $30.00 to each voter and $15.00 to the president. The number the president rolled remains secret. Additional 0 tiles are supplied to complete the president's initial endowment of ten tiles. The president now has ten tiles of which up to six are $'s, if he rolled a six. Three are $ and seven are 0s if the president rolled a three. The president knows what tiles he has, but the voters do not.

8. The president then decides how to divide the ten tiles between himself and the voters. He keeps four for himself. The remaining six tiles are placed in a bag. The tiles the president keeps are face down and remain secret unless the attorney general turns them.

9. Each voter privately draws a tile from the bag. Voters do not know what kind of tile other voters draw. Tiles are not replaced in the bag; thus all tiles will eventually be drawn. Each voter who draws a $ tile earns $30.00. Voters that draw a 0 tile earn nothing for that round.

10. The attorney general starts with $40.00. The attorney general can turn over any and as many of the president's tiles as he wants. The first two can be turned for free. The third costs $10.00 and the fourth costs $15.00. Any money that the attorney general has left over after turning tiles is his to keep.

11. The president does not receive payment for $ tiles that are turned by the attorney general. The president receives $15.00 for each $ tile he holds that is not turned. The money that the president earns for holding the tiles is in addition to his $60.00 salary.

12. The next round begins. The sitting president, the sitting attorney general, and one of the current voters are the candidates for president and attorney general during the next round. The candidate that was a voter in the last round is selected according to the role of a six-sided die. The number rolled is counted off from the voter furthest to the experimenter's left. The participant that is in that position becomes the new candidate. Go to step 3.

We will now review the visual instructions. (They are at the end do to margin considerations.)

Institutional variations:

Players were shown and read out the instructions below.
Direct election of attorney general: Voters cast one vote in each of two simultaneous elections. One election is for president and the other is for attorney general. The candidate that receives the most votes in the presidential election becomes president and the candidate who receives the most votes in the attorney general election becomes attorney general. If the same candidate wins both elections, that candidate becomes president and the runner up in the attorney general election becomes attorney general.

Appointment of attorney general: Voters cast one vote in a single election. The candidate who receives the most votes becomes president. The new president chooses any of the other participants in the game to be his attorney general.

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Appendix B: Visual instructions

P# = represents a particular numbered participant who is identified by a sticker.

Step 1

| P 1 | P 2 | P 3 | P 4 | P 5 | P 6 | P 7 | P 8 |

Three participants are chosen as candidates according to the roles of an eight-sided die cast by the proctor.

Step 2

Voters

| P 1 | | P 3 | | P 5 | P 6 | P 7 |

| P 2 | P 4 | P 8 |

Candidates

Each candidate (P2, P4, and P8) will speak for 15 seconds on why they would make a good public official.

Step 3
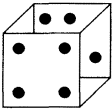
| P 1 | | P 3 | | P 5 | P 6 | P 7 |

| P 2 | P 4 | P 8 | Arrows represent votes

The five voters (all of the participants that are not candidates) anonymously vote.

Step 4

Votes are counted. The President and the Attorney General are determined (exactly how will be explained later).

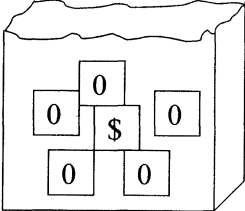**Step 5**

| 0 | 0 | 0 | 0 | 0 | 0 |

| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| $ | $ | 0 | 0 | 0 | 0 | 0 | 0 |

The President receives sixteen "0" tiles. Then President rolls a six-sided die to determine the number additional $ tiles he receives. He receives the same number of additional $ tiles as the number he rolls. The number the President rolled remains secret. 0 tiles are supplied to complete the Presidents initial endowment of twenty-two tiles. The President now has twenty-two tiles of which up to six are $'s (if he rolled a six). Three are $ if the President roles a three. In this example the President rolled a two.

Step 6

In the Bag

For the President

The President decides how to divide the Twenty-two tiles between himself and the voters. He keeps sixteen for himself. The remaining six tiles are placed in a bag. The tiles the President keeps remain face down and secret.

Step 7

| 0 | | | | | | |

| | $ | | | | | |

The Attorney General starts with $40.00. The Attorney General can turn over up to four of the President's tiles. The first and second can be turned for free. The third costs $5.00 and the fourth costs $10.00. Any money that the Attorney General has left over after turning tiles is his to keep.

Step 8

The President does not receive payment for $ tiles that are turned by the Attorney General. The President receives $15.00 for each $ tile he holds that is not turned over by the Attorney General. The President receives his $60.00 salary regardless of how many tiles are turned by the Attorney General.

Step 9

Each voter privately draws a tile from the bag so voters do not know what kind of tile each voter draws. Tiles are not replaced into the bag, so all tiles will eventually be drawn. Each voter who draws a $ tile earns $30.00.

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Step 10

The next round begins. The sitting President, the sitting Attorney General, and one of the current voters
are the candidates for the next round. The candidate that was a voter in the last round is selected
according to the role of a six-sided die. The number rolled is counted off from the candidate furthest to
the proctors left. The participant that is in that position becomes the new candidate. Go to step 3.

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