ABSTRACT

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This dissertation consists of three studies in behavioral and experimental economics. In the first chapter, I study how vote buying may occur in environments where promises cannot be enforced and investigate how different kinds of behavioral biases lead to the use of different types of payments (pre-voting transfers vs. promises of post-voting transfer). I provide a simple model of the vote buying exchange as a one-shot interaction of a buyer and a voter, where voting is costly and done in private, and the buyer may make offers with different payments types. I investigate the effects of three behavioral biases on buyer and voter behavior: inequity aversion, guilt aversion and voter reciprocity. Using a laboratory experiment, I present evidence that support the presence of all three behavioral biases.

The second chapter is a joint work with Erkut Y. Ozbay. We study the optimality of pre- and post-voting payments to buy votes in an environment where both the buyer and the voter are able to commit to their promises. Using a modified version of the model used in Chapter 1, we investigate the implications of different risk attitudes and inequity aversion on agent behavior. We test the predictions of different preferences using a lab experiment. Our results support the presence of inequity aversion in this environment.

In the third chapter, I study whether and under what conditions a decision maker may decline a benefit that is provided by another person. I identify the behavioral biases of in-

equity aversion, guilt aversion and reciprocity as possible explanations: an inequity averse decision maker may reject if the resulting allocation is very inequitable, while a guilt averse one may reject if she believes that she cannot fulfill the other person's payoff expectations, and a reciprocal decision maker may reject if she believes the other person made the transfer with good intentions, but she cannot respond in kind. By modifying a widely used experimental two-player game introduced to study trust and reciprocity, I show that a decision maker takes the cost of reciprocating a transfer into consideration when deciding whether to accept, regardless of whether she is reciprocal, inequity averse, or guilt averse. However, the three biases have different implications for how the decision maker's belief about the other player's material payoff expectations affect her behavior. Using a laboratory experiment, I confirm that both guilt aversion and reciprocity motives are present, and they are able to explain different aspects of the behavior.

ESSAYS IN BEHAVIORAL ECONOMICS

by

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DEDICATION

To my parents.

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Chapter 1: Vote Buying with Non-Binding Promises

1.1 Introduction

People in democratic societies make many decisions through voting. These decisions range from elections to choose representatives, referenda to choose policies, shareholder votes to decide on executive compensations, department votes on whom to hire, to the mundane case of deciding where to go to dinner. When there is a decision to be made collectively, it is natural that people will want to sway the votes to their desired outcome. One way to achieve such an outcome is vote buying. Vote buying refers to giving particularized benefits (money, goods or services) to voters in exchange for their votes. The practice of vote buying is undesired in many voting environments as it is thought to undermine the intent of the vote, which is to relay the preferences, sentiments, and private information of the voters. Moreover, vote buying may hinder accountability in the case of electing representatives. As a result, vote buying is strictly prohibited in many voting environments and secret ballot has been introduced to deter vote buying. Despite the countermeasures, however, vote buying remains prevalent, especially in developing countries. For example, vote buying has been documented in elections in Argentina (Brusco, Nazareno, and Stokes, 2004), Egypt (Blaydes, 2006), Lebanon (Corstange, 2012), Mexico (Cantú, 2016), Nicaragua (Gonzalez-Ocantos, Kieviet de Jonge, Melendez, Osorio, and Nickerson, 2011), Paraguay (Finan and Schechter, 2012), Taiwan (Wang and Kurzman, 2007), and Turkey (Çarkoğlu and Aytaç, 2015). In Africa, accounts of electoral handouts exist for a number of countries including Benin, Ghana (Jensen and Justesen, 2014), Nigeria (Bratton, 2008), São Tomé and Príncipe (Vicente, 2014) and Kenya (Kramon, 2016).

The undemocratic nature of vote buying and its prevalence in spite of countermeasures have positioned vote buying as a major issue in political science and political economy literatures. At first glance, the occurrence of vote buying is puzzling because the introduction of secret ballot creates a severe double commitment problem: a voter who has accepted a pre-voting transfer from a buyer may not keep her promise to deliver the vote, and a buyer who has made a promise to deliver some benefit after winning may not keep his promise as well.[1] Therefore, many studies focus on how these commitment problems are solved. For example, Stokes (2005) uses Argentinean election data and argues that parties make use of local brokers to imperfectly monitor voters and take advantage of repeated interaction to credibly commit to punishing voters that do not comply.[2] While other methods such as Tasmanian Dodge, two-part payment schemes, rigged bets,[3] gift cards conditionally activated (Cantú, 2016), and collective vote monitoring by small group of voters (Rueda, 2016) have also been suggested as ways to overcome the voter commitment problem in the literature, there are many cases in which these solutions are not feasible. For example, Guardado and Wantchékon (2016) and Kramon (2016) argue that parties in Africa do not have means to use the solutions listed above. In these cases the occurrence of vote buying remains a puzzle.

In this chapter I shed light on this puzzle and show how vote buying may occur in a

[1] I adopt a broader definition of vote buying which includes post-voting delivery of benefits, conditional on winning. This practice is referred to as clientelistic vote buying in the political science literature (Nichter, 2014).

[2] There are also studies that question whether these commitment problems exist in the first place. For example Nichter (2008) uses the same Argentinean election data as Stokes (2005) and argues that vote buying is actually turnout buying, and hence the problem is not moral hazard but adverse selection.

[3] See Schaffer (2007) for various examples.

non-repeating interaction where monitoring of vote and enforcement of promises are not possible. Since economic models with selfish agents would completely rule out the occurrence of vote buying in such an environment, I investigate (i) how different kinds of behavioral biases might enable vote buying, and (ii) how these biases lead to the use of different types of payments (pre- vs. post-voting transfers). In order to answer these questions, I modify the vote buying model of Dekel, Jackson, and Wolinsky (2008) into a one buyer ("candidate", henceforth) and one voter interaction, allowing the candidate to make simultaneous offers of pre- and post-voting payments (henceforth "up-front payment" and "conditional payment", respectively). In this environment promises are non-binding and information is complete but imperfect. The imperfect information is due to secret ballot. Using this model of vote buying, I investigate the effects of three different behavioral biases on candidate and voter behavior: inequity aversion (Bolton and Ockenfels, 2000; Fehr and Schmidt, 1999), guilt aversion (Battigalli and Dufwenberg, 2007; Charness and Dufwenberg, 2006) and reciprocity (Dufwenberg and Kirchsteiger, 2004). These biases have been studied extensively in the behavioral economics literature. There is ample evidence that economic behavior is affected by concerns for fairness and equity, especially in bargaining situations and environments without market competition. Social preferences (such as guilt aversion and reciprocity) have also been suggested as an explanation for the occurrence of cooperation and coordination in environments that lack commitment devices.[4]

In this study, I develop separate testable predictions of behavior under each of the aforementioned behavioral biases. First, I assume that the players are inequity averse, i.e. they bear a utility cost whenever there is a deviation from equitable payoff distribution. I use Fehr and Schmidt (1999)'s specification for inequity aversion as it allows higher sensitivity

[4]See Camerer (2003) and Cooper and Kagel (2013) for an overview of the experimental results.

to cases where the inequity is to the disadvantage of a player (own payoff is lower than the other player's payoff) than to cases where the inequity is to the advantage of a player (own payoff is higher than the other player's payoff). I show that the type of payment through which vote buying can occur depends on the candidate's sensitivity towards advantageous inequity. If the candidate's sensitivity to advantageous inequity is low, his[5] commitment problem precludes him from buying vote with up-front payments. Furthermore, voter's willingness to engage in vote buying is affected by the potential gain of the candidate; as candidate's potential gain rises, voter's minimum accepted payment rises while her likelihood of voting declines.

Next, I assume that the players are guilt averse. In this case players bear a utility cost when they fail to honor a promise that they made and that promise improves the payoff of the other player. I show that, conditional on the candidate being guilt averse, the type of payment through which vote buying can occur depends on the voter's cost of not keeping her promises. If this cost is sufficiently high, then vote buying can occur with both up-front and conditional payments. However, if the cost is low, vote buying may only occur through conditional payments. Moreover, neither voter's minimum accepted payment nor her likelihood of voting are affected by the potential gains of the candidate. Guilt aversion also predicts that candidate transfers a positive fraction of the amount he promised, despite the fact that his promises are not binding.

Finally, I assume that the voter is reciprocal. This implies that, conditional on observing the candidate taking an action that she considers as kind, the voter gains additional utility from taking an action that improves the payoff of the candidate, even if this action is costly. Under this assumption, I show that vote buying may only occur though up-front payments

[5] In this chapter, whenever required, I refer to the candidate as "he", and the voter as "she" for simplicity.

with payment sizes that are considered as kind by the voter. This requires the payment to be higher than the cost of voting. However, conditional on the payment being higher than the cost of voting, as the potential gain of the candidate rises, voter's minimum accepted transfer declines, while the likelihood of voting a voter who has accepted up-front payment rises.

I test the theoretical predictions of behavioral biases in a lab experiment designed to shed light on which of these biases might be most important in affecting candidate and voter behavior. By varying the gains of the candidate upon winning and the voter's influence on the voting outcome, the experiment allows me to uncover the salient features of the voting environment that make vote buying more likely. Another advantage of using experimental data is the accurate information on the receipt of payments, the delivery of vote as well as the underlying preference of the voter.

My results support the presence of all three behavioral biases: inequity aversion, guilt aversion and voter reciprocity. First, I find that vote buying occurs in a statistically significant fraction of the observations. This allows me to rule out selfish preferences as the sole explanation of behavior. Second, vote buying occurs primarily through conditional payments, which implies that voter reciprocity cannot be the sole behavioral bias behind vote buying; both inequity aversion and guilt aversion may have played a role in enabling vote buying. Third, candidates' offers and payments rejected by voters are positively correlated with the size of the candidate's potential gain, which further supports the presence of inequity aversion in voter preferences. Fourth, for voters who have accepted up-front payment, the likelihood of voting rises in the size of the up-front payment and the candidate's potential gain, which provide support to voter reciprocity. Fifth, voters who have accepted conditional payment are more likely to vote as the size of the up-front payment offers they have been presented rises, which is consistent with Guardado and Wantchékon (2016) and Kramon (2016)'s argument that up-front payment acts as a costly signal, possibly of candidate's trustworthiness/credibility. Sixth, about 50% of the candidates keep their conditional payment promises fully, and 40% of the candidates keep their promises partially, even though there is no enforcement of their promises. This result suggests the presence of guilt aversion in candidate preferences and supports Corazzini, Kube, Maréchal, and Nicolo (2014)'s results that promises are more than cheap talk. Finally, transfer-to-offer ratio is positively correlated with the candidate's potential gain, which points to the need of adding another dimension to the current guilt aversion models; cost of not keeping a promise may be amplified when benefits accrued via that promise increase.

Related Literature and Contribution

This study builds upon and contributes to four strands of literature. The first is on the relationship between behavioral biases and voting behavior. Notably, existing literature in this area focus on almost exclusively on the norm of reciprocity. In a widely cited paper, Finan and Schechter (2012) use data from voter and local broker surveys and field experiments conducted in Paraguay to argue that vote buying is sustained by local brokers' knowledge about voters' attitudes towards reciprocity. Such knowledge enables political parties to target reciprocal voters with small cash transfers or gifts to swing their votes. Lawson and Greene (2014) use survey data from Mexico and argue the same point. In addition, results of Manacorda, Miguel, and Vigorito (2011) De La O (2013) and Zucco (2013) show that incumbents can use welfare programs (such as conditional cash transfers) to successfully increase turnout and favorable votes in the short run, implying that reciprocity is a salient feature of voter behavior. Chang (2016a,b) provides support for the role of reciprocity motive in enabling vote buying both theoretically and experimentally. In a two-candidate one-voter environment, where the voter initially prefers one candidate over the other, Chang allows one of the candidates to make an up-front transfer to the voter. He finds that the transfer increases the likelihood that the voter votes for the candidate making the transfer, regardless of whether he is the voter's initially preferred candidate. Furthermore if a candidate has the ability to make a transfer but chooses not to, then the likelihood of the voter voting for that candidate falls, regardless of voter's initial preference over candidates. Hence, Chang's results suggest that both positive and negative reciprocity play a role in enabling vote buying under ballot secrecy. I complement this literature by showing that the behavioral biases of inequity and guilt aversion may also play a role in vote decisions.

The second strand of literature relates the occurrence of vote buying to the effectiveness of pre- vs. post-voting transfers. Stokes (2005) argues that long term clientelistic relationships (and hence post-voting transfers) with imperfect monitoring of votes incentivize the voters to vote and thereby sustain vote buying in Argentina. Complementing this argument, Hanusch, Keefer, and Vlaicu (2016) argue that vote buying with pre-voting transfers arise when candidates have low credibility. Similarly, Kramon (2016) and Guardado and Wantchékon (2016) contend that pre-voting transfers do not, by themselves, affect voting behavior; instead it is the future benefits that the pre-voting transfers signal motivate voters to vote. My experimental results provide support for this argument by showing that the likelihood of voting increases among voters who choose to accept conditional payment.

Third, this study is related to the literature on moral hazard with social preferences and the effectiveness of pre- vs. post-realization transfers over inducing costly effort. Previous literature has arguments for both types of transfers. For example, inequity aversion supports the use of post-realization transfers; Fehr, Klein, and Schmidt (2007) argue that if employees are inequity averse, contracts that offer voluntary and unenforceable bonus for satisfactory performance are superior to explicit incentive contracts, which in turn are superior to trust contracts that pay a generous wage up-front. Similarly, Dur and Glazer (2008) argue that when workers envy their boss, the worker should get a share from the profit in the optimal contract, regardless of the worker's risk preference. In contrast, reciprocity may support the use of pre-realization transfers. Englmaier and Leider (2012) show generous compensation can substitute for performance-based pay, especially when output is a poor signal of effort. Gneezy and Rey-Biel (2014) provide evidence for the superior effectiveness of noncontingent payments over performance-based pay from a field experiment. I contribute to this strand of literature by studying the interaction between social preferences and payment types in a vote buying context, which is an environment where both the principal and the agent have commitment problems.

Finally, this study contributes to the literature on the behavioral bias of guilt aversion. Existing studies on guilt aversion focus on the role of players' beliefs about other player's payoff expectations. For example, Charness and Dufwenberg (2006), Charness and Dufwenberg (2010) and Battigalli, Charness, and Dufwenberg (2013) consider the effect of communication in the formation of payoff expectations and players' beliefs about these expectations, and Ellingsen, Johannesson, Tjøtta, and Torsvik (2010) focus on the effect of relaying the payoff expectations of other players to decision makers. Additionally, Kawagoe and Narita (2014) compare the guilt resulting from not living up to payoff expectations of other players to not living up to payoff expectations of other players *that are raised by their very own actions*. I contribute to this strand of literature by providing evidence that there exists a relationship between the extent of promise keeping and one's gain. My experimental results show that among candidates who do not keep their promises fully, the candidates whose gains were higher transferred a higher fraction of their promises. This suggests that cost of not keeping a promise may be amplified when benefits accrued via that promise increase.

I proceed as follows. In Section 2, I present my model of the vote buying exchange. In Section 3, I present three different behavioral biases that may account for the occurrence of vote buying. In section 4, I list the testable predictions under each behavioral bias for each stage of the game. In Section 5, I present the experimental design, and Section 6 the experimental results. Finally in Section 7 I offer some concluding remarks.

1.2 A Simple Vote Buying Game

I consider a one-shot interaction of one candidate with one voter. Suppose, as a result of a voting process, the candidate may receive rent $W > 0$ and the voter may affect the candidate's chances of receiving this rent. More specifically, suppose that if the voter votes for the candidate, then the probability of the candidate winning W changes from p to p' where $p \in [0, 1]$ and $p' \in [p, 1]$.[6] The difference in the winning probability can be interpreted in two different ways. First interpretation is about the size of the voting body. For very large voting bodies, an individual voter's contribution to the winning probability is effectively zero. In the model this corresponds to the case $p' = p$. For smaller voting bodies, the contribution of a single vote to the winning probability would be larger than zero. Moreover, for cases where a single vote is pivotal, p' exactly equals 1. Second, this specification also applies to cases where a leader mobilizes a group of voters. This interpretation is consistent with the recent study by Holland and Palmer-Rubin (2015) that focuses on organizational

[6] In modeling the result of the vote as a probabilistic process, I assume that other voters' behavior (which I do not model) is uncertain but both the candidate and the voter have common beliefs about them. The existence of these beliefs can be attributed either to the uncertainty about other voters' preferences or their choice over voting vs. abstaining. This interpretation borrows its intuition from probabilistic voting models. See Mueller (2003) for an overview.

brokers who ”negotiate a price that they will be paid to persuade their members to support the party...” and ”usually, but not always, pass along a portion of this payment as individual or collective goods to mobilize their members for the election.”

It is costly for the voter to vote. This cost, denoted by d, may simply represent the physical costs associated to voting,[7] or it may be viewed as the monetary value of the disutility of voting for a candidate the voter does not initially favor. In this sense, this model does not differentiate between turnout and vote buying; both the cost of turning out and policy preferences are contained in the catchall variable, d.

The candidate may offer to compensate voter's cost of voting, and the compensation may take two different forms: up-front payment (UFP) and conditional payment (CP). With up-front payment, the candidate makes an immediate transfer to the voter upon voter's acceptance of the offer. Thus, up-front payment takes place before the vote with the implicit understanding that the voter will vote. With conditional payment, the candidate promises to make a transfer to the voter only if the candidate wins W. However, this promise is non-binding for the candidate. I denote candidate's offers as the pair $(m_{\text{UFP}}, m_{\text{CP}}) \in \mathbb{R}^2_+$. Up-front payment is financed out of candidate's initial budget, B_c, while conditional payment is financed out of the larger budget, $(B_c + W)$, with the addition of the rent. These conditions restrict the candidate to making offers that he can fulfill.

For simplicity, I assume that the voter can accept at most one type of payment in exchange for her vote. I also assume that players' respective budgets (W, B_c, B_v), the probabilities of winning with and without the voter's vote (p and p'), and the voter's cost of voting (d) are common knowledge.

The game described above is a sequential move game with imperfect information with

[7] For example, the transportation cost of going to the polling station or foregone hourly wages.

the following timing:

1. *Offer stage*

   - *Offer making:* The candidate presents offers $(m_{\text{UFP}}, m_{\text{CP}})$ to the voter.
   - *Offer selection:* Observing the candidate's offers, voter chooses whether to accept compensation from the candidate, and if so, which type of payment she accepts. If the voter accepts up-front payment, m_{UFP} is transferred to the voter.

2. *Voting stage:* In private, voter decides whether to vote for the candidate.

3. *(Post-voting transfer stage):* If the voter has chosen conditional payment at the offer selection stage and the candidate wins W, the candidate decides on the amount of transfer, $t \in [0, B_c + W]$, he makes to the voter.

1.3 Theories of Agent Behavior

In this section I present the main properties of the game equilibria under various behavioral bias assumptions. I start with selfish preferences as the baseline.

Proposition 1.1. ***(Selfish preferences)*** *Suppose both players care only about their own monetary payoffs. Then, vote buying cannot occur due to the double sided commitment problems. In any equilibrium the candidate offers zero up-front payment and does not transfer anything to the voter at the post-election stage, and the voter never votes at the voting stage, regardless of her choice at the offer choice stage.*

Proof. At the post-election stage, regardless of the offer he has made previously and the probabilities p and p', the candidate optimally chooses to transfer nothing to the voter. Anticipating this, the voter does not vote at the voting stage. At the offer stage, voter's optimal strategy is to accept any non-zero up-front payment offer – otherwise the voter is indifferent between accepting a conditional payment offer and not accepting any payment. As a result the candidate never makes a positive up-front payment offer in equilibrium, but may make non-zero conditional payment offers. ∎

Inequity aversion

In their widely cited article Fehr and Schmidt (1999) propose preferences that take inequity concerns into consideration. In a two player game, given material payoffs (π_i, π_j) of players i and j, the utility of player i is given by

$$u_i(\pi_i, \pi_j) = \pi_i - \alpha_i \max\{\pi_j - \pi_i, 0\} - \beta_i \max\{\pi_i - \pi_j, 0\}, i, j \in \{C, V\}, i \neq j \tag{1.1}$$

where the parameters α_i and β_i measure player i's sensitivity to disadvantageous and advantageous inequity, respectively. Following Fehr and Schmidt, I assume $\beta_i \leq \alpha_i$ and $0 \leq \beta_i < 1$ where $i, j \in \{C, V\}$. These parameter assumptions imply that players bear higher utility costs for inequity in cases where the inequity is to their disadvantage (own payoff is lower than the other player's payoff) than to cases where the inequity is to their advantage (own payoff is higher than the other player's payoff).

In the vote buying game, since there is uncertainty over the outcome of the voting process, I assume that players care about the inequity in payoffs in different states of the world (*ex-post* inequity averse), instead of the inequity in expected payoffs (*ex-ante* inequity averse). However, they maximize expected utility and are risk neutral. This implies that players weight the inequity in payoffs in different states of the world proportionally to the relative probabilities of the states.

The equilibria under the assumption of inequity aversion can be divided into two, depending on candidate's sensitivity to advantageous inequity. If the candidate is not particularly averse to inequity in this dimension (i.e. the value of the parameter β_C is less than 0.5) then, in equilibrium, vote buying is only possible via up-front payment. However, if $\beta_C \geq 0.5$, vote buying occurs only via conditional payment in equilibrium. The threshold value of $\beta_C = 0.5$ is due to candidate's comparison of the following two cases: keeping one extra dollar to himself or giving the extra dollar to the voter. While keeping the dollar increases candidate's utility by one unit, giving the dollar to the voter results in a utility loss of $2\beta_C$ units. Below I briefly describe equilibrium behavior under inequity aversion. In the appendix, I provide detailed proof of the results. Since it is a one-shot game, all proofs are done with backward induction.

First, suppose that the candidate is either completely selfish ($\alpha_C = \beta_C = 0$) or is inequity averse with low sensitivity to advantageous inequity ($0 < \beta_C < 0.5$). Then, in equilibrium, the candidate and the voter follow the equilibrium strategies below.

Post-voting transfer: The candidate who is not sufficiently averse to advantageous inequity, regardless of his offers, does not transfer a positive amount to the voter, i.e. $t^* = 0$.

Voting stage: The voter does not vote if she has accepted up-front payment that is less than one-half of the cost of voting, accepted conditional payment, or did not accept payment. The minimum up-front payment offer that also incentivizes the voter to vote, $\underline{x}$, increases as rent (W) increases. Moreover, voter's utility decreases in $(p' - p)W$.

Offer selection stage: The voter accepts positive up-front payment offers. If she receives an offer in which only conditional payment is positive, she does not accept since she expects the candidate to transfer zero in the transfer stage.

Offer making stage: The candidate never makes an up-front payment offer less than the cost of voting, while conditional payment offers may take any value. Candidate's utility increases in $(p' - p)W$, hence equilibrium up-front payment offer increases in $(p' - p)W$.

Proposition 1.2. ***(Candidate insensitive to advantageous inequity).*** *If the candidate's sensitivity to advantageous inequity is sufficiently low ($\beta < 0.5$), then vote buying only occurs with up-front payment.*

Proof. In the appendix. ■

Suppose now that the candidate is inequity averse with high sensitivity to advantageous inequity ($0.5 \leq \beta_C < 1$). Then, the candidate and the voter follow the equilibrium strategies below.

Post-voting transfer: The candidate who is sufficiently averse to advantageous inequity transfers a positive amount, t^*, to the voter where $t^* \in \left[0, \frac{W+d}{2}\right]$. (If $\beta_C > 0.5$, the candidate transfers $t^* = \frac{W+d}{2}$.)

Voting stage: If the accepted up-front payment is less than one-half of the cost of voting, the voter does not vote. The minimum accepted payments that also incentivize the voter to vote, $\underline{x}$ and $\underline{t}$, increases as rent (W) increases. Moreover, voter's utility decreases in $(p' - p)W$.

Offer making stage: Although vote buying with up-front payments is feasible, candidate strictly prefers vote buying with conditional payment if $p' < 1$. If $p' = 1$, this preference is weak. Thus, when vote buying is individually rational and $p' < 1$, he makes a positive conditional payment offer while he never makes a positive up-front payment offer.

Proposition 1.3. ***(Candidate sensitive to advantageous inequity).*** *If the candidate's sensitivity to advantageous inequity is sufficiently high ($\beta_C \geq 0.5$), then vote buying only occurs with conditional payment.*

Proof. In the appendix. ∎

Guilt aversion

Guilt is driven from a player's failure to live up to expectations (Baumeister, Stillwell, and Heatherton, 1994). Beliefs have originally been incorporated into utility through psychological games by Geanakoplos, Pearce, and Stacchetti (1989). Battigalli and Dufwenberg (2007) formalize and extend this idea to introduce two concepts of guilt aversion. With *simple guilt*, a player cares about whether and how much he lets another player down, while *guilt from blame* assumes that a player cares about "others' inferences regarding how much he is willing to let them down." Thus, with simple guilt, players bear a utility cost when they fail to honor a promise that they made and honoring that promise improves the payoff of the other player.

In the context of the vote buying game, I consider the concept of simple guilt and derive its consequences on the behavior of the candidate whose positive conditional payment offer is accepted, and the voter who has accepted some form of payment.

The form of the utility function incorporating simple guilt aversion is

$$u_i = \pi_i - \Phi_i C_i(.) \quad i \in \{C, V\} \tag{1.2}$$

where π_i denotes player i's material payoff, $\Phi_i \geq 0$ denotes his sensitivity to not keeping his promise and $C_i(.)$ denotes the cost of not keeping his promise. Following Corazzini, Kube, Maréchal, and Nicolo (2014), I assume the candidate's cost of not keeping his promise increases with the promise, m_{CP}, and is convex in the difference between his promise and the actual transfer, $(m_{\text{CP}} - t)$. For the voter, the cost of not keeping her promise increases with candidate's probability of winning if the voter votes, p', and is convex in the voter's contribution to winning probability, $(p' - p)$. Moreover, the voter does not bear a cost if her contribution to the winning probability is zero, i.e. $(p' - p) = 0$. Below is a summary of the equilibrium behavior in each stage of the game. Detailed proof of the results is provided in the appendix.

Post-voting transfer: The candidate transfers a fraction of his conditional payment offer, i.e. $t^* \leq m_{\text{CP}}$.

Voting stage: If the cost of voting is less than the cost of not keeping her promise ($d < \Phi_V C_v(p', p)$), the voter votes when she accepts some form of payment. However, in the opposite case ($d \geq \Phi_V C_v(p', p)$), the voter votes only if she has accepted conditional payment and the transfer of the candidate is sufficient to cover the difference between the cost of not keeping her promise and the cost of voting.

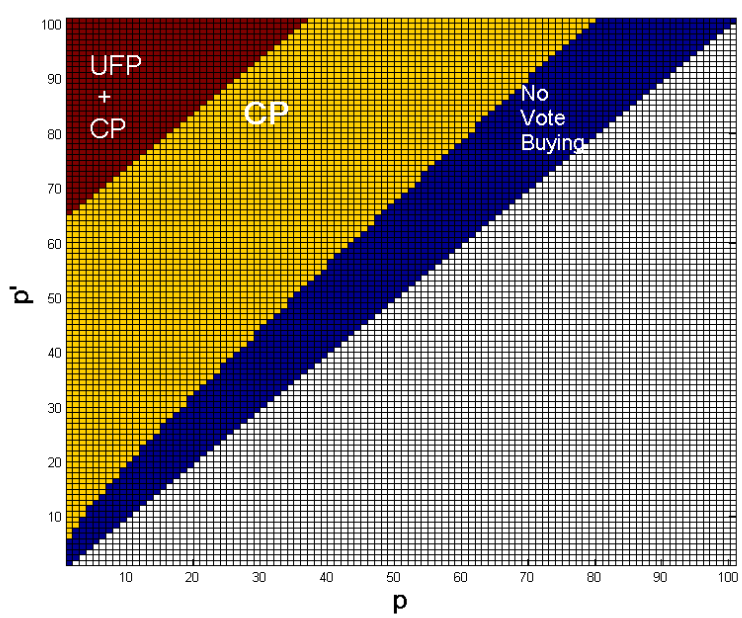
Offer stage: If the cost of voting is less than the cost of not keeping her promise ($d < \Phi_V C_v(p', p)$) and vote buying is individually rational for the candidate, the candidate makes the offer $(m_{\text{UFP}}, m_{\text{CP}}) = \left(d, \frac{d}{p'}\left(\frac{\Phi_C}{\Phi_C - 1}\right)\right)$. If the cost of voting is greater than the cost of not keeping her promise, the candidate chooses $m_{\text{UFP}} = 0$, while the optimal conditional payment offer depends on the difference of cost of voting and not keeping her promise.

Proposition 1.4. ***(Guilt aversion).*** *Suppose both the candidate and the voter are guilt averse. If the voter's cost of not keeping her promise is greater than the cost of voting, then vote buying occurs with either up-front or conditional payment; if voter's cost of not keeping her promise is less than the cost of voting, then vote buying occurs only with conditional payment.*

Proof. In the appendix. ■

Figure 1.1 demonstrates the equilibrium outcome in terms of vote buying over the (p, p') space, with parameters $W = 200$, $\Phi_C = 4$ and $\Phi_V = 50$. At the region where voter's guilt is larger than the cost of voting, the candidate buys the vote with either up-front payment or conditional payment. Whenever voter's guilt is smaller than the cost of voting, vote buying occurs with conditional payment.

Figure 1.1
Vote-buying Outcomes with Guilt Aversion, $W = 200$**,** $\Phi_C = 4$**,** $\Phi_V = 50$



Voter Reciprocity

Formally incorporated into game theory by Rabin (1993), reciprocity is based on the idea that people would like to be kind to people who are kind to them, while they are willing to take costly actions that harm the people who have been unkind to them. Extending this idea into sequential games, Dufwenberg and Kirchsteiger (2004) allow a player's belief about other players' kindness to depend on the history of the game. In the context of the vote buying game, I consider how voter reciprocity may bring forth vote buying with up-front payments.[8] I assume that the candidate is selfish but the voter is reciprocal. Utility incorporating the voter's reciprocity motives has the form

$$U_V(\pi_v, \pi_c) = \pi_v + \theta k_c \pi_c \tag{1.3}$$

where π_v, π_c denote the material payoffs of the voter and candidate, respectively, while $\theta > 0$ denotes voter's sensitivity towards candidate's payoff, and k_c is candidate's kindness towards the voter. I assume the voter perceives up-front payment offers greater than the cost of voting as "kind".[9] Following Cabral, Ozbay, and Schotter (2014), I also assume that candidate's kindness increases in the magnitude of his sacrifice, i.e. the size of the up-front payment offer. Thus candidate's kindness towards the voter is given by

$$k_c(x) = I_{x>d} x \tag{1.4}$$

[8]Except for the special case where $(p, p') = (0, 1)$, it is impossible for the the candidate to observe the vote decision. Moreover, since voting decision takes place after the choice of payment type, the candidate is less likely to perceive actions of the voter as kind.

[9]Since offering positive up-front payment is risky for the candidate, at first glance, it may be considered as kind. However, if the up-front payment does not cover the cost of voting, positive reciprocation results in the voter to have lower material payoff than if she does not accept the payment at all. In this case we have a paradoxical situation where the voter is grateful towards the candidate who is making her worse off in material payoffs.

where x denotes the up-front payment offer, $I_{x>d}$ is an indicator variable that takes a value of 1 if the up-front payment is greater than the cost of voting and 0 otherwise. Below is a summary of the equilibrium behavior in each stage of the game.

Post-voting transfer: The candidate does not transfer a positive amount to the voter i.e. $t^* = 0$.

Voting stage: The voter does not vote if she accepts up-front payment that is less than the cost of voting, conditional payment or if she does not accept payment. The minimum up-front payment that incentivizes the voter to vote is greater than the cost of voting and decreases in candidate's expected gain, $(p' - p)W$.

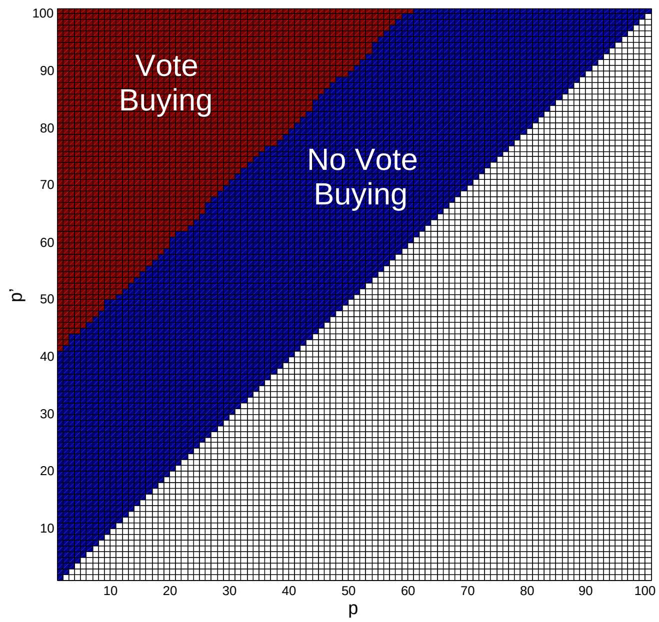
Offer stage: The candidate makes the up-front payment offer $m_{\text{UFP}} = \frac{d}{\theta(p'-p)W}$ whenever this amount is greater than the cost of voting and vote buying is individually rational.

Proposition 1.5. ***(Voter reciprocity).*** *If the candidate is selfish and the voter is reciprocal, vote buying occurs only with up-front payment.*

Proof. In the appendix. ■

Figure 1.2 demonstrates the equilibrium outcome in terms of vote buying over the (p, p') space, with parameters $W = 50$, $B_C = 20$ and $\theta = 0.025$. Vote buying occurs only at the north-west corner of the (p, p') space. In the region marked with blue, either vote buying is not rational or the candidate cannot afford the minimum payment that incentivizes the voter to vote.

Figure 1.2
Vote-buying Outcomes with Voter Reciprocity, $W = 50$**,** $\theta = .025$



1.4 Experiment

The experiment was run at the Experimental Economics Laboratory at the University of Maryland (EEL-UMD). 158 undergraduate students at the University of Maryland participated. Five sessions were conducted in Summer 2015 for each of the treatments, high and low rent ($W = 50$ and $W = 200$). No subject participated in more than one session. Participants were seated in isolated booths. The experiment was programmed in z-Tree (Fischbacher, 2007).

At the beginning of each session, one half of the participants were assigned randomly to the role of ”candidate” and the other half was assigned to the role of ”voter”. These roles stayed fixed throughout the session. In a session, candidates were paired randomly and anonymously with voters in each of the 20 periods. Candidate's rent (W) was kept constant throughout a session.

In each period, the candidate and the voter had the same initial token endowment ($B_C = B_V = 20$), the cost of voting was the same ($d = 10$), and each pair was assigned two numbers: the candidate's initial probability of winning (p), and the candidate's probability of winning if the voter votes (p'). These numbers were drawn randomly from uniform distributions.[10,11] After both the candidate and the voter were informed about the winning probabilities, the candidate was asked to decide on his offers for the two possible forms of payment, up-front and conditional payment, to the voter in exchange for her vote. The voter was then informed about the candidate's offers, and was asked to decide whether she wanted to accept an offer from the candidate and if so, which type of payment she accepted. The voter's decision at this step was relayed to the candidate. Next, the voter was asked whether she wanted to vote for the candidate. Voting decision was not relayed to the candidate. If the voter decided to vote, the election took place with the candidate's probability of winning being p', otherwise it took place with winning probability p. If the voter had accepted conditional payment from the candidate at the offer stage and the candidate had won, the candidate was reminded of his conditional payment offer and was asked to choose an amount to transfer to the voter.

Earnings in each period depended on whether vote buying took place, and if so, which type of payment was accepted by the voter and the result of the election lottery. After all periods were finished, one round of the 20 was chosen randomly and the participants were paid their earnings on that round. The participants were also paid a participation fee of \$5. Participants earned \$13 on average. Screen shots from the experiment program and a copy of the instructions are provided in the Appendix.

[10] p was drawn from $U[0, 1]$, while p' was drawn from $U[p, 1]$.

[11] For each treatment, in three out of five sessions, the same set of (p,p') pairs were presented to the subjects. I refer to data from these sessions as "matched." For the remaining two sessions of each treatment, the (p,p') pairs are not matched one-to-one between treatments. I use the latter data only for regression analysis.

1.5 Hypotheses

The testable predictions of each behavioral bias based on the occurrence of vote buying and the stages of the game is given below.

1.5.1 Vote buying

Define vote buying as the voter accepting some type of payment and then voting for the candidate. Thus, if the voter accepts payment but does not vote, vote buying does not occur. The predictions of different theories are:

Selfish preferences: Vote buying never occurs.

Inequity Aversion: Vote buying occurs via either up-front or conditional payment for some probability pairs (p, p').

Guilt Aversion: Vote buying occurs via either up-front or conditional payment for some probability pairs (p, p').

Voter Reciprocity: Vote buying occurs only via up-front payment for some probability pairs (p, p').

1.5.2 Offer stage

Selfish preferences: Candidate never offers positive up-front payment, but may make positive conditional payment offer.

Inequity Aversion: Candidate makes positive offers in either payment types for some probability pairs (p, p'). The likelihood of candidate making positive offers increases in candidate's marginal expected rent, $(p' - p)W$. The size of offers increase as the candidate's rent, W, increases.

Guilt Aversion: Candidate makes positive offers for some probability pairs (p, p'); the likelihood of candidate making positive offers increases in candidate's marginal expected rent, $(p' - p)W$. Up-front payment offer is equal to the cost of voting, while conditional payment is, in expectation, greater than or equal to the cost of voting. Size of payments in rejected offers by the voter do not respond to changes in the candidate's rent.

Voter Reciprocity: Candidate makes positive offers for some probability pairs (p, p'); the likelihood of candidate making positive offers increases in candidate's marginal expected rent, $(p' - p)W$. Whenever positive, the candidate offers up-front payment greater than the cost of voting.

1.5.3 Voting stage

Selfish preferences: Voter never votes.

Inequity Aversion: Conditional on accepting payment, voter's likelihood of voting increases in the payment she has accepted, and decreases in candidate's marginal expected earning, $(p' - p)W$.

Guilt Aversion: If the voter has accepted up-front payment, voter's likelihood of voting increases in her contribution to winning probability, $(p' - p)$. If she has accepted conditional payment, voter's likelihood of voting increases in the conditional payment offer and her contribution to winning probability, $(p' - p)$.

Voter Reciprocity: If she has accepted up-front payment, voter's likelihood of voting increases in up-front payment and candidate's marginal earning, $(p' - p)W$.

1.5.4 Transfer stage

Selfish preferences: Candidate does not transfer anything to the voter, i.e. $t^* = 0$.

Inequity Aversion: Candidate transfers a positive amount, $t^* \in \left[0, \frac{W+d}{2}\right]$.

Guilt Aversion: Candidate transfers a positive amount, $t^* \in [0, m_{\mathrm{CP}}]$. The average transfer-to-offer ratio does not respond to changes in candidate's rent.

Voter Reciprocity: Candidate does not transfer anything to the voter, i.e. $t^* = 0$.

1.6 Results

In this section I analyze the data with respect to five main questions. The first two questions are whether vote buying occurs and the conditions under which vote buying occurs. Answers to these questions provide a description of the data as well as shed light on whether behavioral biases are present. Next, I analyze the candidate behavior at the offer making stage. Specifically, I consider the candidates' utilization of up-front and conditional offers and investigate the factors behind their decision on how much to offer. Fourth, I analyze voter behavior. I start with analyzing voters' choice on offers. Then, taking the offers made by the candidates as given, I compare voters' choices with predicted behavior by various behavioral biases. Next, I investigate the factors behind voters decision over voting. Finally, I examine candidates' behavior at the transfer stage.

1.6.1 Does vote buying occur?

Vote buying occurs when some form of payment (up-front or conditional) is accepted by the voter and the voter votes. With selfish preferences, vote buying is not predicted to occur. In contrast to the prediction of selfish preferences, however, vote buying occurs in 33% of the observations. This number is significantly different from 0%.[12] This result allows me to reject selfish preferences as the sole explanation of behavior.

Does the occurrence of vote buying change with respect to the candidate's rent? Proportions test indicates that the there is a statistically significant relationship between the occurrence of vote buying and the size of the rent. Table 1.1 presents the fraction of observations where vote buying occurs for each rent size. In the low rent treatment, vote buying occurs in 29% of the observations. In the high rent treatment this number is 36%.

Table 1.1
Fraction of observations where vote buying occurs w.r.t. rent

	Low (W=50)	**High (W=200)**	**Proportions Test**
Vote Buying Occurs	.29 (0.02)	.36 (0.02)	z = -2.27 (two sided) p = 0.023
Number of Cases	140	173	
Total Observations	480	480	

Data from matched sessions. Standard errors in parentheses.

1.6.2 How does vote buying occur?

Next question is which payments are used to buy votes; up-front or conditional payment? Does the payment used depend on the winning probabilities and the rent?

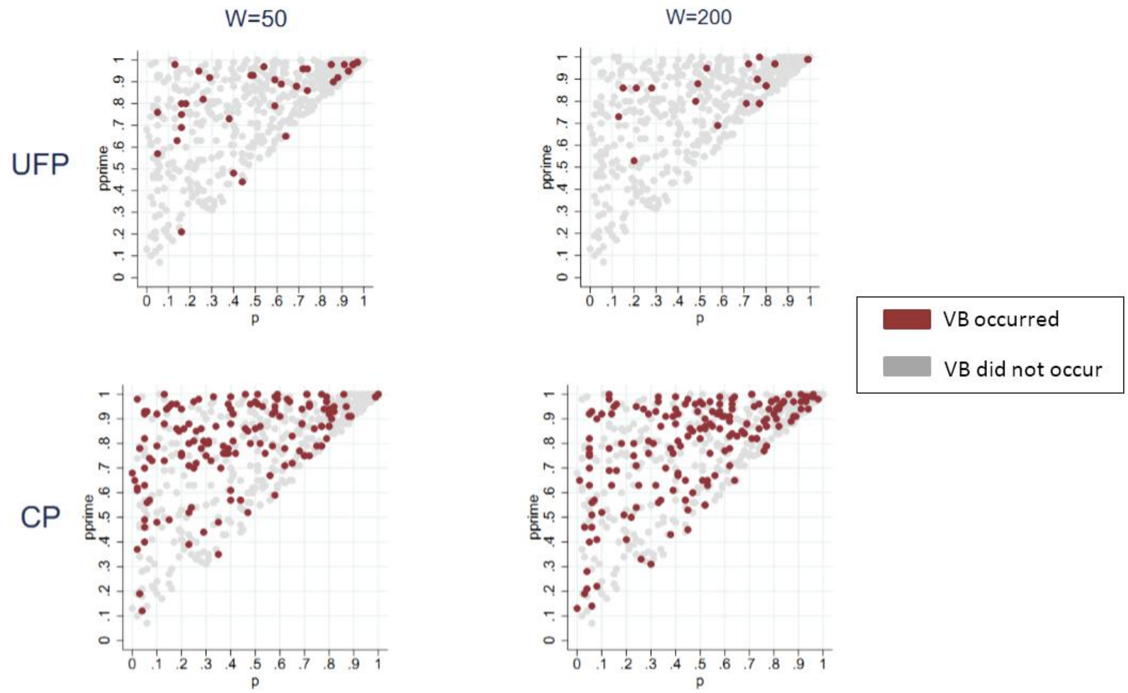
I find that vote buying occurs predominantly through conditional payments, which provides support for the presence of inequity and guilt aversion, and rules out voter reciprocity as the sole bias enabling vote buying. Of the observations where vote buying occurs, 86% are bought with conditional payments. This number is significantly different from 50%.[13]

Figure 1.3 provides a first look at the payments used for vote buying in different treat-

[12] Binomial test, $H_0 : p(vb) = 0.05$ $prob(p(vb) \neq 0.05) = 0.000$. The number 0.05 allows for the possibility of errors by subjects.

[13] One sample test of proportion, z = 16.60, p=0.000

Figure 1.3
Occurrence of vote buying with up-front and conditional payments, conditional on candidate's rent



Data from matched sessions.

ments. For each (p, p') pair presented to the subjects in the matched sessions, the figure indicates whether vote buying has occurred with the specified payment type and at the corresponding rent size. Observe in the figure that vote buying predominantly occurs via conditional payment. Furthermore the occurrences of vote buying are not exclusively concentrated in the northern region of the graphs, indicating that pivotality ($p' = 1$) is a not a good predictor of vote buying. Table 1.2 reports the fraction of observations where conditional payment is used for vote buying for each treatment. In the low rent treatment, vote buying occurs with conditional payment in 79% of the observations where vote buying happens. In the high rent treatment this number is 91%.[14] Mann-Whitney test indicates that the difference in vote buying with conditional payment with respect to treatments is

[14]These percentages are both significantly different from 50%. (Proportions test. Low rent: z=6.93, p=0.000. High Rent: z=10.72, p=0.000).

statistically significant.

Table 1.2
Fraction of observations where conditional payment is accepted for vote buying

	W=50	W=200	Mann-Whitney U-test
Conditional Payment	.79 (.03)	.91 (.02)	z = -2.87 p = 0.004
Observations where vote buying occurs	140	173	

Data from matched sessions. Standard errors in parentheses.

1.6.3 How do candidates make offers?

In this section I analyze how candidates behave at the offer making stage. Particularly, do candidates make offers that are positive in both payment types? If so, do the offers compensate for the cost of voting?

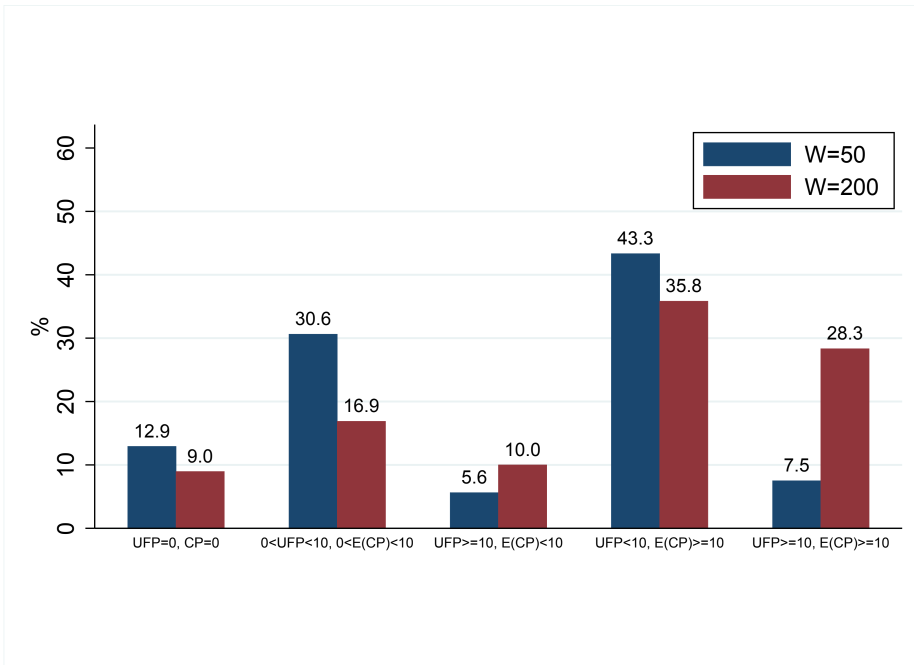
To answer these questions, in Figure 1.4, I classify the offers with respect to whether the payments cover the cost of voting, and if so, which type of payment covers the cost of voting. The distributions of offers with respect to this classification are significantly different between the two treatments.[15] Notice that the offers in the first two categories do not cover the cost of voting in either of the payment types, up-front or conditional payment. Hence, the share of the offers that do not cover the cost of voting is 44% for the low rent treatment and 26% for the high rent treatment.

The offers in the last three offer categories (3-5) cover the cost of voting in either up-front or conditional payments (or both). For these categories, the first thing to notice is candidates' predominant use of conditional payments to convince their voter counterparts.

[15] Pearson Chi-Square test, chi2(4)=89.97 p=0.000.

The share of offers that cover the cost of voting in only conditional payment type is 43% for low rent treatment, while this number is 36% for high rent treatment. Given that up-front payments are risky for candidates, it is also unsurprising that offers that cover the cost of voting only with up-front payments is made least frequently.

Figure 1.4
Distribution of offers w.r.t. cost of voting and rent



Data from matched sessions.

What motivates candidates to make offers that cover the cost of voting? For all behavioral biases considered, the equilibrium behavior of candidate depends the winning probabilities, (p, p'), and expected marginal gain of the candidate, $(p' - p)W$. I define an indicator variable (”offer¿d”) which takes on the value 1 if the offer falls into categories (3-5) and 0 otherwise. Results from probit regressions reported in Table 1.3 indicate that in deciding whether to make offers that cover the cost of voting, candidates take winning probabilities into consideration, but they are not concerned with their marginal expected gain, $(p' - p)W$. Moreover, the candidates in the high rent treatment are more eager to buy votes.

Table 1.3
Determinants of candidate choice on making offers that cover the cost of voting, I(Offer≥d)=1

	(1)	(2)	(3)	(4)
p	-5.27***	-4.48***	-5.20***	-4.33***
	(1.29)	(0.82)	(1.31)	(0.82)
p′	7.06***	6.92***	6.73***	6.17***
	(1.36)	(0.93)	(1.40)	(0.89)
(p′-p)*W	-0.01	-0.01	-0.01	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)
p′W	-0.00	-0.01		
	(0.01)	(0.00)		
High Rent	0.30	1.10**	0.08	0.61***
	(0.69)	(0.45)	(0.26)	(0.14)
period	0.02	0.02*	0.02	0.02
	(0.02)	(0.01)	(0.02)	(0.01)
Constant	-1.28***	-1.72***	-1.19***	-1.49***
	(0.36)	(0.28)	(0.39)	(0.26)
Observations	800	1400	800	1400
Sessions	Matched	All	Matched	All

Random effects probit regression with candidate's offer covering cost of voting on either type of payment as dependent variable (offer>d=1). All regressions include subject fixed effects. Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01.

Next, I consider the average size of offers with respect to the rent, which provides a test on the presence of inequity aversion. Table 1.4 reports the average offers conditional on (i) the offers being nonzero, and (ii) the offers covering the cost of voting. Notice that regardless of whether the offers are positive or the offers are greater than the cost of voting, average offers in each payment type is significantly higher in the high rent treatment. It is also worth noting that the ratio of conditional payment offer to candidate's budget, $(B+W)$, after winning declines as rent increases. Hence, although inequity aversion makes offers positively correlated to the rent, there is no universal offer-to-budget ratio that candidates use as a rule of thumb when making conditional payment offers.

What factors into candidates' decisions on the size of the offers? Tobit regressions in

Table 1.4
Average offers w.r.t Rent Size

		W=50	W=200	Mann -Whitney U-test	Observations (N_{50}, N_{200})
*(i) If offer is positive**	UFP	7.24	11.33	z = -7.00	(164, 252)
		(0.35)	(0.37)	p = 0.000	
	CP	21.91	42.78	z = -8.46	(394, 421)
		(0.77)	(1.80)	p = 0.000	
	E(CP)	16.60	31.15	z = -8.17	
		(0.65)	(1.30)	p = 0.000	
	CP/(B+W)	.31	.19	z = 9.48	
		(0.01)	(0.01)	p = 0.000	
*(ii) If offer covers cost of voting***	UFP	12.08	13.96	z = -2.68	(63, 184)
		(0.41)	(0.33)	p = 0.007	
	CP	29.14	54.75	z = -9.97	(244, 308)
		(0.93)	(2.06)	p = 0.000	
	E(CP)	23.20	40.15	z = -8.99	
		(0.79)	(1.47)	p = 0.000	
	CP/(B+W)	.42	.25	z = 11.21	
		(0.01)	(0.01)	p = 0.000	

Data from matched sessions. Standard errors in parentheses.
*For conditional payment, expected value of the offer must be positive.
**For conditional payment, expected value of the offer must cover the cost of voting.

Table 1.5 provide a more detailed picture on candidates' offer making behavior. In general, candidates rely on the winning probabilities (p, p') and on the size of the rent when making their decisions on how much to offer. Furthermore, as candidates gain more experience in playing the game, they use conditional payments more frequently than up-front payments. This is indicated by the coefficient of the variable "period" having opposite signs in regressions for up-front payment and conditional payment.

Table 1.5
Determinants of offer size

	(1) m_{UFP}	(2) m_{CP}	(3) m_{CP}/B+W
p	-7.83***	-26.64***	-0.38***
	(3.01)	(6.19)	(0.04)
p′	7.41**	5.45	0.25***
	(3.38)	(6.87)	(0.05)
(p′-p)*W	0.02	0.04	-0.00***
	(0.02)	(0.04)	(0.00)
High Rent	23.73***	-4.53	-0.31***
	(4.06)	(6.97)	(0.05)
period	-0.49***	0.26**	0.00*
	(0.06)	(0.12)	(0.00)
Constant	-8.78**	38.32***	0.48***
	(3.63)	(5.46)	(0.04)
Observations	960	960	960

Data from matched sessions. Random effects tobit regression with candidate's offer as dependent variable. All regressions include subject fixed effects. Standard errors in parentheses; * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

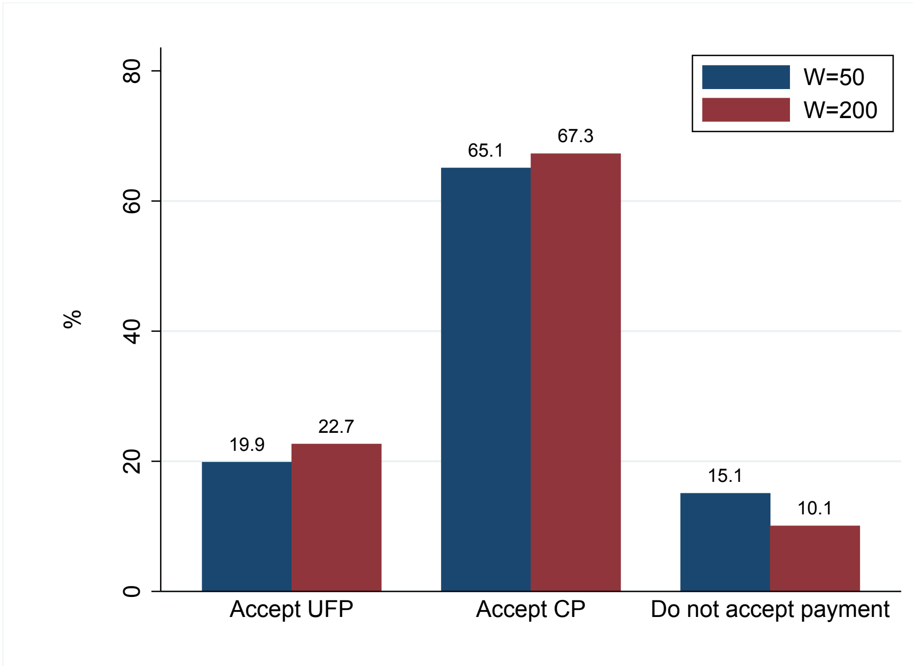
1.6.4 How do voters behave?

Offer stage

How do voters behave when they are offered positive payments? Do they prefer one type of payment over another one? Do the voters reject positive offers? What determines whether voters reject a positive offer?

Figure 1.5 provides an overview of voter choice at the offer stage. Voter choice distributions in the figure are conditional on the offers where both type of payments are nonzero. Overall, voters choose conditional payments in 66% of the observations, and voter choice distributions are not significantly different with respect to the rent size (Pearson Chi-Square test, p=0.074). However, since the choice of the voter depends on the offer she is presented, and the distribution of the offers are very different in the two rent treatments, comparison

Figure 1.5
Voter choice at the offer stage, excluding offers (UFP, CP)=(0,0)



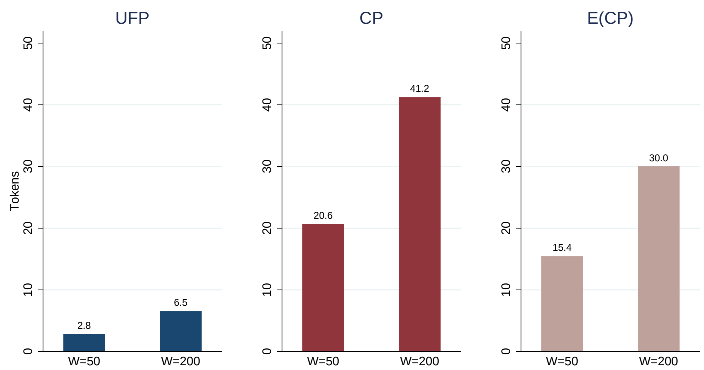
Data from matched sessions. $N_{W=50} = 418$ $N_{W=200} = 437$.

of these distributions leads to an incomplete picture.

Table 1.6 presents the results of regressions on the variable "accept payment", controlling for offer sizes, period, and the candidate's expected earning. Results indicate that voters are less likely to accept receiving payment in the high rent treatment. This finding is also supported by the average payments rejected by the voters, presented in Figure 1.6. Panel (a) reports average offers for which voters have chosen the option "do not accept" at the offer stage, excluding (UFP,CP)=(0,0), with respect to the rent size. For both up-front and conditional payments, the average rejected payment is significantly higher in the high rent treatment.[16] Panel (b) shows that the same relationship holds for individual offers of payments that cover the cost of voting.[17]

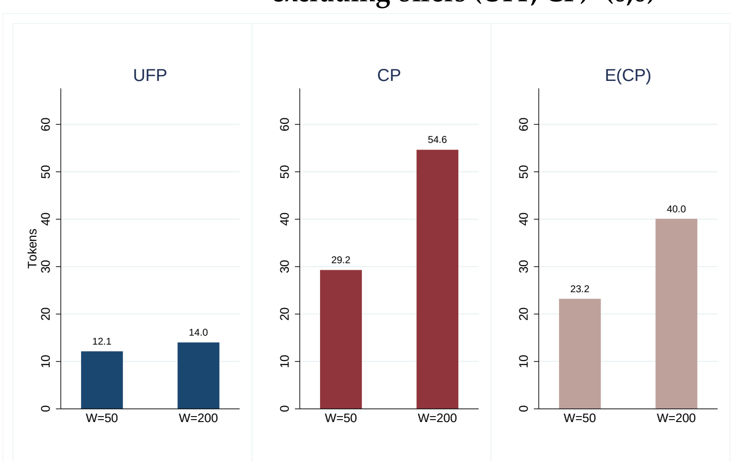
[16] Mann-Whitney test: (i) UFP: z=-7.48 p=0.000, (ii) CP: z=-8.40 p=0.000, (iii) E(CP): z=-8.35 p=0.000
[17] Mann-Whitney test: (i) UFP: z=-3.43 p=0.001, (ii) CP: z=-14.22 p=0.000, (iii) E(CP): z=-12.80 p=0.000

Figure 1.6
Average rejected payments



Data from matched sessions. $N_{W=50} = 418$ $N_{W=200} = 437$

(a) Average payments in offers for which voter has chosen ”do not accept”, excluding offers (UFP, CP)=(0,0)



Data from matched sessions. UFP: $N_{W=50} = 97$ $N_{W=200} = 293$. CP, E(CP): $N_{W=50} = 405$ $N_{W=200} = 520$

(b) Average rejected payments that cover the cost of voting

Table 1.6
Determinants of accepting payment

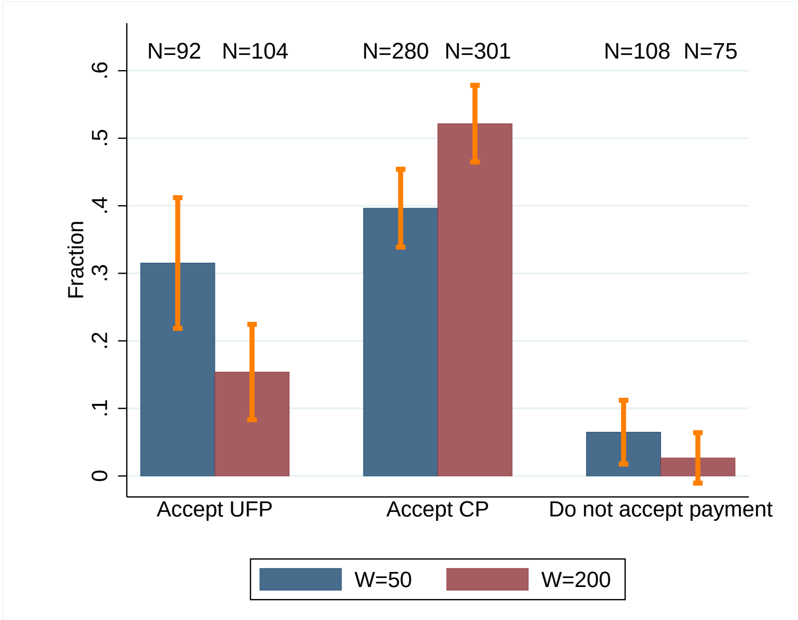
	(1)	(2)	(3)	(4)
UFP Offer	0.09***	0.13***	0.05**	0.08***
	(0.02)	(0.03)	(0.02)	(0.02)
E(CP offer)	0.04***	0.03***	0.02***	0.01**
	(0.01)	(0.01)	(0.01)	(0.00)
(p′-p)*W	0.00	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
High Rent	-0.20**	-0.32***	-0.10	-0.16***
	(0.08)	(0.08)	(0.10)	(0.06)
Period	0.01	0.01	0.03	0.03**
	(0.02)	(0.01)	(0.02)	(0.01)
Offer cat. 3-5			0.04	0.31*
			(0.25)	(0.17)
Offer non-zero			1.89***	2.12***
			(0.27)	(0.24)
Constant	1.09***	0.25*	-0.36	-1.17***
	(0.22)	(0.15)	(0.29)	(0.20)
Observations	960	1580	960	1580
Data	Matched	All	Matched	All

Random effects probit regression with accepting payment as dependent variable. ”Offer cat. 3-5” takes on value 1 if the offer covers the cost of voting in either of payment types, 0 if otherwise. ”Offer non-zero” takes on value 1 if the offer is (0,0) and 0 otherwise. All regressions include subject fixed effects. Standard errors in parentheses; * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

Voting stage

Next, I consider the behavior at the voting stage. As an overview, Figure 1.8 shows the fraction of observations where voting has occurred, conditional on the choice at the offer stage and the rent size. It is not surprising that the highest fraction of voting coincides with the choice of accepting conditional payment at the offer stage – by voting, the voter may think that she is improving her likelihood of receiving payment. However, note that from the perspective of selfish preferences, it is impossible to explain the positive fraction of voting; conditional on acceptance of up-front payment, voting is irrational if the voter is selfish; conditional on acceptance of conditional payment, voting requires the voter to

Figure 1.8
Voter choice at the voting stage,
conditional on choice at the offer stage and rent size



Data from matched sessions.

believe that the candidate is not selfish.

Table 1.7 presents the regression results on voting. First, the likelihood of voting increases in both up-front and expected conditional payment offers. Moreover, having accepted some payment (either up-front or conditional payment) increases the likelihood of voting, which provides support for the presence of guilt aversion. Not surprisingly, however, accepting up-front payment is less motivating than accepting conditional payment. Finally, the significant negative effect of high rent is consistent with the inequity averse voter's utility decreasing in W.

Additionally, I analyze voting behavior conditional on accepted payment types. First, on columns (1) and (2) in Table 1.8 I report the results of the regression results on voting, conditional on acceptance of up-front payment. The significant effect of the size of up-front payment on the likelihood of voting provides support for voter reciprocity. Presence

Table 1.7
Determinants of voting

	(1)	(2)
UFP Offer	0.04***	0.05***
	(0.01)	(0.01)
E(CP offer)	0.02***	0.02***
	(0.00)	(0.00)
p	-2.39***	-2.07***
	(0.79)	(0.63)
p′	2.73***	2.20***
	(0.77)	(0.66)
(p′-p)*W	-0.01	-0.00
	(0.01)	(0.00)
Accept	2.32***	2.69***
	(0.56)	(0.53)
Accept UFP	-1.23***	-1.58***
	(0.33)	(0.27)
High Rent	-0.72**	-1.93***
	(0.35)	(0.20)
Period	-0.06***	-0.05***
	(0.02)	(0.01)
Constant	-4.02***	-1.89***
	(0.64)	(0.48)
Observations	960	1580
Data	Matched	All

Random effects probit regression with "vote" as dependent variable. "Accept" takes on value 1 if the voter accepts either UFP or CP, 0 if otherwise. "Accept UFP" takes on value 1 if the voter accepts UFP and 0 otherwise. All regressions include subject fixed effects. Standard errors in parentheses; * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

of voter reciprocity is also supported by the significant positive effect of high rent and the probability of winning with the vote (p′) on the likelihood of voting.

Next, on columns (3) and (4), I report the regression results on voting, conditional on acceptance of conditional payment. The positive effect of expected conditional payment suggests that the voters do believe the promises of the candidates. Moreover, the positive effect of up-front payment offers (which has been rejected in favor of conditional payment) on the likelihood of voting suggest that voters use up-front payment offer as a signal about the candidate's credibility/trustworthiness. Finally, voters in the high rent treatment are less likely to vote, which is consistent with the predicted voting behavior under inequity aversion.

Table 1.8
Determinants of voting, conditional on accepted payment type

	(1)	(2)	(3)	(4)
UFP Offer	0.39**	0.34***	0.07***	0.07***
	(0.19)	(0.12)	(0.02)	(0.01)
E(CP offer)	-0.01	-0.01	0.03***	0.020***
	(0.05)	(0.02)	(0.01)	(0.01)
p	-2.89	-4.08	-2.95***	-2.31***
	(3.44)	(3.16)	(1.13)	(0.75)
p′	11.37**	10.95***	2.88**	2.10**
	(4.87)	(3.93)	(1.25)	(0.82)
(p′-p)*W	0.02	-0.01	-0.00	0.00
	(0.03)	(0.02)	(0.01)	(0.01)
High Rent	2.86**	-0.70	-1.25***	-2.16***
	(1.42)	(0.74)	(0.47)	(0.24)
Period	-0.15	-0.14*	-0.08***	-0.06***
	(0.10)	(0.08)	(0.02)	(0.01)
Constant	-12.81**	-8.79***	-1.61***	0.78**
	(5.40)	(3.40)	(0.53)	(0.31)
Observations‡	43	54	516	817
Data	Matched	All	Matched	All
Conditional on	UFP Accepted	UFP Accepted	CP Accepted	CP Accepted

Random effects probit regression with "vote" as dependent variable. All regressions include subject fixed effects. Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01. ‡Regressions exclude data from several subjects as the dependent variable "vote" takes only one value.

1.6.5 Transfer stage behavior of candidates

How do the candidates behave once they win? How much do candidates transfer to their voter counterparts? To what extent do candidates keep their promises? Is candidates decision to honor their promises affected by factors such as the size of their earnings and voter's contribution to the winning probability?

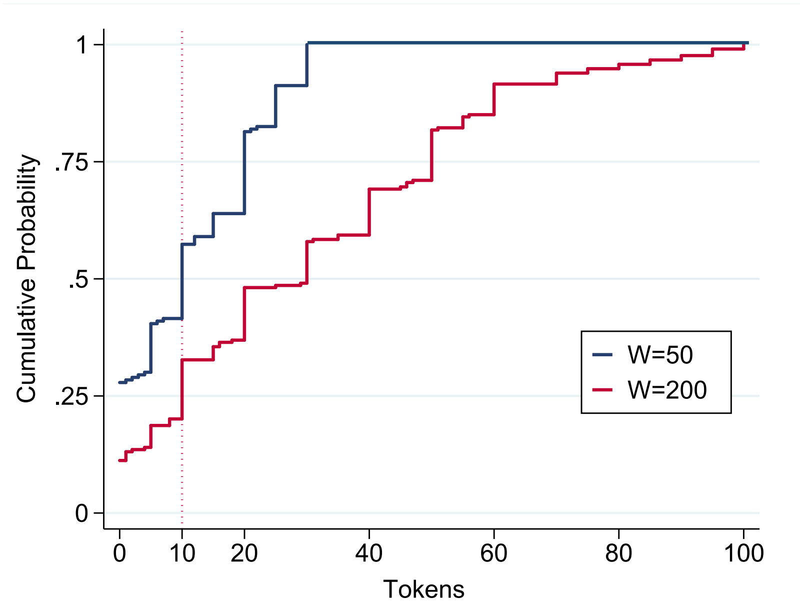
Figure 1.9 provides the cumulative distribution function of the transfers made by the candidate for each treatment. It is worth noting that candidates choose not to transfer anything to the voter in 27% and 11% of the observations in the low and the high rent treatments, respectively. This discrepancy also holds for transfers that do not cover the cost of voting: in 40% and 20% of the observations, respectively, candidates make transfers less than 10 tokens.

Given the large difference between transfer distributions in the low and high rent treatments, the question of whether the higher transfers are driven by the higher promises or simply due to having a large budget arises. Regression results reported on columns (1) and (2) of Table 1.9 aim to answer this question. Results suggest that both factors matter; both high rent treatment and conditional payment offers have a significant positive effect on transfers. The former result provides support to candidate inequity aversion while the latter result provides support to guilt aversion. Moreover, the significant positive effect of up-front payments suggests that candidates signal their intention of making a transfer by making positive up-front payment offers.

Finally, Figure 1.10 provides an overview to candidates' promise-keeping behavior. It is striking that in both treatments approximately 50% of the observations have candidates' keeping their promises fully. Figure 1.11 provides the transfer-to-offer ratios of individual candidates in the matched sessions, which shows that promise keeping is the predominant feature of almost all candidates' behavior.

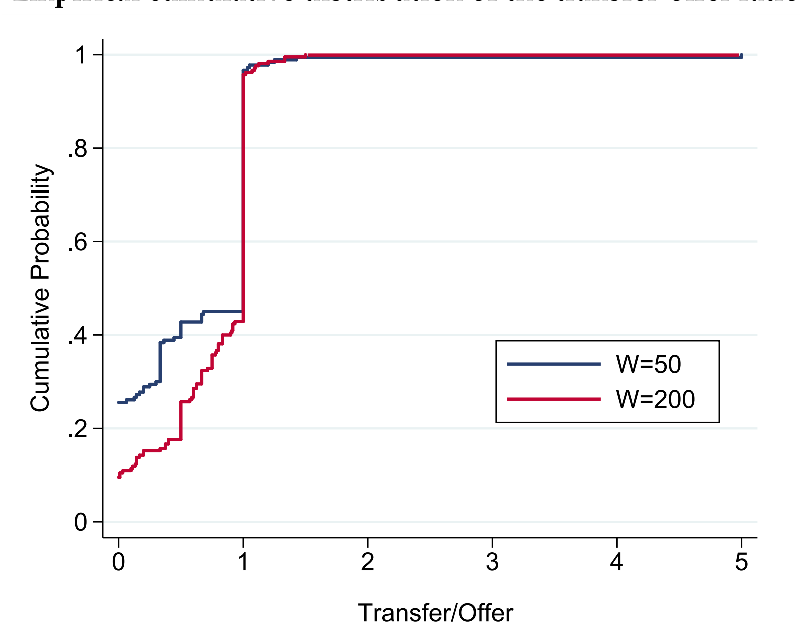
To decompose the factors that motivate candidates' to keep their promises, columns (3) and (4) in Table 1.9 reports the results of regressions on the determinants of promise-keeping, which is measured by the ratio of transfers to conditional payment offers. The significant negative effect of conditional payment offer points to the fact that high conditional

Figure 1.9
Empirical cumulative distribution of the transfers



Data from matched sessions. $N_{W=50} = 186$ $N_{W=200} = 214$.

Figure 1.10
Empirical cumulative distribution of the transfer-offer ratio



Data from matched sessions. $N_{W=50} = 180$ $N_{W=200} = 210$.

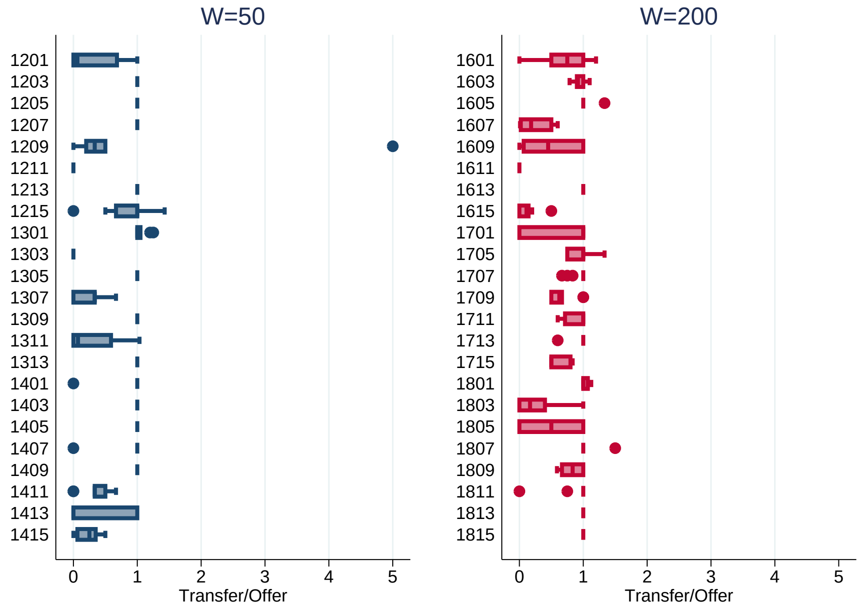
Table 1.9
Determinants of transfers and promise keeping

	(1)	(2)	(3)	(4)
	t	t	$t/m_{\mathbf{CP}}$	$t/m_{\mathbf{CP}}$
UFP Offer	0.53***	0.48***	0.01	0.01*
	(0.15)	(0.14)	(0.01)	(0.00)
CP Offer	0.38***	0.39***	-0.00**	-0.00***
	(0.04)	(0.03)	(0.00)	(0.00)
p	-8.32	-3.77	0.18	0.24*
	(5.16)	(4.85)	(0.17)	(0.14)
p′	4.30	-2.52	-0.24	-0.33**
	(6.06)	(5.66)	(0.19)	(0.16)
(p′-p)*W	-0.03	-0.00	0.00	0.00
	(0.03)	(0.03)	(0.00)	(0.00)
High Rent	25.74***	65.55***	0.69***	1.33***
	(5.59)	(7.54)	(0.18)	(0.22)
Period	-0.43***	-0.48***	-0.02***	-0.02***
	(0.10)	(0.10)	(0.00)	(0.00)
Constant	-3.25	-13.52*	0.54***	0.09
	(5.41)	(7.38)	(0.17)	(0.21)
Observations	400	609	390	594
Data	Matched	All	Matched	All

Columns (1) and (2): Random effects tobit regression with transfer amount as dependent variable, bounded below at 0 and above at 20+W. Columns (3) and (4): Random effects tobit regression with "Transfer/Offer" as dependent variable, bounded below at 0. All regressions include subject fixed effects. Standard errors in parentheses; * * p<0.1, ** p<0.05, *** p<0.01.

payments offers are less likely to be kept by the candidates. Surprisingly, transfer-to-offer ratio is higher for candidates in the high rent treatment. Combined with the fact that the fraction of candidates who keep their promise fully is approximately the same in the two rent treatments, higher transfer-to-offer ratio in the high rent treatment suggests that candidates' cost of not keeping their promise is amplified when their benefits accrued via that promise increase.

Figure 1.11
Transfer-offer ratio of individual candidates



Data from matched sessions. $N_{W=50} = 180$ $N_{W=200} = 210$.

1.7 Conclusion

In this chapter I analyze different behavioral biases that enable vote buying under secret ballot in a one-shot interaction, which is an environment economic models of selfish agents have failed to account for the occurrence of vote buying. Whereas previous studies have focused on the role of voter reciprocity in response to up-front payments in enabling vote buying, I argue that inequity aversion and guilt aversion combined with the candidate's ability to offer up-front and conditional payments may also be salient in shaping voting behavior, and hence facilitate vote buying.

In order to derive the implications of inequity aversion, guilt aversion and reciprocity on vote buying, I model vote buying as a one-shot exchange between a candidate and a voter where the candidate may make both up-front and conditional payment offers, and I allow the candidate and the voter to not keep their promises. I develop separate testable predictions of behavior in this game for each behavioral bias. First, if the players are inequity averse, I show that the type of payment through which vote buying can occur depends on the candidate's sensitivity towards advantageous inequity. If both the candidate and the voter are guilt averse, the type of payment through which vote buying can occur depends on how the voter's cost of not keeping her promises compares to the cost of voting; I show that when voter's cost is sufficiently high, vote buying can occur with both up-front and conditional payments. Finally, if the voter is reciprocal, vote buying may only occur though up-front payments that are considered as kind by the voter.

In a lab experiment, by varying the gains of the candidate upon winning and voter's influence on the voting outcome, I test the predictions of behavior of each model. My results support the presence of all three behavioral biases: inequity aversion, guilt aversion and voter reciprocity. First, I find that vote buying occurs in a significant fraction of the observations. This allows me to rule out selfish preferences as the sole explanation of behavior. Second, vote buying occurs primarily through promises, which implies that voter reciprocity cannot be the sole behavioral bias that enables vote buying. Third, sizes of candidates' offers and payments that are rejected by the voters are positively correlated with the size of the candidate's potential gain, which supports the presence of inequity concerns in voter preferences. Fourth, for voters who have accepted up-front payment, likelihood of voting rises in the size of up-front payment and the candidate's potential gain, which provides supports to voter reciprocity. Fifth, voters who have accepted conditional payment are more likely to vote after receiving positive up-front payment offers, which is consistent with Guardado and Wantchékon (2016) and Kramon (2016)'s argument that positive up-front payment may be a costly signal, in this case, the candidate's trustworthiness/credibility. Sixth, a considerable fraction of candidates keep their promises either fully or partially, despite not having outside enforcement for their promises. This provides support for the presence of guilt aversion. Finally, transfer-to-promise ratio is positively correlated with candidate's potential gain, which suggests that cost of not honoring a promise may be amplified when one's benefits accrued via that promise increase – a feature current models of guilt aversion fail to account for.

Chapter 2: Vote Buying with Binding Promises

2.1 Introduction

[1] Vote buying is defined as the exchange of particularized benefits (money, goods, or services) for votes. This practice, although viewed undesirable in many voting environments, is widespread in many societies. Examples include (but are not limited to) direct cash payments to voters in general elections, donations to a legislator's campaign by groups and the buying of the voting shares of a stock. In this chapter we study the optimality of pre- and post-voting payments for buying votes in an environment where both the candidate and the voter are able to commit to their promises, and may either be sensitive to inequity or have different risk attitudes. We address this question by using a modified version of the model used in Chapter 1: voter's acceptance of an up-front or conditional payment binds her vote and candidate's actions. We motivate full compliance with promises with the following real world examples: Stokes (2005) argues that parties make use of local brokers to imperfectly monitor voters and take advantage of repeated interaction to credibly commit to punishing voters that do not comply. Nichter (2008) uses the same Argentinean election data as Stokes (2005) and argues that vote buying is actually turnout buying, and hence the problem is not moral hazard but adverse selection – if the voter's cost of voting is compensated, e.g. with providing transportation to the polling place, she can be trusted to keep

[1] This chapter is co-authored with Erkut Y. Ozbay.

her promise to vote. Combinations of methods such as Tasmanian dodge,[2] gift cards activated conditionally on a candidate winning(Cantú, 2016), and collective vote monitoring by small group of voters (Rueda, 2016) may also enable voter and candidate to commit to their promises.

In this chapter, we theoretically show that vote buying occurs exclusively via conditional payment if either the players are inequity averse and the candidate's initial budget is sufficiently small, or the candidate is more risk averse than the voter. For the case of inequity aversion, in comparison to up-front payment, conditional payment allows for a larger payment to the voter (which may diminish inequality), and fixes the payment to only one state. For the candidate, these properties make vote buying with conditional payment more desirable than vote buying with up-front payment.On the other hand, the optimaity of vote buying with conditional payment when the candidate is at least as risk averse as the voter follows from optimal allocation of risk between two agents. However, we show that, the behavioral implications of these two cases are different when the candidate's gain from winning is varied. While risk averse preferences imply invariance of voter behavior to candidate's gain, inequity aversion implies sensitivity.

We test the predictions of selfish risk neutral, selfish risk averse, and inequity averse equilibria using a lab experiment, where we vary the gains of the candidate upon winning and voter's influence on the voting outcome. Our results support the presence of inequity aversion: First, vote buying occurs less frequently than predicted by the selfish risk neutral preferences. Second, vote buying occurs predominantly (83%) with conditional payment. Third, for both payment types, we find a large discrepancy between the offers made by

[2]With this method, an unmarked ballot is stolen by a voter and delivered to the person buying votes for marking outside the polling place. Later, the marked ballot is deposited in the ballot box by another voter, who in turn steals a new ballot to continue the process.

the candidates and the offers predicted by selfish risk neutral preferences. We argue that the discrepancy for up-front payment cannot be explained by a candidate who is more or less risk averse than the voter. Fourth, both up-front payment and conditional payment offers are correlated to the candidate's expected marginal gain from the vote. As this gain rises, the candidate offers lower up-front payment and higher conditional payment. This suggests that as the gain of the candidate rises, the candidate prefers to buy vote with conditional payment, possibly because he intends to give a larger amount than what is feasible with up-front payment. In order to convince the voter to choose conditional payment, the candidate simultaneously decreases his up-front payment offer and increases his conditional payment offer. Finally, controlling for offers, a voter is less likely to accept payment when candidate's expected marginal gain from her vote is higher, indicating that she demands to share the benefits of her vote.

Additionally, we compare the outcomes and behavior to those under non-binding promises (studied in Chapter 1). We find that when promises are binding, vote buying is more likely to occur. However, the payment type used for vote buying does not vary with respect to whether promises are binding or not. In both cases, conditional payment is used for vote buying in at least 80% of the observations. However, the sizes of the offers vary with respect to whether promises are binding: up-front payment offers are higher, while conditional payment offers are lower when promises are binding. The first observation points to the lack of trust the candidate has towards the voter, while the second observation indicates candidate's tendency to use cheap talk in the non-binding promises game.

This chapter proceeds as follows. In Section 2, we present the model of the vote buying with binding promises. In Section 3, we present the implications of risk aversion and inequity aversion on equilibrium behavior. In section 4, we provide a list of testable predictions for each theory of behavior. In Section 5, we present the experimental design, and Section 6 the experimental results. Finally in Section 7 we offer some concluding remarks.

2.2 A Model of Vote Buying with Binding Promises

We consider a modified version of the vote buying game studied in Chapter 1: A candidate interacts with a voter only once, and the candidate may receive rent $W > 0$ with some probability $p \in [0, 1]$ The voter may affect the candidate's chances of receiving this rent. More specifically, suppose that if the voter votes for the candidate, then the probability of the candidate winning W changes from p to p' where $p' \in [p, 1]$. The reader is referred to Chapter 1 for the interpretation of the voter's contribution to winning probability.

It is costly for the voter to vote. This cost is denoted by d. The candidate may offer to compensate voter's cost of voting, and the compensation may take two different forms: up-front payment (UFP) and conditional payment (CP). With up-front payment, the candidate makes an immediate transfer to the voter upon voter's acceptance of the offer, and the voter commits to voting. With conditional payment, the candidate commits to make a transfer to the voter if the candidate wins W. We assume that commitment is made possible by a technology that forces both sides to honor their promises.

We denote candidate's offers as the pair $(m_{\text{UFP}}, m_{\text{CP}}) \in \mathbb{R}^2_+$. Up-front payment is financed out of candidate's initial budget, B_c, while conditional payment is financed out of the larger budget, $(B_c + W)$, with the addition of the rent. These conditions restrict the candidate to making offers that he can fulfill.

For simplicity, we assume that the voter can accept at most one type of payment in exchange for her vote. Additionally, we assume that players' respective budgets (W, B_c, B_v), the probabilities of winning with and without the voter's vote (p and p'), and the voter's cost of voting (d) are common knowledge.

The game described above is a sequential move game with perfect information with the following timing:

1. Players observe the probability pair (p, p') and the candidate's rent, W.
2. The candidate presents offers $(m_{\text{UFP}}, m_{\text{CP}})$ to the voter.
3. Observing the candidate's offer, voter chooses whether to vote for the candidate and and if so, whether she accepts a type of payment from the candidate. If the voter accepts up-front payment, m_{UFP} is transferred to the voter. The cost of voting d is deducted from the voter's account if she chooses either to vote in exchange of some payment or vote without accepting payment.
4. Election lottery takes place. If the voter has chosen conditional payment at the offer stage and the candidate wins W, m_{CP} is transferred to the voter's account.

2.3 Theories of Behavior

In this section we present the main properties of the behavior in equilibrium under different behavioral assumptions. Proofs of all propositions are provided in the Appendix. We start our analysis with selfish risk neutral preferences as the baseline.

Proposition 2.1. ***(Selfish risk neutral preferences).*** *Suppose both players care only about their own material payoffs and are risk neutral. Then vote buying may occur only if $(p' - p)W \geq d$. Moreover, whenever the candidate makes a nonzero offer, he offers both up-front payment and conditional payment which are equal to the cost of voting in expectation.*

The intuition behind this proposition is very simple: the voter accepts to vote only if at least one payment in the offer is greater than the cost of voting in expectation. If both payments are larger than the cost of voting, she accepts the payment type that gives her the largest expected value. Given the voter's strategy, the candidate makes a nonzero offer only if the expected benefit of the vote is higher than its cost, i.e. $(p' - p)W - d \geq 0$. Since both players are risk neutral, they are indifferent between payments that are equal in expectation.

Proposition 2.2. ***(Differing risk attitudes).*** *If the candidate is more (less) risk averse than the voter, vote buying occurs only with conditional (up-front) payment.*

The intuition behind this proposition is as follows. Suppose that the candidate is risk neutral but the voter is risk averse. Since up-front payment is riskless for the voter, any up-front payment that is greater than the cost of voting is still acceptable, while a conditional payment that just covers the cost of voting in expectation is no longer acceptable. Since the candidate is risk neutral, he offers non-zero payments as long as $(p' - p)W \geq d$. However, since voter is risk averse, if $p' < 1$, then voter's minimum acceptable conditional payment is, in expectation, greater than her cost of voting. This makes up-front payment cheaper than conditional payment for the candidate. As a result, the optimal offer is $(m_{UFP}, m_{CP}) = (d, 0)$.

Inequity Aversion

Fehr and Schmidt (1999) propose preferences that take inequity aversion concerns into consideration. In a two player game, the utility function of player i is given by

$$u_i(x) = x_i - \alpha_i \max\{x_j - x_i, 0\} - \beta_i \max\{x_i - x_j, 0\}, i, j \in \{C, V\}, i \neq j$$

where x_i denotes player i's material payoff, and the parameters α_i and β_i measure player i's sensitivity to different types of inequality. More specifically, $0 < \beta_i < 1$ measures player i's sensitivity to advantageous inequality (i.e. when $x_i > x_j$), while α_i measures player i's sensitivity to disadvantageous inequality, (i.e. when $x_i < x_j$). Fehr and Schmidt assume that $\alpha_i \geq \beta_i$. In a game with no outcome uncertainty, player i's utility is maximized at $x_j = x_i$. However, in the vote buying game, players are subject to uncertainty over the outcome due to the election process. We assume that their preferences exhibit *ex-post* inequity concerns, i.e. they care about inequity in payoffs in every state of the world and weight the payoffs from each state by its probability. This assumption is necessitated by the fact that currently none of the expected utility models of social preferences accommodate both *ex-ante* and *ex-post* inequity concerns.[3] For simplicity, we assume that $B_C = B_V = B$, $\alpha_C = \alpha_V = \alpha$ and $\beta_C = \beta_V = \beta$. We also assume that inequity concerns do not dominate self-interest, i.e. $\alpha + \beta < 1$.

Proposition 2.3. ***(Inequity aversion).*** *Suppose both players are inequity averse and their preferences can be represented by Fehr-Schmidt preferences. Then, if either $B < \frac{W+d}{2}$ or $\frac{d}{W} \leq (1-2\beta)\left(1+\frac{2\beta}{W}\right)$, vote buying occurs with conditional payment only. If $B \geq \frac{W+d}{2}$ and $\frac{d}{W} > (1-2\beta)\left(1+\frac{2\beta}{W}\right)$, vote buying may occur either with up-front payment or conditional payment. Moreover, the minimum accepted payment of the voter varies with W.*

Note that if the voter is inequity averse and if $p' < 1$, up-front payment is no longer a safe option for her, as it is not possible to make the voter indifferent across different states. In other words, there is always a positive probability of ex-post inequality between the voter and the candidate. Similarly, with conditional payment, the voter always bears the

[3] See Fudenberg and Levine (2012) for detailed discussion.

risk of paying for the cost of voting, but not receiving anything in return. As a result, for each payment type, the minimum accepted amount by the voter depends on the rent of the candidate from winning the election, W. Conditional payment fixes the payment to only one state, and due to the larger budget, it allows for a larger payment to the voter. For the candidate, these properties make conditional payment more desirable with respect to the up-front payment.

2.4 Experiment

The experiment was run at the Experimental Economics Laboratory at the University of Maryland (EEL-UMD), with 158 undergraduate students' participation. We conducted five sessions in May 2013 for each of the treatments, high and low rent ($W = 50$ and $W = 200$). No subject participated in more than one session. Participants were seated in isolated booths. The experiment was programmed in z-Tree (Fischbacher, 2007).

At the beginning of each session, participants were assigned randomly to roles of either a "candidate" or a "voter." There were an equal number of candidates and voters. The roles and candidate's rent from winning (W) were fixed throughout a session. In a session, each candidate was matched randomly and anonymously to a voter in each of the 20 periods.

In each period, the candidate and the voter had the same initial endowment ($B = 20$), the cost of voting was the same ($d = 10$), and each pair was assigned two numbers: the candidate's initial probability of winning (p), and the candidate's probability of winning if the voter votes (p'). These numbers were drawn randomly from uniform distributions.[4] [5] After both the candidate and the voter were informed about the probability pair of that round,

[4] p was drawn from $U[0,1]$, while p' was drawn from $U[p,1]$.

[5] For each rent treatment, in three out of five sessions, the same set of (p,p') pairs were presented to the subjects. We refer to data from these sessions as "matched." For the remaining two sessions of each treatment, the (p,p') pairs are not matched one-to-one between rent treatments. We use the latter data only for regression analysis.

the candidate was asked to decide on his offers for the two possible forms of payment (up-front and conditional payment). The voter was then informed about the candidate's offers, and was asked to decide to choose between four options: (i) vote without accepting payment (VwoP), (ii) vote in exchange for up-front payment (UFP), (iii) vote in exchange for conditional payment, and (iv) do not accept payment and do not vote (DNV). If the voter chose to vote, the election took place with the candidate's probability of winning being p', otherwise the election took place with the candidate's probability of winning being p.

Earnings in each period depended on whether the voter voted and whether she accepted an offer from the candidate, and the result of the election lottery. After all periods were finished, one round of the 20 was chosen randomly, and the participants were paid their earnings on that round. The participants were also paid a participation fee of $5. Participants earned $11 on average. A copy of the instructions is provided in the Appendix.

2.5 Hypotheses

The testable predictions of each theory based on the occurrence of vote buying and behavior of the players is given below.

Vote Buying

We define vote buying as the voter accepting some type of payment from the candidate. Thus if the voter chooses to vote without accepting payment, vote buying does not occur.

Selfish Preferences with Risk Neutrality (RN): Vote buying occurs if and only if $(p'-p)W \geq d$, and both up-front and conditional payment may be used.

Selfish Preferences with Differing Risk Attitudes (DRA): Vote buying occurs with either up-front or conditional payment for some probability pairs (p, p').

Inequity Aversion: Vote buying occurs with conditional payment for some probability pairs (p, p'). Vote buying with up-front payment does not occur due to the experiment parameters: $B < \frac{W+d}{2}$, where $B = 20$, $W \in \{50, 200\}$ and $d = 10$.

Candidate Offers

Selfish Preferences with Risk Neutrality: If $(p' - p)W \geq d$, candidate makes offers $m_{UFP} = d$ and $m_{CP} = d/p'$.

SeSelfish Preferences with Differing Risk Attitudes: For some probability pairs (p, p'), candidate may make positive offers. If only up-front payment offer is positive, then $m_{UFP} = d$. Note that since subjects' relative risk preferences are unknown, selfish preferences with risk aversion is not able to predict which of $m_{CP} < d/p'$, $m_{CP} = d/p'$, or $m_{CP} > d/p'$ will be made. However, for any given (p, p') pair, if conditional payment offers are non-zero, then the sizes of the offers are not correlated with the candidate's rent, W.

Inequity Aversion: For some probability pairs (p, p'), candidate makes positive offers in both payment types. The size of the offers depend on the candidate's rent, W.

Voter choice

Selfish Preferences with Risk Neutrality: Voter's minimum acceptable up-front payment is the cost of voting, d, and minimum acceptable conditional payment is d/p'. If she receives offers in which both amounts are greater than her minimum accepted amounts, she chooses the payment type that has highest expected value.

Selfish Preferences with Differing Risk Attitudes: Voter's minimum acceptable up-front payment is the cost of voting, d, but her minimum acceptable conditional payment can be greater or less than d/p'. Nevertheless, voter's minimum accepted payment does not vary with respect to the candidate's rent, W.

Inequity Aversion: Voter's minimum acceptable up-front payment increases with $(p' - p)W$. While voter's minimum acceptable conditional payment also varies with W, the direction of the relationship is indeterminate.

RN, DRA, Inequity Aversion on Choice of "Vote without payment": Voter never chooses the option "Vote without Accepting Payment."

2.6 Results

In this section we analyze the data with respect to four main questions. The first two questions are whether vote buying occurs and the conditions under which vote buying occurs. Answers to these questions provide a description of the data as well as provide a preliminary indication of whether inequity aversion may be present. Next, we analyze the candidate behavior at the offer stage. Specifically, we consider the candidates' utilization of non-zero up-front and conditional offers, and investigate the factors behind their decision on how much to offer. Finally, we analyze voter behavior. Specifically, we analyze voters' rejected offers and chosen offers, taking the offers made by the candidates as given. When applicable, we also make comparisons with the vote buying data in Chapter 1 where promises are not binding.

2.6.1 Does vote buying occur?

Vote buying occurs when some form of payment (up-front or conditional) is accepted by the voter. Thus the cases in which voters choose the option "Vote without Accepting Payment" is not included. In the data, vote buying occurs in 58% of the observations. This number is significantly different from 0%.[6] However, the occurrence of vote buying is significantly lower than the percentage predicted by selfish risk neutral preferences, 65%.[7] Additionally, vote buying occurs more frequently when promises are binding than when promises are not binding (33%).[8]

Does the frequency of occurrence of vote buying vary with respect to the candidate's rent? In the low rent treatment, vote buying occurs in 55% of the observations, while in the high rent treatment this number is 62%. Proportions test indicates that the difference of these numbers is significantly different than zero, (z=-2.36, p=0.02), indicating a positive correlation between frequency of vote buying and candidate's rent. Moreover, Table 2.1 reports the fraction of observations where vote buying occurs for each rent size and provides a comparison with the outcomes for different rent levels in the vote buying game with non-binding promises. For both games, vote buying occurs more often in the high rent treatment. This relationship is not surprising, however, since conditional on the cost of voting, d and the probability pair, (p, p'), higher rent loosens the participation constraint of the candidate.

2.6.2 How does vote buying occur?

The next question is concerned with which payments vote buying occurs; up-front or conditional payment. We find that vote buying occurs predominantly via conditional payment (83%). This number is significantly different than 50.%[9] The predominant use of conditional payment supports either the inequity aversion hypothesis, or the differing risk attitudes hypothesis where the candidate is more risk averse than the voter.

[6]Binomial test, $H_0 : p(vb) = 0.05, \quad prob = 0.000$. Here, 0.05 allows for the subjects' possibility of making errors.

[7]Binomial test, $H_0 : p(vb) = 0.65, \quad prob(p(vb) \neq 0.65) = 0.000$.

[8]Proportions test, $H_0 : p(vb_{\text{Binding}}) = p(vb_{\text{Non-binding}}), \quad$ z=-11.41, $p = 0.000$

[9]Binomial test: $H_0 : p(CP|vb = 1) = 0.5, \quad prob(p(CP|vb = 1) \neq 0.5) = 0.000$.

Table 2.1
Fraction of observations where vote buying occurs w.r.t. Rent

	Low (W=50)	**High (W=200)**	**Proportions Test***
Binding Promises	.55 (0.02)	.62 (0.02)	z=-2.36 p=0.018
Non-Binding Promises	.29 (0.02)	.36 (0.02)	z=-2.27 p=0.023
Proportions Test*	z=-8.04 p=0.000	z=-8.13 p=0.000	

Data from matched sessions. Standard errors in parentheses. $N_{B50}=N_{B200}=N_{NB50}=N_{NB200}=480$, where B: Binding, NB: Non-binding, 50: W=50, and 200: W=200.
* Two-sided test

Table 2.2
Fraction of observations where vote buying occurs with conditional payment

	Low W=50	**High W=200**	**Proportions Test***
Binding Promises	0.82 (0.02)	0.85 (0.02)	z=-0.79 p=0.429
Non-Binding Promises	0.79 (0.03)	0.91 (0.02)	z=-2.87 p=0.004
Proportions Test*	z=-0.69 p=0.487	z=1.90 p=0.057	

Data from matched sessions. Standard errors in parentheses. $N_{B50}=140$, $N_{B200}=299$, $N_{NB50}=263$, $N_{NB200}=173$, where B: Binding, NB: Non-binding, 50: W=50, and 200: W=200.
* Two-sided test

Table 2.2 reports the fraction of observations where conditional payment is used for vote buying with respect to the candidate's rent, and also provides comparison values from the non-binding promises game. In the low rent treatment, conditional payment is chosen in 82% of the observations where the voter accepts some payment. In the high rent treatment, this number is slightly higher at 85%. Two sample proportions test indicates that the difference of these frequencies is not statistically different from zero. In comparison, for the non-binding promises game, conditional payment is used more frequently in the high rent treatment. However, we find that, for a given value of candidate's rent, the frequency of vote buying with conditional payment is not statistically different between the cases where promises are binding and promises are not binding.

2.6.3 How do candidates make offers?

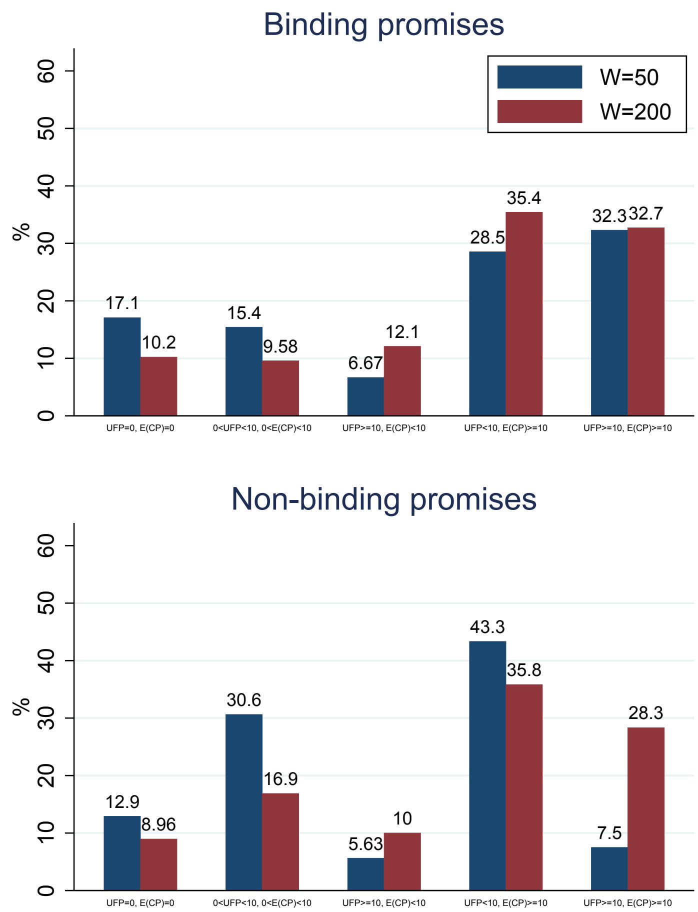
In this section we analyze the offers made by the candidates. Particularly, we consider whether candidates make offers that are positive in both payment types or choose to make a positive offer in only one payment type. Second, we consider whether the offers compensate for the cost of voting and whether positive offers vary with respect to the candidate's rent.

In Figure 2.1, offers are classified with respect to whether the payments cover the cost of voting, and if so, which type of payment covers the cost of voting. The distributions of offers with respect to this classification are significantly different between the two levels of rent.[10] Notice that the offers in the first two categories do not cover the cost of voting in either of the payment types, up-front or conditional payment. Hence, the share of the offers that do not cover the cost of voting is 32% for the low rent treatment and 20% for the high rent treatment. In contrast, these numbers are higher in the non-binding promises game: 44% for the low rent treatment and 36% for the high rent treatment.

The offers in the last three offer categories cover the cost of voting in either up-front or conditional payments, or both. For these categories, the first thing to notice is candidates' preference for two types of offers: those that cover the cost of voting only in conditional payment, and those that cover the cost of voting in both payment types. The offers in these

[10] Pearson Chi-Square test, chi2(4)=19.33 p=0.001.

Figure 2.1
Distribution of offers w.r.t cost of voting and rent

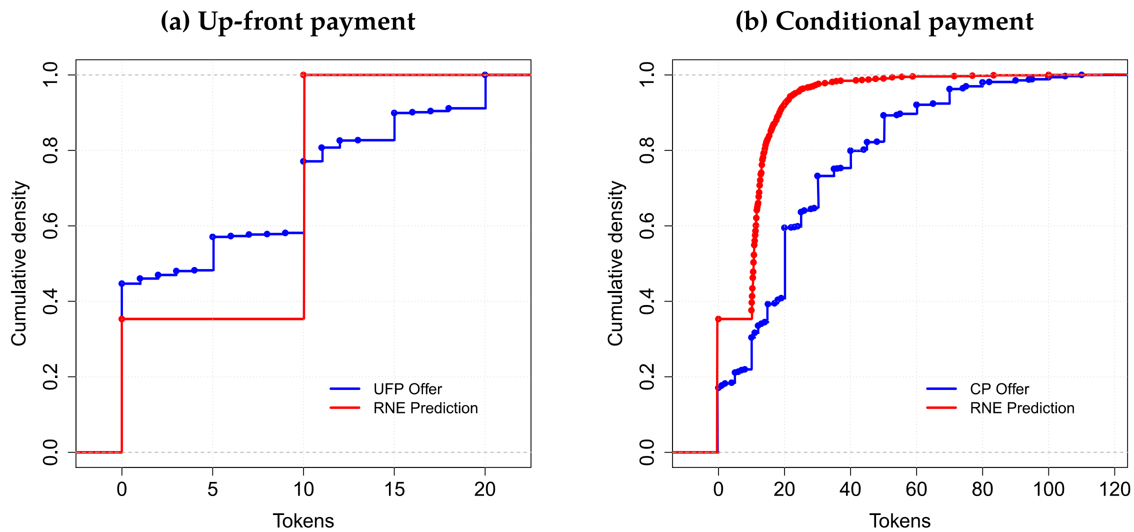


Data from matched sessions.

two categories account for 60% of the offers made by the candidates. In contrast, when promises are not binding, candidates use offers of the former type predominantly (approximately 40% of offers). This difference between binding and non-binding promises cases are not surprising, however, since when promises are not binding, the other player not keeping his promise is an additional risk factor. In this case, candidates use their first mover's advantage to make offers that are less risky for them.

How does the distribution of the offers compare to the selfish preference risk neutral equilibrium? Figure 2.2 provides empirical and predicted cumulative distributions of up-

Figure 2.2
Empirical and predicted distributions of offers



front and conditional payment offers. The large discrepancies between the empirical and predicted distribution clearly show that selfish risk neutral preferences do not approximate the behavior in the vote buying game well. Note also that while the differing risk attitudes with risk averse players and candidate more risk averse than the voter can explain the empirical cumulative distribution of conditional payment being below the risk neutral equilibrium predicted distribution for all payment levels, the both players being risk averse cannot account for the observed up-front payment distribution, since its prediction overlaps with that of risk neutral equilibrium for up-front payments.

Next, we consider the average size of offers with respect to the rent. Table 2.3 reports the average offers conditional on (i) the offers being non-zero, and (ii) the offers compensating the cost of voting. Notice that except for the up-front payments that cover the cost of voting, average offers in each payment type is significantly higher in the high rent treatment. It is also worth noting that the ratio of conditional payment offer to candidate's budget after winning, $(B + W)$, declines as rent increases. Hence, although conditional payment offers are positively correlated to the rent, there is no universal offer-to-budget ratio that candidates use as a rule of thumb when making conditional payment offers.

We also consider whether promises being binding makes a difference. We find that, on average, non-zero up-front payment offer is higher in binding promises game, for both rent levels.[11] However, for up-front payment offers greater than the cost of voting, the difference between binding promises and non-binding promises game vanishes.[12] This suggests that candidates who offer up-front payments greater than the cost of voting ($m_{UFP} \geq d$) in the non-binding promises game trust the voters to keep their promise of voting.

Additionally, on average, conditional payment offers that are greater than the cost of voting in expectation ($p' m_{CP} \geq d$) are higher in non-binding promises game.[13] This might be indicative of candidate cheap talk in the non-binding promises game.

What factors do candidates take into consideration when they decide on the size of their offers? Tobit regressions presented in Table 2.4 give a detailed account of candidates' offer making behavior. In the regressions, in addition to the exogenous variables p, p' and W, we include the variables RNE(UFP) and RNE(CP), up-front and conditional payment offers predicted by selfish risk neutral preferences, to find out whether candidate's rent size can explain the discrepancy between the actual offers and risk neutral equilibrium predictions. We find that candidates take the probabilities (p, p') into consideration as expected, but their decision is also affected by the expected marginal benefit of vote, $(p' - p)W$, when deciding how much to offer. Furthermore, the expected marginal benefit of the vote seems to create a substitution between up-front payment and conditional payment offer sizes: as the benefit increases, candidates offer higher amounts for conditional payment and lower

[11] Mann-Whitney Test, W=50: z=-7.37, p=0.000, W=200: z=-2.26, p=0.02
[12] Mann-Whitney Test, W=50: z=-1.91, p=0.06, W=200: z=-0.28, p=0.77
[13] Mann-Whitney Test, W=50: z=3.16, p=0.002, W=200: z=2.45, p=0.01

Table 2.3
Average offers w.r.t Rent Size

		W=50	W=200	Mann -Whitney U-test	Observations (N_{50}, N_{200})
*(i) If offer is positive**	UFP	11	11.37	z = -2.70	(247, 284)
		(0.33)	(0.31)	p = 0.007	
	E(CP)	16.66	28.29	z = -7.42	(389, 407)
		(0.53)	(0.97)	p = 0.000	
	CP/(B+W)	.31	.17	z = 8.74	
		(0.01)	(0.01)	p = 0.000	
*(ii) If offer covers cost of voting***	UFP	13.11	13.61	z = -1.87	(187, 215)
		(0.29)	(0.27)	p = 0.06	
	E(CP)	20.07	33.67	z = -10.49	(292, 327)
		(0.57)	(1.01)	p = 0.000	
	CP/(B+W)	.36	.21	z = 13.65	
		(0.01)	(0.01)	p = 0.000	

Data from matched sessions. Standard errors in parentheses.
*For conditional payment, expected value of the offer must be positive.
**For conditional payment, expected value of the offer must cover the cost of voting.

amounts for up-front payment, possibly to encourage voters to choose conditional payment, which they favor.

Next, we investigate the effect of binding promises on the behavior of the candidates. Tobit regressions presented in Table 2.5 include a dummy variable that takes on the value 1 if promises are binding and 0 otherwise. Results confirm the pattern observed in the matched data averages: when promises are binding, up-front payments are higher and conditional payments are lower on average.

2.6.4 How do voters behave?

In this section we consider how voters behave, taking candidates' offers as given. More specifically, we are interested in how voters behave when they are offered positive pay-

Table 2.4
Determinants of offer size, Binding Promises

	(1)	(2)	(3)	(4)
	m_{UFP}	m_{UFP}	m_{CP}	m_{CP}
p	-14.73***	-16.62***	-12.54***	-17.47***
	(3.34)	(2.79)	(4.52)	(3.69)
p′	22.64***	22.71***	6.82	10.75***
	(3.54)	(2.93)	(4.59)	(3.74)
W	-0.01	-0.04*	0.24***	0.01
	(0.02)	(0.02)	(0.03)	(0.03)
(p′-p)W	-0.04**	-0.05***	0.10***	0.10***
	(0.02)	(0.02)	(0.03)	(0.02)
RNE(UFP)	0.48***	0.41***		
	(0.10)	(0.08)		
RNE(CP)			0.40***	0.38***
			(0.07)	(0.05)
Period	-0.05	-0.10**	-0.13	-0.03
	(0.05)	(0.04)	(0.08)	(0.07)
Constant	-4.47	-5.97*	-7.59	12.86***
	(2.96)	(3.11)	(5.00)	(4.71)
Observations	960	1580	960	1580
Log likelihood	-1829.57	-2881.96	-3349.72	-5296.78
Data	Matched	All	Matched	All

Random effects tobit regression with candidate's offer as dependent variable. All regressions include subject fixed effects. Standard errors in parentheses; * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

ments. Do voters prefer one type of payment over the other? Do they reject offers greater than the cost of voting? If so, what determines their decision to reject?

Figure 2.4 provides the distribution of voter choice for the subset of offers that exclude zero payments in both payment types. First, we notice that there are some voters who choose the option ”vote without accepting payment,” which is not predicted by any of the theories we have considered. However, since these voters constitute 2% of the data, we find these observations negligible. Overall, voters choose conditional payment in 60% of the observations where at least one payment type offers a non-zero amount. Moreover the

Table 2.5
Determinants of offer size

	(1) m_{UFP}	(2) m_{UFP}	(3) m_{CP}	(4) m_{CP}
p	-16.76***	-17.55***	-25.99***	-26.14***
	(2.04)	(1.68)	(3.75)	(3.04)
p′	20.47***	21.47***	8.13*	11.70***
	(2.31)	(1.90)	(4.17)	(3.37)
W	0.10***	0.04**	-0.05	0.25***
	(0.02)	(0.02)	(0.04)	(0.04)
(p′-p)W	-0.03*	-0.03***	0.05**	0.09***
	(0.01)	(0.01)	(0.03)	(0.02)
Binding Promises	7.66***	-1.65	-31.12***	-6.99
	(2.96)	(2.96)	(5.96)	(6.04)
Period	-0.25***	-0.30***	0.06	0.23***
	(0.04)	(0.03)	(0.07)	(0.06)
Constant	-11.63***	-3.75	42.66***	10.11
	(3.21)	(2.91)	(6.05)	(6.19)
Observations	1920	3160	1920	3160
Log Likelihood	-3354.19	-5408.31	-7124.81	-11609.67
Data	Matched	All	Matched	All

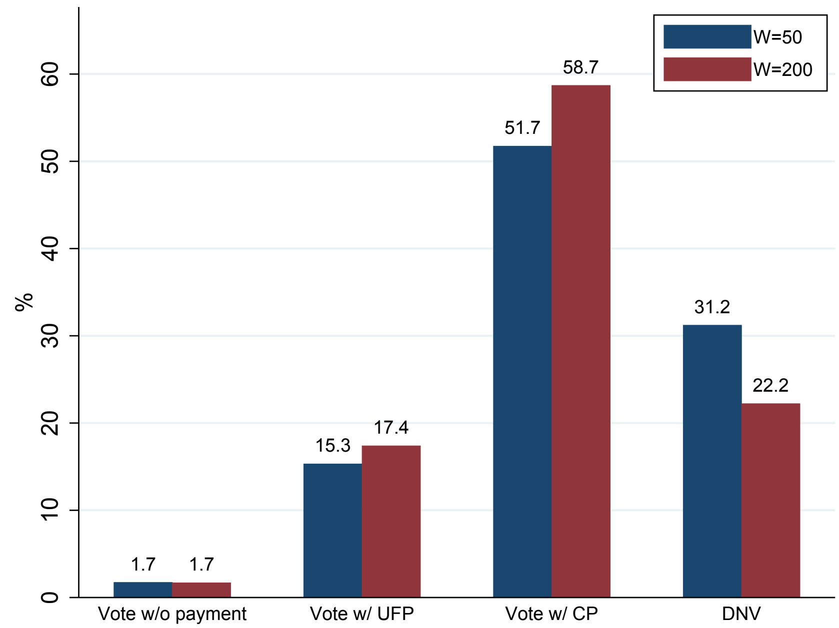
Random effects tobit regression with candidate's offer as dependent variable. All regressions include subject fixed effects. Standard errors in parentheses; * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

distribution of voter choice varies with respect to the candidate's rent.[14] The difference stems from the substitution towards "vote with conditional payment" from "do not vote" when candidate's rent rises. However, since the choice of the voter depends on the offer she is presented, and the distribution of the offers have been shown to be different in the two rent treatments, comparison of these distributions leads to an incomplete picture.

The average payments rejected by the voters are presented in Figure 2.5. Panel (a) shows the average offers for which voters have chosen the option "do not vote", excluding offers (m_{UFP}, m_{CP})=(0,0), with respect to the rent size. While for up-front payment the average rejected payment is significantly higher in the high rent treatment, for conditional and ex-

[14] Pearson Chi-Square test, chi2(3)=58.24, p=0.000

Figure 2.4
Voter choice at the offer stage, excluding offers (UFP, CP)=(0,0)



Data from matched sessions. $N_{W=50} = 398$ $N_{W=200} = 431$.

pected conditional payments, the difference in rejected non-zero payments between high and low rent treatments is not significantly different than zero.[15] However, panel (b) shows that when an offer covers the cost of voting for a given payment type, the average rejected up-front payment for high and low rent treatments are virtually the same, while the average rejected conditional and expected conditional payments are significantly higher when the rent is high.[16]

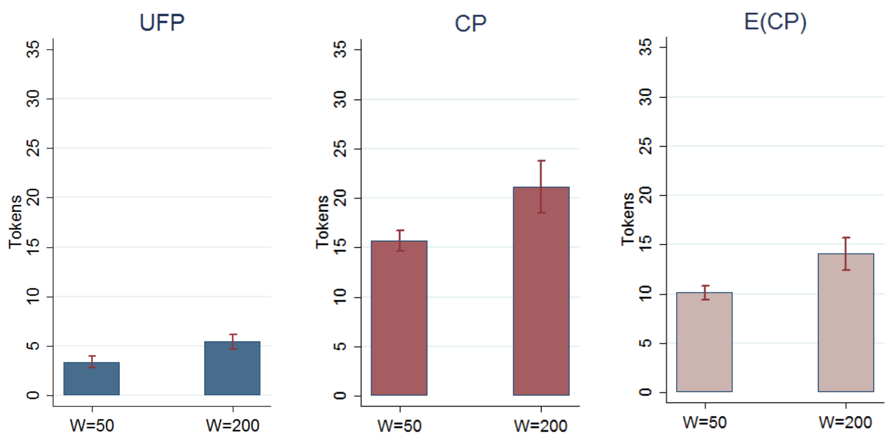
Table 2.6 presents the results of regressions on the variables "accept payment", "accept up-front payment", and "accept conditional payment", controlling for offer sizes, winning probabilities, period, candidate's expected marginal benefit from the vote, and behavior predicted by selfish risk neutral preferences. Results indicate that voters are more likely to accept payment in the high rent treatment, but their likelihood of accepting payment

[15] Mann-Whitney test: (i) UFP: z=-2.85 p=0.004, (ii) CP: z=-0.35 p=0.73, (iii) E(CP): z=-1.63 p=0.10

[16] Mann-Whitney test: (i) UFP: z=-1.81 p=0.07, (ii) CP: z=-3.69 p=0.000, (iii) E(CP): z=-4.52 p=0.000

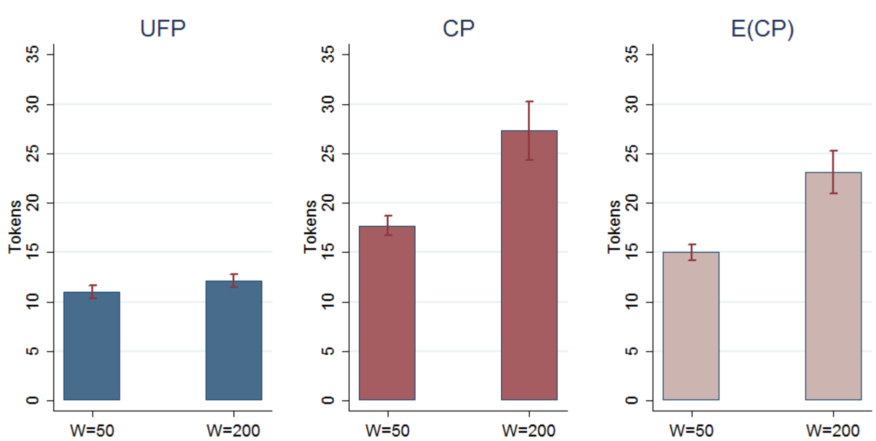
Figure 2.5
Average rejected payments

(a) Average payments in offer pairs for which voter has chosen ”do not vote”, excluding offers (UFP, CP)=(0,0)



Data from matched sessions. $N_{W=50} = 130$ $N_{W=200} = 121$

(b) Average rejected payments that cover the cost of voting



Data from matched sessions. UFP: $N_{W=50} = 28$ $N_{W=200} = 46$. CP, E(CP): $N_{W=50} = 57$ $N_{W=200} = 61$

Table 2.6
Determinants of accepting payment

	(1) Accept Payment	(2) Accept UFP	(3) Accept CP
UFP offer	0.08***	0.16***	-0.19***
	(0.01)	(0.03)	(0.03)
E(CP offer)	0.07***	-0.13***	0.12***
	(0.01)	(0.02)	(0.01)
p	-0.86*	-1.22	0.35
	(0.48)	(0.94)	(0.78)
p′	0.52	1.70	-1.28
	(0.53)	(1.06)	(0.88)
(p′-p)W	-0.01***	-0.01	0.00
	(0.00)	(0.01)	(0.01)
W	0.01**	0.02**	-0.01**
	(0.00)	(0.01)	(0.01)
Period	0.00	-0.05***	0.04**
	(0.01)	(0.02)	(0.02)
RNE(Acc. UFP)		0.83*	
		(0.49)	
RNE(Acc. CP)			-1.29***
			(0.35)
Constant	-2.96***	-1.48*	2.28***
	(0.65)	(0.90)	(0.84)
Observations	960	485	520
Log likelihood	-367.42	-91.05	-123.52

Data from matched sessions. Random effects probit regression with accepting payment as dependent variable. All regressions include subject fixed effects. Standard errors in parentheses; * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

decreases in candidate's expected marginal benefit from the vote. This finding provides support for the presence of inequity concerns: as the voter's contribution to the candidate's expected gain rises, the more likely the voter is to withold her vote.

2.7 Conclusion

In this chapter we study the optimality of pre- and post-voting payments for buying votes in an environment where both the candidate and the voter are able to commit to their promises. Using a modified version of the vote buying model used in Chapter 1, we investigate the implications of different risk attitudes and inequity aversion on agent behavior. Our theoretical result establishes conditional payment as the sole payment type used for vote buying if either the players are inequity averse and the candidate's initial budget is sufficiently small, or the candidate is more risk averse than the voter.

We test the predictions of selfish risk neutral, selfish risk averse, and inequity averse equilibria using a lab experiment. Our main treatment variables, the rent of the candidate upon winning and voter's influence on the voting outcome, allow us to have distinguishing predictions for each model. Our results support the presence of inequity aversion: First, vote buying occurs less frequently than predicted by the selfish risk neutral preferences. Second, vote buying occurs predominantly (83%) with conditional payment. Third, for both payment types, we find a large discrepancy between the offers made by the candidates and the offers predicted by selfish risk neutral preferences. We argue that the discrepancy for up-front payment cannot be explained by a candidate who is more or less risk averse than the voter. Fourth, both up-front payment and conditional payment offers are correlated to the candidates' expected marginal gain from the vote. As this gain rises, candidates offer lower up-front payment and higher conditional payment. This suggests that as the gain of the candidates rises, candidates prefer to buy vote with conditional payment, possibly because they intend to give a larger amount than what is feasible with the their initial budget. In order to convince the voters to choose conditional payment, candidates simultaneously decrease their up-front payment offers and increase their conditional payment offers. Finally, controlling for offers, voters are less likely to accept payment when candidates' expected marginal gain from the vote is higher, indicating that they demand to share the benefits of their vote.

Additionally, we compare the outcomes and behavior in binding and non-binding promises games (studied in Chapter 1). We find that when promises are binding, vote buying is more likely to occur. However, the payment type used for vote buying does not vary with respect to whether promises are binding or not. In both games, conditional payment is used for vote buying in at least 80% of the observations. However, offer sizess vary with respect to whether promises are binding: up-front payment offers are higher, while conditional payment offers are lower when promises are binding. The first observation points to the lack of trust the candidates in non-binding game have for the voters, while the second observation suggests that candidates' engage in cheap talk in the non-binding promises game.

Chapter 3: Anticipated Guilt and Cost of Reciprocation

3.1 Introduction

There is a large body of evidence that indicates a significant number of people are motivated by fairness and reciprocity, and that presence of such people may have important economic effects (Fehr and Gächter, 1998, 2000; Kahneman, Knetsch, and Thaler, 1986; Sobel, 2005). In this chapter I study whether a decision maker ever turns down a beneficial offer from another player, and if so, under what conditions she does.

One may think of several scenarios where this might occur. For example, consider the case where Ann is invited to lunch at a nice restaurant by an acquaintance. If she suspects that she will be asked a favor at the lunch, she may decide to turn down the offer if she anticipates the favor to be something she does not want to do. As a second example, consider Bob, whose friend gives him a very expensive gift. If Bob's budget is tight, he may decline the gift as he knows that he cannot reciprocate the gift by returning something of similar value, despite knowing that the gift giver does not expect something in return.

The behavior of the decision makers in these examples may be explained by the following behavioral biases: guilt aversion, reciprocity and inequity aversion. Ann's behavior can be modeled by guilt aversion because she anticipates that if she attends the lunch, she will hear about the favor her acquaintance will ask. But, while she will not fulfill the expectation of her acquaintance, she will also feel guilt of not doing the favor. In contrast, Bob's behavior may be explained by either positive reciprocity or inequity aversion. Positive reciprocity predicts Bob to reject because he will be unable to be kind to a person who he perceives as being kind to him. If Bob cares about equity, accepting the gift but not being able to give something with similar value back would also result in Bob rejecting the gift.

In order to formalize and refine the predictions of these biases, I modify the trust game, introduced first by Berg, Dickhaut, and McCabe (1995)[1] to study trust and reciprocity, and used extensively in different forms for testing other-regarding preferences. In a typical trust game, both players have the same initial endowment. First mover has the opportunity to send money to second mover, where the amount of money sent is multiplied by a number greater than one (typically three) when being transferred to the second mover. Then, second mover gets the opportunity to send money back to the first mover, which is transferred one-ton-one to the first mover, after which the game ends. In this study, I modify the trust game in four dimensions. First, I allow the second mover to decline a transfer from the first mover. However, in contrast to the impunity game (Bolton and Zwick, 1995) where rejection results in money burning, in my game, second mover's rejection results in the amount rejected to be returned to the first mover. Second, I vary the second mover's cost of reciprocation by varying the amount transferred to the first mover when the second mover sends back one unit of money back to the first mover. I call this amount as the second mover's transfer rate, and the higher the second mover's transfer rate, the lower is her cost of reciprocation. Third, I assume the second mover's transfer rate is her private information. Finally, to simplify analysis, I restrict the first mover to make a binary decision between sending all of his endowment to the second mover and keeping his endowment.

[1]In their paper Berg, Dickhaut, and McCabe call this game the "investment" game, and liken it to the "trust" game of Kreps (1990) and the centipede game of Rosenthal (1981) in that passing money to the other player is risky but leads to an expanded pie, some of which may be returned. The differences between Berg, Dickhaut, and McCabe's game and these games lies in the repeated nature and the limited choices at each stage of the games in Kreps (1990); Rosenthal (1981).

The combination of these modifications allows me to derive distinct testable predictions for the behavioral biases considered over second mover's decisions on rejection and giving back.

In my theoretical analysis, I first assume that the second mover is inequity averse, i.e. she bears a utility cost when payoffs are not equitable. I use Fehr and Schmidt (1999)'s inequity aversion model and show that both the second mover's likelihood of rejection and giving back weakly decreases in her transfer rate.

Next, I assume that the second mover is guilt averse, i.e. she bears a utility cost when she believes that she has let the first mover down. I show that, given her belief about first mover's payoff expectation, second mover's likelihood of rejection decreases in second mover's transfer rate. I also show that second mover's likelihood of rejection increases in her belief over first mover's payoff expectation. Moreover, conditional on accepting, second mover's giving back weakly decreases in her transfer rate and increases in her belief about first mover's payoff expectation.

Finally, I assume that second mover is reciprocal and she estimates the first mover's kindness based on how her belief about first mover's payoff expectation compares to a "fair" payoff for the first mover. Additionally, I assume that rejection absolves the second mover from reciprocation concerns as she does not receive the benefit of the first mover's action. To the best of my knowledge, this last assumption is novel for reciprocal preferences. I specify a general form of the utility function that satisfies these properties and show that likelihood of rejection weakly decreases in second mover's transfer rate. Furthermore, there is a nonlinear relationship between second mover's belief about first mover's payoff expectation and her likelihood of rejection.

I test the theoretical predictions of the three behavioral biases in an experiment where

I vary the second movers' transfer rate and collect information on second movers' beliefs about first movers' payoff expectations. My results support the presence of both guilt aversion and reciprocity. First, I find that a significant proportion of second movers (47%) reject non-zero transfers from first movers. Second, second movers' likelihood of rejection decreases in their transfer rate and is higher when the second movers are unable to transfer to the first mover their stated beliefs about first movers' payoff expectation. Third, second movers' giving back decreases in their transfer rate, and on average lower when second movers are unable to transfer their stated belief about first movers' payoff expectation. However, the transfers first movers receive back from second movers increase in second movers' transfer rate, suggesting that second movers' giving back is price inelastic. In a subsample where the second movers are able to transfer their stated beliefs to the first mover, I also find evidence of non-linear relationship between second movers' giving back and their stated beliefs about first movers' payoff expectation.

Finally, an unexpectedly large fraction of first movers choose to send their endowments (73%) to the second mover, without knowing second mover's transfer rate. In an additional treatment where the first mover can also condition his decision on second mover's transfer rate, I find that first movers' likelihood of sending increases in second movers' transfer rate. This finding suggests that first movers may be correctly anticipating the behavior of second movers, but further research with an experiment design that collects first movers' beliefs is necessary.

Trust Game and Related Literature

Berg, Dickhaut, and McCabe (1995) and later studies of the trust game[2] find that an overwhelming majority of first movers send positive amounts to second movers, and while

[2] See Cooper and Kagel (2013) for an overview of results.

there is considerable variability across the money sent, on average, first movers send half of their endowment. Moreover, second movers respond positively to the amount sent by first movers by sending back higher amounts as the first movers' transfer increases. However, on average, the amount sent back by second movers is less than the amount sent by first movers. Berg, Dickhaut, and McCabe argue that the amount sent by first mover signals his[3] trust (and belief in reciprocity), and a second mover with "a predisposition to reciprocate may be more willing to reciprocate when they believe their counterpart shares a common regard for trust", likening their conception of trust to Rabin (1993)'s conception of "kindness." Indeed, Berg, Dickhaut, and McCabe (1995) and later studies find that first movers' investment pay off when they send high fractions of their endowments to second movers (and take more risk by doing so).

The findings on the second movers' responsiveness to how much risk first mover takes has been called as the self-fulfilling property of trust by Bacharach, Guerra, and Zizzo (2007), who argue that perceptions of kindness increase trust responsiveness. For modeling trust and reciprocity, a common approach has been to use the tools of psychological game theory,[4] where a decision maker's utility depends on her belief about other players' beliefs about all players' choices. In the context of the trust game, second mover's belief on the payoff expectation of the first mover (which is linked to first mover's beliefs on second mover's behavior) may play a role in her decision to how much to send back to the first mover. This belief of the second mover has been called second mover's second-order belief.

Using the second-order belief, Charness and Dufwenberg (2006) introduce the notion of "guilt aversion" and modify the trust game to include chance moves to contend that

[3] I will refer to the first mover as "he" and second mover as "she" in this chapter.

[4] Pyschological game theory has been introduced by Geanakoplos, Pearce, and Stacchetti (1989) and later generalized to include dynamic games by Battigalli and Dufwenberg (2009)

higher orders of beliefs factor in second mover's decision to take a costly action to give first mover a chance of a high payoff. Since guilt may arise from a person's failure to live up to expectations of others (Baumeister, Stillwell, and Heatherton, 1994), models of guilt aversion (such as Battigalli and Dufwenberg (2007)) typically incorporate second-order belief of the decision maker into her utility by adding payoff deviations from the second-order belief as a cost. Thus, in the context of the trust game, a guilt averse second mover's giving back would weakly increase in her belief about first mover's payoff expectation. Indeed, Charness and Dufwenberg show that many second movers trade off their material benefits for the potential let-down their behavior may cause to the first mover.

Reciprocity may also be captured through incorporating second-order beliefs into utility. Since reciprocity is based on the idea that people would like to be (un)kind to people who are (un)kind to them, Battigalli and Dufwenberg (2009) show that the essence of Dufwenberg and Kirchsteiger (2004)'s model of sequential reciprocity can be captured in a model where kindness of other players are defined using the second mover's second-order beliefs about them. This approach captures the intentions notion: the decision maker's judgment about the sincerity of another player's action that provides benefits to the decision maker depends on whether she believes the other player is trying to take advantage of her reciprocal nature, i.e. acting strategically kind. Hence, in the context of the trust game, a reciprocal second mover's giving back may decrease in her belief about the first mover's payoff expectation – if second mover thinks that the first mover is manipulating the second mover to achieve a high return, the second mover may decide to be unkind to the first mover by sending nothing back.

This study contributes to the literature on the behavioral biases of guilt aversion and reciprocity. A majority of the existing studies on reciprocity focus on environments when a player is either (i) the initiator of a chain of pro–social actions, or (ii) a receiver of benefits of pro-social actions, but not given a choice to decline them (although they might prefer to do so) and are asked to make their decisions based on kindness that is pushed onto them.[5] Although reciprocity/trust is an "important lubricant of a social system" (Arrow, 1974), not allowing the recipients to opt out may bias results in favor of the effectiveness of reciprocity.

Second, this study contributes to the debate on how second-order beliefs may affect behavior. Currently there is no consensus in the literature on how second-order beliefs may enter the utility of the decision maker. On one side are the studies that support intentions-based reciprocity by providing evidence of negative correlation between second-order beliefs and giving/giving back (Bacharach, Guerra, and Zizzo, 2007; Guerra and Zizzo, 2004; Stanca, Bruni, and Corazzini, 2009; Toussaert, 2017); while on the other side are the studies that provide evidence of positive correlation in favor of guilt aversion (Bellemare, Sebald, and Strobel, 2011; Charness and Dufwenberg, 2006; Khalmetski, 2016); and yet on another side, there are studies that provide evidence for no correlation (Al-Ubaydli and Lee, 2012; Ellingsen, Johannesson, Tjøtta, and Torsvik, 2010; Engler, Kerschbamer, and Page, 2016; Strassmair, 2009; Vanberg, 2008). Finally, Regner and Harth (2014) argue for an inverse U-shaped relationship between second-order beliefs and giving back: for low second order beliefs, giving back increases in second-order belief, while it decreases for high second-order beliefs. It should also be noted that Regner and Harth interpret the former as the region where guilt aversion dominates, while the latter as the region where negative reciprocity dominates. However, one may think that the inverse U-shape can also be produced with reciprocity only: in the first region, because the second-order belief of the decision maker is lower than a "fair" level, the decision maker perceives the other player as kind.

[5] In the impunity game the second mover has the option to decline, but after this decision, she does not have any futher actions.

Thus she is compelled to act kind towards the other player in the first region, which would produce a positive correlation between giving back and second-order belief. In this study, I propose a utility function that satisfies this intuition, however, I argue that while it is useful for explaining why a second mover may decline a transfer from the first mover, it does not have predictive power for second mover's interior giving back decisions. Nevertheless, my experimental results are consistent with a non-linear relationship between second mover second-order beliefs and second mover giving back.

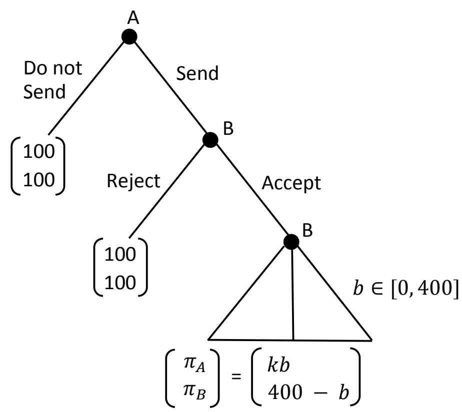
I proceed as follows. In Section 2, I present the modified trust game and discuss the three different behavioral biases that may account for second mover's rejection of a transfer from the first mover. In section 3, I present the experimental procedures. This is followed by a list of testable predictions under each behavioral bias in Section 4. In Section 5, I present the experimental results and finally in Section 6, I offer some concluding remarks.

3.2 Theories of Behavior

3.2.1 Mini Trust Game with Second Mover Rejection

I consider a one-shot sequential interaction of two players, A and B. The players have identical initial endowments ($B_A = B_B = 100$). Player A moves first, and decides between keeping his endowment and sending all of it to Player B. If Player A decides to send his endowment to Player B, Player B decides between accepting and rejecting the transfer from Player A. If Player B rejects the transfer, Player A receives his transfer back and the game ends with both players keeping their initial endowments. If Player B accepts the transfer, she receives Player A's endowment multiplied by three and gets the opportunity to send money back to Player A. Player B can choose any amount $b \in [0, 400]$ to send back. While being transferred, the amount Player B decides to send back to Player A is multiplied by

Figure 3.1
Mini Trust Game with Second Mover Rejection



Player B's transfer rate ($k \geq 0$) and the game ends with the monetary payoffs $\pi_A = kb$ and $\pi_B = 400 - b$. This game is depicted in Figure 3.1.

The most important modifications to the original trust game are (i) the ability of Player B to reject tokens from Player A and the rejection leading to both players returning to their initial payoff positions; and (ii) the variation in Player B's transfer rate.[6] The first modification adds elements of the impunity game ((Bolton, Katok, and Zwick, 1998; Bolton and Zwick, 1995)) to the dynamic. However, in contrast to the impunity game, in my game, rejection does not result in money burning: if Player B rejects a transfer from Player A, the amount is returned to Player A. The second modification borrows its intuition from the relationship between giving and the cost of giving in Andreoni and Miller (2002). However, the dictator in my game (Player B) has a history with the other player.

Under assumptions of different behavioral biases, it is possible for Player B to reject a transfer from Player A. For example, consider the case where $k = 0$, i.e. any amount Player

[6]Player B's transfer rate being private information is a simplifying assumption, since, otherwise, Player B's second-order beliefs may also depend on her transfer rate k. Thus any analysis would require further assumptions on how Player B forms her second-order beliefs. While this is an interesting research question, since this study is about how beliefs may affect behavior, the added complexity would be out of scope of this study.

B decides to give back to Player A will be burned. Then, I show below that, conditional on accepting, an inequity averse Player B sends back zero tokens.[7]

3.2.2 Behavioral predictions

In this section I present the main properties of Player B's optimal behavior in the game equilibria under various behavioral assumptions. I start with selfish preferences as the baseline.

Proposition 3.1. ***(Selfish preferences).*** *Suppose Player B cares only about her own material payoff. Then, for all values of $k \geq 0$, Player B accepts Player A's transfer and give back zero to Player A.*

Inequity aversion

Suppose Player B cares about equal splitting of the surplus. In this case, her preferences may be represented with the utility function proposed by Fehr and Schmidt (1999). In the context of the trust game, utility of Player B is given by

$$u_B(\pi_B, \pi_A) = \pi_B - \alpha \max\{\pi_A - \pi_B, 0\} - \beta \max\{\pi_B - \pi_A, 0\} \tag{3.1}$$

where $\pi_i, \quad i \in \{A, B\}$ indicate material payoffs and the parameters α and β measure Player B's sensitivity to disadvantageous and advantageous inequity, respectively. Following Fehr and Schmidt, I assume $\beta \leq \alpha$ and $0 \leq \beta < 1$. These parameter assumptions imply that Player B bears higher utility cost for inequity in cases where the material inequity is to her disadvantage (B's payoff is lower than A's payoff) than to cases where the inequity is to her advantage (B's payoff is higher than A's payoff).

[7]For inequity aversion, I follow Fehr and Schmidt (1999)'s restrictions on sensitivity to advantageous inequality and assume that players are not *extremely* inequity averse such that they would burn money.

The equilibrium behavior under inequity aversion can be summarized by Player B's sensitivity to advantageous utility, β, and how it relates to her transfer rate, k. Her decisions on acceptance and transfer can be characterized by the following proposition, whose proof is provided in the Appendix.

Proposition 3.2. ***(Inequity aversion).*** *If Player B is inequity averse, she may optimally decline a transfer from Player A. More specifically, if*

(i) $\beta \leq \frac{3}{4}$ *and* $\beta < \frac{1}{k+1}$*, then Player B accepts Player A's transfer and sends back* $b^* = 0$*;*

(ii) $\beta \in \left[\frac{3}{4}, \frac{1}{k+1}\right)$*, where* $k < \frac{1}{3}$*. then Player B rejects Player A's transfer;*

(iii) $\beta \geq \frac{1}{k+1}$*, then Player B accepts Player A's transfer and sends back* $b^* \in \left[0, \frac{400}{k+1}\right]$.

The intuition behind these thresholds are as follows. First, the threshold value of $\frac{1}{k+1}$ governs Player B's giving back behavior, and is due to Player B's comparison of keeping one extra dollar to herself or sending the extra dollar to Player A (in which case the dollar gets multiplied by k), when her material payoff is higher than that of Player A. While keeping the dollar to herself increases Player B's utility by $(1 - \beta)$, sending the dollar to Player B results in a utility gain of βk units. Second, the threshold value of $\frac{3}{4}$ is due to Player B's comparison of accepting vs. rejecting a transfer from Player A, when she knows that if she accepts, she will not give anything back to Player A. In the case that she accepts, the material payoffs will be very unequal ($(\pi_A, \pi_B) = (0, 400)$). This may be tolerated only by a Player B who is sufficiently insensitive to advantageous inequity. Finally, notice that, Player B's optimal behavior implies a threshold function for her rejection decision, weakly decreasing in her transfer rate, k.

Guilt aversion

Suppose Player B cares about living up to the expectations of Player A. In this case, her preferences should depend on how her actions measure up to the expectations of Player A, but since there is not an opportunity for Player A to relay what he expects Player B to do, Player B is left on her own to guess this expectation. Such a situation is captured by Battigalli and Dufwenberg (2007)'s model of *simple guilt*, where a player cares about whether and how much she lets another player down. In the context of the trust game with private information, utility of guilt averse Player B has the following general form:

$$u_B(s_B; s_A, e_B) = \pi_B(s_A, s_B) - \Phi \max\{\pi_A(s_A, s_B) - e_B, 0\} \tag{3.2}$$

where $\pi_i(s_A, s_B),\ i \in \{A, B\}$ indicate material payoffs resulting from strategies s_A and s_B, $\Phi \geq 0$ is a coefficient reflecting guilt sensitivity, and e_B is Player B's belief about Player A's payoff expectation. Thus, $\max\{\pi_A(s_A, s_B) - e_B, 0\}$ gives Player B's guilt.

Proposition 3.3. ***(Guilt aversion).*** *If Player B is guilt averse, she may decline a transfer from Player A, i.e. there exists $k \geq 0$, $e_B \geq 0$ and $\Phi \geq 0$ such that utility of rejecting is higher than accepting a transfer from Player A. Moreover, Player B's utility difference between accepting and rejecting weakly increases in k and weakly decreases in e_B. For some e_B, this utility difference is lower when Player B cannot transfer e_B to Player A than when she can transfer e_B to Player A. If Player B accepts, her giving back weakly decreases in k and weakly increases in e_B.*

The intuition behind this proposition is as follows. First, whether Player B sends anything back to Player A conditional on accepting is governed by her guilt sensitivity, Φ and her transfer rate, k. If $\Phi k \geq 1$, then, upon accepting, Player B sends a positive amount back to Player A. Ideally in this case, Player B prefers to send back an amount that is equal to her second order belief when it is transferred to Player A, i.e. send b such that $kb = e_B$. However, if her transfer rate is low such that transferring her second order belief is infeasible ($400k < e_B$), Player B will choose to send all of her tokens to Player A. Whether Player B prefers to choose this route or reject a transfer from Player A depends on how her second-order belief compares to Player A's initial endowment. For example, if her second order beliefs are high ($e_B > 100$) and her transfer rate is very low such that $400k < e_B$ then what she can transfer to Player A will create a higher disappointment than if she declines ($e_B - 400k > e_B - 100$). Such a case would occur, for instance, if $k < 1/4$.

Reciprocity

Now suppose that Player B is reciprocal, i.e. she prefers to respond pro-socially to kindness, and anti-socially to unkindness. Ideally, when judging the kindness of an action, a decision maker would consider (i) the resulting allocations, (ii) how the allocations came into being (e.g. Blount (1995)), (iii) the menu of choices available at the time, and (iv) intentions. Since Player A has a binary choice in the modified trust game, like in the case of guilt aversion, Player B is left on her own to guess what Player A may be expecting. Based on this expectation and a reference payoff, Player B can decide whether, by sending his endowment, Player A has been kind to Player B. Additionally, since Player B's rejection results in both players finishing the game with their initial endowments, if she rejects a transfer from Player A, Player B may consider herself as not a recipient of a benefit from Player A. Thus, rejecting Player A's transfer can exempt Player B from reciprocal concerns. In the context of the modified trust game, the following general form for Player B's utility may be appropriate:

$$u_B(s_B, s_A; k, e_B, \bar{e}) = \pi_B(s_A, s_B) - \theta\lambda_A(e_B, \bar{e}, \Delta_B(s_A, s_B))\lambda_B(e_B, \pi_A(s_A, s_B)) \tag{3.3}$$

where $\pi_i(s_A, s_B),\ i \in \{A, B\}$ denote material payoffs resulting from strategies s_A and s_B, $\lambda_A(.)$ indicates Player A's perceived kindness towards Player B, $\lambda_B(.)$ indicates Player B's kindness towards Player A, $\Delta_B(s_A, s_B)$ is Player B's interim material gain/loss resulting from strategies s_A and s_B in comparison to her initial endowment, $\theta \geq 0$ is a coefficient reflecting sensitivity to reciprocity, e_B is Player B's second-order belief, $\bar{e}$ is Player B's reference payoff for which she considers payoff expectations higher than $\bar{e}$ as "greedy" and hence unkind. This is a modified version of the utility proposed by Dufwenberg and Kirchsteiger (2004), where second order belief and its fairness reference is added as an additional factor alongside the material payoffs in the kindness functions. As a simple example, consider the following kindness functions which produces the proposition below:

$$\begin{aligned} \lambda_A &= (\bar{e} - e_B)\Delta_B(s_A, s_B) \\ \lambda_B &= (kb - e_B) \end{aligned} \tag{3.4}$$

Proposition 3.4. ***(Reciprocity).*** *If Player B is reciprocal, she may decline a transfer from Player A. More specifically, let $\Delta_B(s_A = Send, s_B = Accept) = \Delta_B$. If*

(i) $e_B \leq \bar{e}$ *and* $\theta k \geq \frac{1}{(\bar{e}-e_B)\Delta_B}$*, then Player B accepts Player A's transfer and sends back* $b^* \in [0, 400]$*;*

(ii) $e_B \leq \bar{e}$ *and* $\theta k < \frac{1}{(\bar{e}-e_B)\Delta_B}$ *and*

- $\theta > \frac{1}{e_B(\bar{e}-e_B)}$, *then Player B rejects Player A's transfer;*

- $\theta \leq \frac{1}{e_B(\bar{e}-e_B)}$, *then Player B accepts Player A's transfer and sends back* $b^* = 0$*;*

(iii) $e_B > \bar{e}$, *then Player B accepts Player A's transfer and sends back* $b^* = 0$.

The reason why Player B may reject a transfer is as follows. While she perceives Player A to be kind ($e_B \leq \bar{e}$), if her transfer rate is very low (e.g. $k = 0$), she would be unable to return the kindness of Player A. Rejecting Player A's transfer, however, absolves her from the disutility from not reciprocating, since $\Delta(s_A = \text{Send}, s_B = \text{Reject}) = 0$. Also note that if $e_B > \bar{e}$, Player B considers Player A as greedy, and hence, she is happy to act selfishly and send back $b = 0$. Finally, since the utility of money is assumed to be linear in this example, it is not possible to pin down how much Player B would choose to send back to Player A. Moreover, due to the complexity of the form of the utility, substituting the linear utility of money with a concave utility does not yield intuitive results.

3.3 Experiment

The experiment was conducted on Amazon Mechanical Turk (MTurk) in April 2017 with 317 MTurk workers located in the US, with HIT[8] Approval Rate of at least %85 and number of approved HITs greater than 100.[9] No MTurk worker with the same worker ID participated in the experiment more than once. The experiment program was written in oTree (Chen, Schonger, and Wickens, 2016). Subjects were given a link on MTurk platform to the website that hosted the experiment program, and were assigned to the roles of Player

[8] Human Intelligence Task

[9] Amazon Mechanical Turk is an online labor market that provides quick and inexpensive access to a large and diverse subject pool. Horton, Rand, and Zeckhauser (2011) and Goodman, Cryder, and Cheema (2013) argue that there are many similarities between MTurk participants and traditional samples. However, Goodman, Cryder, and Cheema (2013) also caution researchers to the potential reduction of statistical power, as MTurk participants are found to be less likely to pay attention to experimental materials.

A and Player B randomly. Players were matched ex-post. Informed consent was obtained from all subjects.

Both players had the same initial token endowment ($B_A = B_B = 100$). Data was collected using strategy method: subjects in the role Player A were asked whether they would like to send their 100 tokens to Player B. They knew that k would be randomly drawn from $\{0, \frac{1}{5}, \frac{1}{3}, 1, 3\}$, but they made their decisions without knowing the actual transfer rate of Player B. Data from subjects in the role Player B were collected using strategy method (Selten, 1967): for every value of $k \in \{0, \frac{1}{5}, \frac{1}{3}, 1, 3\}$, they were asked, if Player A sent them tokens, whether they would accept a transfer from Player A; and if so, how many tokens they would send back to Player A. They were allowed to choose integer amounts only for their giving back decision. In the sending back decision screen, subjects in role B were provided a calculator to aid them in their calculations. Additionally, subjects in the role Player B were asked how many tokens they thought Person A expects to receive back from them. Their answer to this question was not incentivized. Finally, subjects answered a survey including questions about their age, gender and personality types according to the Big Five Inventory (BFI) (Benet-Martinez and John, 1998; John, Donahue, and Kentle, 1991; John, Naumann, and Soto, 2008).[10] After all decisions were finished, a transfer rate k was drawn randomly from the set of possible values and the subjects' corresponding decisions were implemented to determine the payoffs. The subjects were also paid a participation fee of \$0.25. Average earning was \$1. The average completion time of the experiment was 10 minutes. Screenshots from the experiment program and a copy of the instructions are provided in the Appendix.

[10]The survey also included five control questions meant to test subjects' attention. 26 subjects who answered control questions incorrectly are excluded from analysis.

3.4 Hypotheses

Rejection of transfers and transfer rate (k)

R1-Selfish (R1-S). Player B never rejects a transfer from Player A.

R1-Other-regarding (R1-OR). Player B bases her rejection decision on her transfer rate, k. Player B's likelihood of rejecting a transfer from Player A decreases in k.

Rejection of transfers and second-order beliefs (e_B)

R2-Inequity averse (R2-IA). Player B's likelihood of rejecting a transfer from Player A is independent of e_B.

R2-Guilt averse (R2-GA). Player B's likelihood of rejecting a transfer from Player A increases in e_b, and may depend on whether she can afford to transfer back e_B to Player A.

R2-Reciprocal (R2-R). Player B's likelihood of rejecting a transfer from Player A has a non-linear relationship with e_B.

Giving back (b)

B-Selfish (B-S). Player B never gives back positive amounts.

B-Inequity averse (B-IA). If non-zero, the amount given back by Player B weakly decreases in k, and is independent of second-order beliefs, e_B.

B-Guilt averse (B-GA). The amount sent back by Player B weakly decreases in k, and weakly increases in second-order beliefs, e_B.

B-Regner and Harth (B-RH). The amount sent back by Player B has an inverse U-shaped relationship with second-order beliefs, e_B.

3.5 Results

In this section, I analyze the data obtained from the experiment by testing each of the hypotheses for Player B behavior stated in Section **??**. I also provide a simple analysis of Player A behavior.

I start with providing descriptive statistics of the subjects, obtained from their answers in the post-experiment survey. Tables 3.1 and 3.2 provide information on subjects' self-reported age, gender, experience in economics experiments, self-assessed score on being politically liberal, and calculated scores of Big Five personality traits (BFI; Benet-Martinez and John (1998); John, Donahue, and Kentle (1991); John, Naumann, and Soto (2008)) based on their answers to the 44-item BFI test. Overall, as noted by Goodman, Cryder, and Cheema (2013) as well, the average subject appears to be less extroverted than the average person in a general population sample.

Table 3.1
Summary Statistics, Demographics

	Player A	**Player B**
Age	37.54	39.34
	(12.11)	(12.38)
Female	0.63	0.59
	(0.49)	(0.49)
Experience	0.17	0.11
	(0.38)	(0.31)
N	179	111*

Standard deviations in parentheses.
*One subject did not answer the demographics questions.

Table 3.2
Summary Statistics, Personality Traits

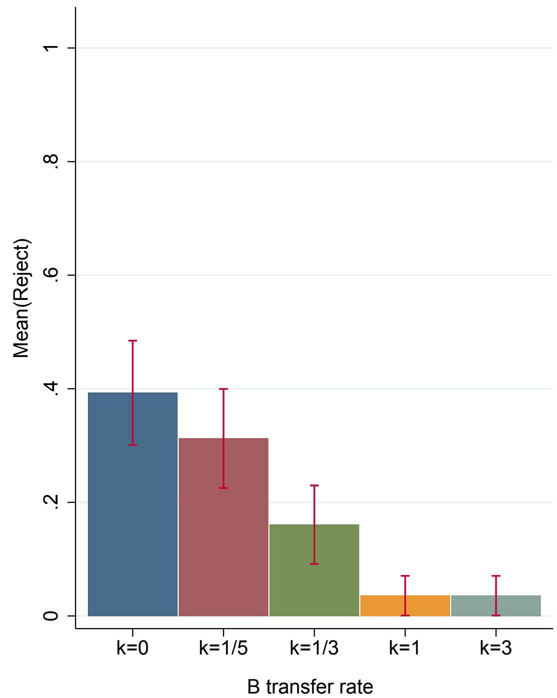
	Player A	**Player B**	**Pop. Sample***
Extraversion	2.95	2.82	3.23
	(0.86)	(1.03)	(0.90)
Agreeableness	3.84	3.97	3.84
	(0.67)	(0.71)	(0.64)
Conscientiousness	3.99	3.98	3.74
	(0.72)	(0.75)	(0.71)
Neuroticsm	2.59	2.56	3.13
	(0.96)	(1.02)	(0.85)
Openness	3.61	3.52	3.87
	(0.72)	(0.71)	(0.69)
Politically Liberal	3.13	3.13	–
	(1.53)	(1.47)	
N	179	112	1406

Standard deviations in parentheses.
*Comparison sample obtained from Srivastava, John, Gosling, and Potter (2003) for age 38.

3.5.1 Player B: Rejection of Transfers

Selfish preferences predict Player B to always accept a transfer from Player A – hence the predicted rejection rate is zero. In contrast, if Player B has other-regarding preferences, she may reject a transfer from Player A. Moreover, her likelihood of rejecting is predicted to decrease in her transfer rate, k **(Hypothesis R1-OR)**. As Figure 3.2 shows, the data is very much in support of the prediction of other-regarding preferences, both in terms of the positive rejection rates and behavior with respect to the change in transfer rates. First, about 46% of the subjects in role B choose to reject a transfer from Player A at least once, as shown in Table 3.3. For each transfer rate, the fraction of subjects who have rejected a

Figure 3.2
Fraction of subjects choosing reject



transfer from Player A is also presented in Table 3.4.[11] Proportions tests for consequent transfer rates indicate that the rejection rates for the lowest two transfer rates, $k = 0$ and $k = 1/5$ are not significantly different from each other. However, the rejection rates for $k = 1/5$ is higher than that for $k = 1/3$, and in return, rejection rates for $k = 1/3$ is higher than that for $k = 1$. These findings provide support for the negative relationship between rejection and Player B's transfer rate.

Next question is whether Player B rejection is related to Player B's second-order beliefs. The distribution of second-order beliefs are presented in Figure 3.3. The average belief is that subjects in role Player A expect to receive 88 tokens back. This number is significantly less than the number of tokens A can send, 100, at the 5% confidence level (t-test, p=0.034). However, the average non-zero belief of 91.6 tokens is not statistically different than 100

[11] A graph of subjects' individual responses is provided in the Appendix.

Table 3.3
Total rejections per subject

Total(Reject=1)	Frequency	%
0	60	53.57
1	16	14.29
2	21	18.75
3	14	12.50
4	0	0
5	1	0.89
Total	112	100

Table 3.4
Fraction of subjects choosing reject

	$k = 0$	$k = 1/5$	$1/3$	$k = 1$	$k = 3$
Fraction	0.39	0.31	0.16	0.04	0.04
	(0.05)	(0.04)	(0.03)	(0.02)	(0.02)
Proportions test*	$p = 0.10$	$p = 0.003$	$p = 0.001$	$p = 0.5$	

Standard errors in parentheses, $N = 112$.
$^*H_0$: $\text{Frac}_{k_j} = \text{Frac}_{k_{(j+1)}}$, where $k_1 = 0$, $k_2 = 1/5$, $k_3 = 1/3$, $k_4 = 1$, $k_5 = 3$, two-tailed test.

(t-test, p=0.096).

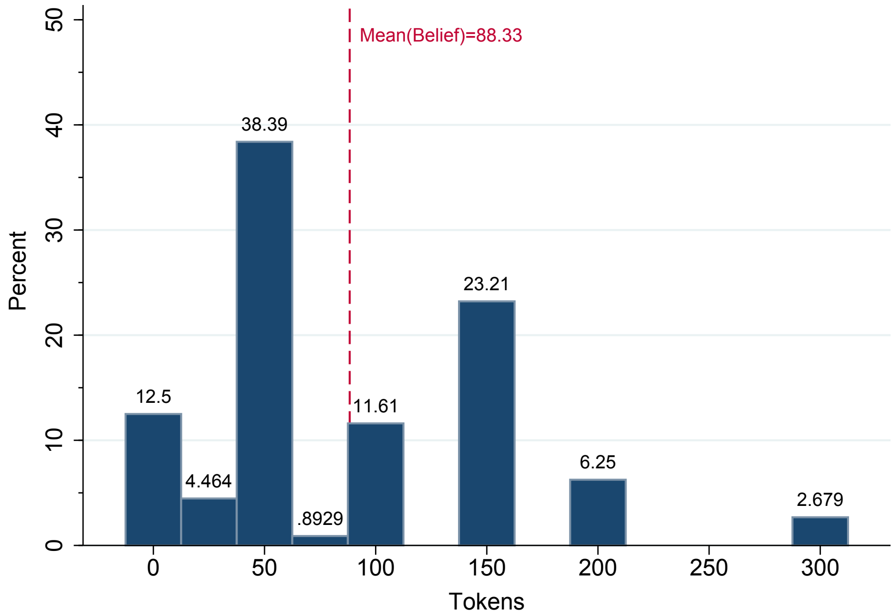
The overall Spearman correlation coefficient between rejection and second-order beliefs is 0.13 (p=0.003), however, for different values of Player B's transfer rate, this correlation varies both in sign and significance (Table 3.5). Nevertheless, these findings indicate that Player B rejection and Player B second-order beliefs are uncorrelated is incorrect. This rules out **Hypothesis R2-IA**.

Table 3.5
Spearman correlation: Rejection and second-order beliefs

	$k = 0$	$k = 1/5$	$k = 1/3$	$k = 1$	$k = 3$
ρ	0.21	0.23	0.26	-0.19	-0.12
	$p = 0.02$	$p = 0.013$	$p = 0.006$	$p = 0.04$	$p = 0.20$

H_0: Rejection and second-order belief is independent, N=112.

Figure 3.3
Distribution of Player B second-order beliefs



Since the relationship between Player B rejection and second-order belief also depends on Player B's transfer rate, a more detailed analysis is required. Columns (1) and (2) of Table 3.6 present the results of regressions on the binary variable "reject transfer" on Player B's transfer rate, Player B's second-order belief and its square, a dummy variable (D) that takes a value of 1 if it is not possible for Player B to transfer back her second-order belief to Player A (second-order belief is infeasible, i.e. $e_B > 400k$) and 0 otherwise, and demographic variables and personality scores from the survey as controls. This yields the following model:

$$\text{Reject} = \beta_0 + \beta_1 k + \beta_2 \text{Belief} + \beta_3 \text{Belief}^2 + \beta_4 D(e_B > 400k) + \sum_{j=5}^{13} \beta_j \text{Control}_j \tag{3.5}$$

Results indicate that, overall, subjects in role Player B take only their transfer rate and whether they can fulfill their second-order beliefs into consideration when deciding whether to reject a transfer from Player A. The likelihood of rejection decreases in Player B's transfer rate and is higher when Player B is unable to transfer back her second-order belief to Player A. These results are consistent with the predictions of guilt aversion model, stated in **Hypothesis R2-GA**. Furthermore, likelihood ratio test for $\beta_2 = \beta_3 = \beta_5 = ... = \beta_{13} = 0$ indicates that the coefficients of Player B's second-order belief and its square and other controls are jointly insignificant (*chi2(11)*=9.91, $prob > 0.54$). Finally, columns (3) and (4) of Table 3.6 show the results of the regression conditional on Player B second-order beliefs being feasible (i.e. $e_B \leq 400k$). Not surprisingly, the significant negative relationship between rejection and transfer rate is maintained.

3.5.2 Player B: Giving Back

How do the subjects behave once they accept? Figure 3.4 provides an overview of subjects' giving back behavior with respect to Player B's transfer rate. The average amount sent is significantly different from zero for $k > 0$ at 1% significance level.[12] Since subjects send back positive amounts significantly different from zero, selfish preferences can be ruled out for explaining the overall data. Nevertheless, as presented in Figure C.3, there are some subjects (n=13) who can be classified as selfish types: they accept a transfer from Player A for all transfer rates and send back zero tokens (or an amount very close to zero) to Player A. Additionally, Wilcoxon signed rank tests (Table 3.7) show that Player B's giving back in transfer rates for $k = 1/5$ and $k = 1/3$ are not significantly different from each other, suggesting overall insensitivity to small differences in transfer rate.

[12] At $k = 0$, there are 17 subjects who send back non-zero amounts to Player A, and hence burn money. The average non-zero amount sent back by these subjects is approximately 58 tokens, which is significantly different than zero. It should be noted that, *conditional on acceptance*, the money burning behavior of these subjects may be explained by a very high sensitivity to advantageous inequality (i.e. $\beta > 1$ in Fehr-Schmidt utility). However, if the explanation is high sensitivity to advantageous inequality, these subjects should have not chosen to accept a transfer from Player A in the previous stage. Thus, the behavior of these subjects cannot be explained by the behavioral biases considered in this study.

Table 3.6
Determinants of Rejection

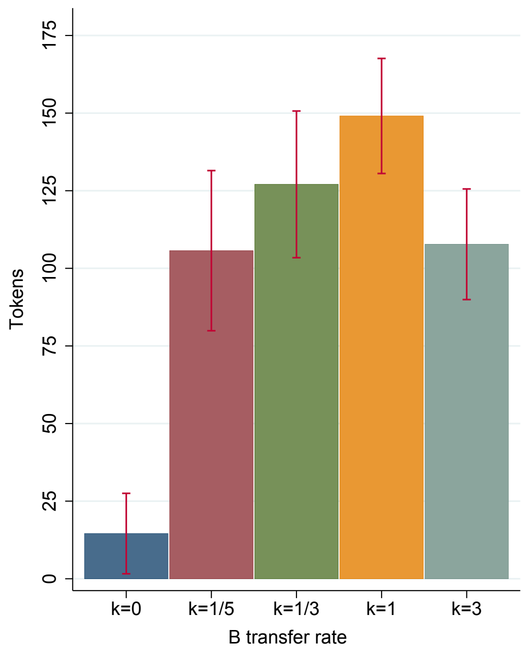
	(1)	(2)	(3)	(4)
Transfer rate	-1.07***	-0.49***	-0.46***	-0.46***
	(0.16)	(0.15)	(0.17)	(0.17)
Belief		0.01		-0.02
		(0.13)		(0.08)
Belief^2		-0.00		0.00
		(0.00)		(0.00)
D($e_B > 400k$)		1.86***		
		(0.30)		
Age		0.03		0.02
		(0.05)		(0.03)
Female		1.68		-0.86
		(4.21)		(1.36)
Experience		-1.77		-0.80
		(12.85)		(2.27)
Extraversion		0.85		0.06
		(1.16)		(0.56)
Agreeableness		-0.87		-0.17
		(5.60)		(1.31)
Conscientiousness		-0.53		0.34
		(2.05)		(1.01)
Neuroticism		-0.24		0.02
		(1.28)		(0.57)
Openness		-0.65		1.10
		(3.54)		(1.09)
Liberal		-0.11		-0.13
		(0.44)		(0.36)
Constant	0.40	3.48	-0.27	-3.71
	(0.67)	(33.17)	(0.74)	(7.48)
N	255	255	76	76
Log likelihood	-113.79	-91.78	-41.66	-41.66
Data	All	All	Belief$\leq 400k$	Belief$\leq 400k$

Random effects probit regression with "Reject" as dependent variable. All regressions include subject fixed effects. Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01.

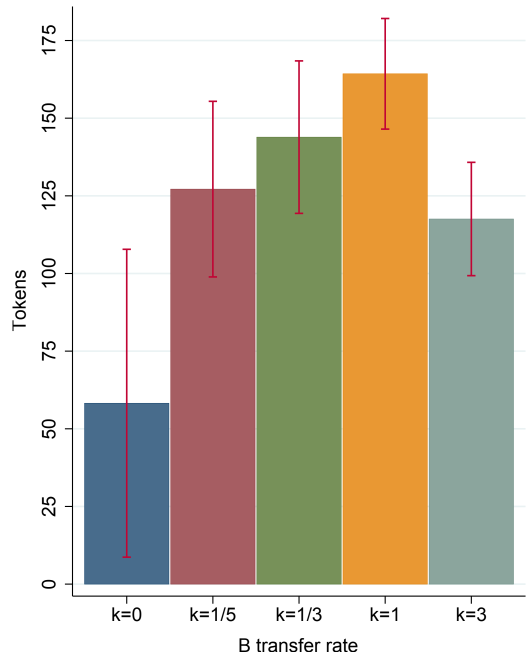
Panels (a) and (b) in Figure 3.4 show that there is an inverse U-shaped relationship between Player B giving and the transfer rate. However, as panel (c) shows, even with the decline in Player B giving back from $k = 1$ to $k = 3$, actual transfers to Player A are higher on average when $k = 3$. In fact, the average amount of tokens received by Player A increases in Player B's transfer rate. This pattern is maintained when subjects in role Player B who send everything back are excluded from the analysis (11 subjects, 18 observations). These findings suggest that Player B giving back is price inelastic.

To further investigate the sensitivity of Player B giving back to the cost of giving back, I use regression analysis. Table 3.8 presents the results of regressions with the amount of tokens sent back by Player B as the dependent variable and Player B's transfer rate, Player B's second-order belief and its square, a and demographic variables and personality scores from the survey as explanatory variables. With this specification, the coefficient of Player B's transfer rate is not significantly different from zero, indicating insensitivity to cost of giving back (column (1)). However, when the regression is repeated with an additional independent variable indicating Player B's inability to transfer her second-order belief to Player A, $D(e_B > 400k)$, the coefficient of Player B's transfer rate is found to be negative and significant (column (2)). Furthermore, the coefficient of the dummy variable for the condition $e_B > 400k$ is also significant and negative, indicating that subjects in role B take both their transfer rates and their second-order beliefs into account when deciding how much to send back. The negative relationship between Player B's transfer rate and Player B's giving back is consistent with the predictions of guilt aversion model.

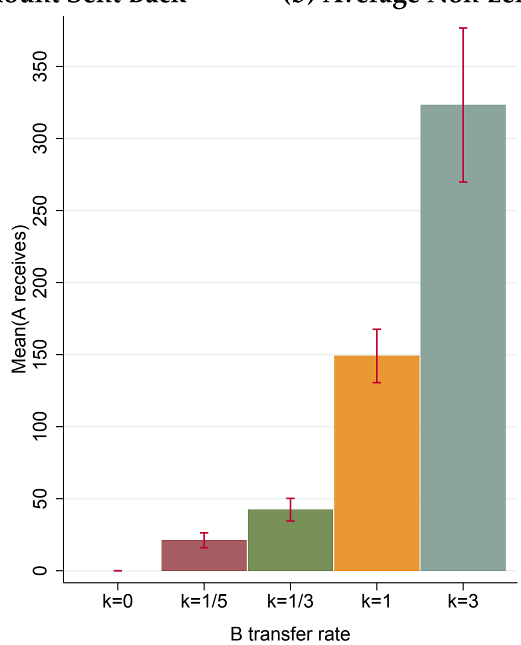
Figure 3.4
Player B Giving Back



(a) Average Amount Sent Back



(b) Average Non-zero Amount Sent Back



(c) Average Amount Received by Player A

Table 3.7
Player B Giving Back

	$k = 0$	$k = 1/5$	$k = 1/3$	$k = 1$	$k = 3$
(i) Mean(Sent)	14.56	105.69	127.05	149.07	107.75
	(6.49)	(12.95)	(11.90)	(9.35)	(8.99)
N	68	77	94	108	108
Wilcoxon signed rank test*	$z = -5.46$ $p = 0.000$	$z = -0.75$ $p = 0.46$	$z = -0.60$ $p = 0.55$	$z = 5.19$ $p = 0.000$	
(ii) Mean(Sent¿0)	58.24	127.16	143.89	164.29	117.55
	(23.38)	(14.14)	(12.34)	(8.97)	(9.19)
N	17	64	83	98	99
Wilcoxon signed rank test*	$z = -0.80$ $p = 0.42$	$z = -0.58$ $p = 0.56$	$z = -0.34$ $p = 0.73$	$z = 5.17$ $p = 0.000$	
(iii) Mean(Transfer)†	0	21.14	42.35	149.07	323.25
	(0)	(2.59)	(3.96)	(9.35)	(26.96)
N	68	77	94	108	108
Wilcoxon signed rank test*	$z = -7.42$ $p = 0.000$	$z = -5.62$ $p = 0.000$	$z = -7.91$ $p = 0.000$	$z = -7.69$ $p = 0.000$	

Standard errors in parentheses.
* H_0 : $\text{Transfer}_{k_j} = \text{Transfer}_{k_{(j+1)}}$, where $k_1 = 0$, $k_2 = 1/5$, $k_3 = 1/3$, $k_4 = 1$, $k_5 = 3$.
† Transfer = $k \times$ Amount Sent Back

Additionally, in column (3) of Table 3.8, the regression on Player B's giving back decision is repeated with a sub-sample where subjects in Role B are able to transfer their second order beliefs to Player A. Here, the coefficients of second-order belief and its square are significantly different from zero. Moreover their opposing signs, with the coefficient of the second-order belief itself being positive indicate that Player B giving back and second-order beliefs have an inverse U-shaped relationship in this sub-sample. This finding supports Regner and Harth (2014)'s claims, as provided in hypothesis **Hypothesis B-RH**.

Table 3.8
Determinants of Giving Back

	(1)	(2)	(3)
Transfer rate	6.63*	-11.83***	-11.82***
	(3.82)	(4.00)	(3.19)
Belief	2.33	2.79*	3.74***
	(1.56)	(1.43)	(1.34)
Belief^2	-0.00	-0.00	-0.01**
	(0.00)	(0.00)	(0.00)
D($e_B > 400k$)		-109.76***	
		(12.10)	
Age	6.02	5.86	6.45
	(6.54)	(5.98)	(4.80)
Female	-326.53	-294.13	-274.42
	(351.21)	(321.19)	(254.52)
Experience	-44.74	-80.67	-93.57
	(206.78)	(189.22)	(153.27)
Extraversion	-216.71***	-214.26***	-173.46***
	(69.99)	(64.06)	(51.84)
Agreeable.	4.79	-0.63	-9.10
	(120.96)	(110.64)	(88.79)
Conscientious.	400.74	387.56*	301.57
	(253.12)	(231.54)	(184.52)
Neuroticism	66.44	61.39	30.35
	(73.05)	(66.82)	(53.65)
Openness	-39.26	-49.28	-29.10
	(60.18)	(55.31)	(44.61)
Liberal	95.00	90.95*	68.61
	(59.04)	(54.01)	(43.46)
Constant	-1614.29	-1480.20	-1177.58
	(1961.93)	(1794.43)	(1422.89)
Observations	450	450	332
Log likelihood	-2039.82	-1999.91	-1587.78
Data	All	All	Belief$\leq 400k$

Random effects tobit regression with "Amount sent back" as dependent variable, bounded below at 0 and above at 400. All regressions include subject fixed effects. Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01.

3.5.3 Player A: Sending to Player B

In this section, I analyze the decisions of subjects in role Player A to send their endowments to Player B. This analysis is largely exploratory as data collected from subjects in

Player A role is limited.

First, 73% of subjects have chosen to send their endowments to Player B, which is significantly different than 0%. The high proportion of subjects who have decided to send is surprising, given that subjects in role Player A do not know the exact value of Player B's transfer rate at the time they are making this decision. Regression results reported on column (1) of Table 3.10 suggest that the likelihood of subjects in role A of sending their endowment is positively correlated with the Big Five Inventory personality trait "agreeableness." This positive correlation is not surprising, however, since agreeableness is defined to be correlated with qualities such as trust and altruism (John, Naumann, and Soto, 2008). Additionally, likelihood ratio test does not reject joint insignificance of variables excluding agreeableness ($chi2(8) = 9.06$, $prob > chi2 = 0.3376$).

Table 3.9
Fraction of A subjects Choosing Send Endowment

	$k = 0$	$k = 1/5$	$k = 1/3$	$k = 1$	$k = 3$
Fraction	0.12	0.29	0.38	0.71	0.82
	(0.03)	(0.04)	(0.05)	(0.04)	(0.04)
Proportions test	$z = -3.31$	$z = -1.41$	$z = -4.97$	$z = -1.90$	
	$p = 0.001$	$p = 0.16$	$p = 0.000$	$p = 0.06$	

Standard errors in parentheses.
$^*H_0$: Transfer$_{k_j}$ = Transfer$_{k_{(j+1)}}$, where $k_1 = 0$, $k_2 = 1/5$, $k_3 = 1/3$, $k_4 = 1$, $k_5 = 3$.

Since in the mini trust games studied so far in the literature, both players have binary choices, a comparison of Player A's sending decision in my game with the findings in the existing literature may be misleading. This is because, in the binary trust games, payoff expectations of subjects in role A can be summarized by one parameter: the probability that Player B chooses the action that yields Player A the higher payoff. In contrast, in my version of the trust game, Player A's payoff expectations depend on his beliefs over Player

B's strategy, which may depend on Player B's transfer rate. However, in my modified trust game, Player B has a richer action space, and her strategy has been shown, both theoretically and empirically, to depend on Player B's transfer rate.

In order to gain further understanding of the factors driving the trusting behavior of subjects in role Player A, I held an additional treatment where subjects in role A are able to condition their answers on Player B's transfer rate. In this treatment, subjects in role A are asked to choose between sending and keeping their endowments conditional on the value of Player B's transfer rate. Table 3.9 reports the proportion of subjects in role A who have chosen to send their endowment for each value of Player B's transfer rate. Results of proportions tests suggest that the fraction of subjects in role A who send their endowments weakly increases in Player B's transfer rate. Moreover, regression results in column (2) of Table 3.10 support the positive relationship between Player B's transfer rate and the likelihood of the choice "send endowment." Furthermore, likelihood ratio test results indicate that variables excluding transfer rate are jointly insignificant ($chi2(9) = 9.06$, $Prob > chi2 = 0.4314$).

3.6 Conclusion

In this study, I investigate a decision maker's motives for declining a positive transfer from another player in a one-shot interaction, and focus on the behavioral biases of guilt aversion, reciprocity and inequity aversion as possible drivers of behavior. In order to formalize and refine the predictions of these behavioral biases, I modify the widely used trust game by allowing the second mover to decline a transfer from the first mover and by varying the second mover's cost of reciprocation. In contrast to the impunity game where rejection results in money burning, in my game, second mover's rejection results in the amount declined to be returned to the first mover. The cost of reciprocation is varied by changing

Table 3.10
Player A: Decision to Send Endowment to Player B

	(1)	(2)
Transfer rate		1.19***
		(0.11)
Age	-0.01	-0.05
	(0.01)	(0.05)
Experience	-0.19	-0.38
	(0.53)	(1.12)
Female	0.09	-1.48
	(0.39)	(1.48)
Extraversion	-0.17	-0.81
	(0.23)	(0.59)
Agreeableness	0.83**	1.44
	(0.38)	(2.01)
Conscientiousness	-0.25	-1.00
	(0.38)	(1.23)
Neuroticism	0.54*	-0.03
	(0.28)	(1.10)
Openness	0.40	0.91
	(0.25)	(0.65)
Liberal	0.05	0.09
	(0.13)	(0.57)
Constant	-3.50	0.20
	(2.18)	(5.98)
Observations	67	435
Treatment	Incomplete Info	Complete Info

Incomplete Info: Probit regression with "Send=1" as dependent variable. Complete Info: Random effects probit regression with subject fixed effects and "Send=1" as dependent variable. Standard errors in parentheses; * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

how much of a unit of money second mover sends to the first mover reaches the first mover. These modifications allow me to derive distinct testable predictions for the behavioral biases considered over second mover's rejection and giving decisions.

In an experiment conducted on Amazon Mechanical Turk, I vary the cost of reciprocation for the second mover, and test the predictions of each model. My results support the presence of guilt aversion and reciprocity. First, a significant proportion of subjects (46%)

rejects at least once a transfer that is materially beneficial to them. Second, the likelihood of rejection increases in second mover's cost of reciprocation and is higher if the second mover cannot transfer back to the first mover her belief about first mover's payoff expectation. Third, second mover's giving increases in her cost of reciprocation, but the actual transfers to first mover decreases in the cost of reciprocation. This suggests that price elasticity of second mover giving back is low. Finally, a large proportion of first movers chooses to send their endowments, despite not knowing the exact value of second mover's cost of reciprocation. In a treatment where the first movers can condition their decision on the second mover's cost of reciprocation, first movers' likelihood of sending a positive amount decreases in second mover's cost of reciprocation. This last finding is suggestive for first movers' correct anticipation of second mover's behavior, however due to the limitations of the current design, the answer to this last question is left for future research.

Appendix A: Appendix to Chapter 1

A.1 Non-Binding Promises and Inequity Aversion

Payoffs of candidate and voter in transfer and voting stages are given below. For simplicity I assume $\alpha_C = \alpha_V = \alpha$.

Post-voting stage: Candidate chooses transfer t to maximize

$$\begin{aligned} U_C(t|\text{CP, vote}) &= B + W - t - \alpha \max\{B + t - d - (B + W - t), 0\} \\ &\quad - \beta_c \max\{B + W - t - (B + t - d), 0\} \qquad \text{(A.1)} \\ &= B + W - t - \alpha \max\{2t - W - d, 0\} - \beta_c \max\{W + d - 2t, 0\} \end{aligned}$$

Voting stage: Voter chooses between "vote" and "do not vote", conditional on her choice at the offer stage.

- If the voter has accepted **up-front payment**, x,

$$\begin{aligned} U_v(\text{vote}|\text{UFP}, x) &= B + x - d \\ &\quad - p' \left[\alpha \max\{W + d - 2x, 0\} + \beta_V \max\{2x - W - d, 0\}\right] \\ &\quad - (1 - p') \left[\alpha \max\{d - 2x, 0\} + \beta_V \max\{2x - d, 0\}\right] \qquad \text{(A.2)} \\ U_v(\text{DNV}|\text{UFP}, x) &= B + x - p \left[\alpha \max\{W - 2x, 0\} + \beta_V \max\{2x - W, 0\}\right] \\ &\quad - (1 - p) \left[\alpha \max\{-2x, 0\} + \beta_V \max\{2x, 0\}\right] \qquad \text{(A.3)} \end{aligned}$$

- If the voter has accepted **conditional payment**, and believes that the transfer will be t^*,

$$\begin{aligned} U_v(\text{vote}|\text{CP}, t^*) &= B + p't^* - d \\ &\quad - p' \left[\alpha \max\{W + d - 2t^*, 0\} + \beta_V \max\{2t^* - W - d, 0\}\right] \\ &\quad - (1 - p') \left[\alpha \max\{d, 0\} + \beta_V \max\{-d, 0\}\right] \qquad \text{(A.4)} \\ U_v(\text{DNV}|\text{CP}, t^*) &= B + p't^* - p \left[\alpha \max\{W - 2t^*, 0\} + \beta_V \max\{2t^* - W, 0\}\right] \\ &\quad - (1 - p) \left[\alpha \max\{0, 0\} + \beta_V \max\{0, 0\}\right] \end{aligned}$$

- If the voter does not accept any payment,

$$\begin{aligned} U_v(\text{vote}|\text{DNA}) &= B - d - p' \left[\alpha \max\{W+d, 0\} + \beta_V \max\{-W-d, 0\}\right] \\ &\quad - (1-p') \left[\alpha \max\{d, 0\} + \beta_V \max\{-d, 0\}\right] \quad \text{(A.5)} \\ U_v(\text{DNV}|\text{DNA}) &= B - p \left[\alpha \max\{W, 0\} + \beta_V \max\{-W, 0\}\right] \\ &\quad - (1-p) \left[\alpha \max\{0, 0\} + \beta_V \max\{0, 0\}\right] \quad \text{(A.6)} \end{aligned}$$

In the proofs of Propositions 1.2 and 1.3, I show that there are up-front and conditional payments, x and t^*, for which the utility of voting to utility from not voting difference is positive. However, if the voter does not accept any payment, the utility difference is always negative, implying that the voter never votes if she does not accept any payment:

$$\Delta_V^{\text{DNA}} = U_v(\text{vote}|\text{DNA}) - U_v(\text{DNV}|\text{DNA}) = -d - (p'-p)\alpha W < 0 \quad \text{(A.7)}$$

Proof of Proposition 1.2

Proposition 1.2: If the candidate's sensitivity to advantageous inequity is sufficiently low ($\beta_C < 0.5$), then vote buying only occurs with up-front payment.

Proof. Suppose the voter is inequity averse ($0 < \beta_V < 1$) and has utility function (1.1); the candidate is either selfish ($\beta_C = 0$) or also inequity averse, but has low sensitivity to advantageous inequity ($0 < \beta_C < 0.5$). I first show that there exists an equilibrium in which vote buying occurs and the candidate offers only up-front payment; I then show, by contradiction, that vote buying cannot occur if the candidate offers conditional payment.

First, assume that there exists an equilibrium in which the candidate buys vote with up-front payment, i.e. the candidate offers positive up-front payment, the voter accepts the up-front payment and votes for the candidate. Since it is a one-shot game, I proceed with backward induction. Note that, because the voter accepts up-front payment in this equilibrium, the game ends after the voting stage.

At the voting stage, the following inequality should hold for the voter who has accepted up-front payment:

$$[U_V(\text{vote}|\text{UFP}) - U_V(\text{DNV}|\text{UFP})] = \Delta_V^{\text{UFP}} \geq 0$$

$$\Delta_V^{\text{UFP}} = \begin{cases} 2(1-p)(\alpha+\beta_V)x - (1+\alpha)d - (p'-p)\alpha W & \text{if } x \leq \frac{d}{2} \\ 2(p'-p)(\alpha+\beta_V)x - (1+p'(\alpha+\beta_V)-\beta_V)d - (p'-p)\alpha W & \text{if } \frac{d}{2} \leq x \leq \frac{W}{2} \\ 2p'(\alpha+\beta_V)x - (1+p'(\alpha+\beta_V)-\beta_V)d - (p'\alpha+p\beta_V)W & \text{if } \frac{W}{2} \leq x \leq \frac{W+d}{2} \\ (p'-p)\beta_V W - (1-\beta_V)d & \text{if } x \geq \frac{W+d}{2} \end{cases} \quad \text{(A.8)}$$

Let $x \leq \frac{d}{2}$ be case(i), $\frac{d}{2} \leq x \leq \frac{W}{2}$ be case(ii), $\frac{W}{2} \leq x \leq \frac{W+d}{2}$ be case (iii), and $x \geq \frac{W+d}{2}$ be case (iv). Note that when $x = \frac{d}{2}$, $\Delta_V^{\text{UFP}} < 0$. Hence the UFP offer should be strictly greater than $\frac{d}{2}$ to provide incentive to vote. This allows us to ignore case (i).

From (A.8), we can find the minimum accepted UFP the voter requires to vote. For case (ii) this is

$$x \geq \frac{[1 - \beta_V + p'(\alpha + \beta_V)]\, d + (p' - p)\alpha W}{2(p' - p)(\alpha + \beta_V)} = \underline{x}_2 \tag{A.9}$$

while for case (iii),

$$x \geq \frac{[1 - \beta_V + p'(\alpha + \beta_V)]\, d + (p'\alpha + p\beta_V)W}{2p'(\alpha + \beta_V)} = \underline{x}_3 \tag{A.10}$$

Finally for case (iv), if $\Delta_V^{UFP} = (p' - p)\beta_V W - (1 - \beta_V)d \geq 0$, the voter accepts

$$\underline{x}_4 = \frac{W + d}{2} \tag{A.11}$$

At the offer choice stage the following inequalities should hold for the voter:

$$\begin{aligned} \left[U_V(\text{UFP, vote}|x) - U_V(\text{CP, DNV}|y = 0)\right]_{x=\underline{x}} &\geq 0 \\ \left[U_V(\text{UFP, vote}|x) - U_V(\text{DNA, DNV})\right]_{x=\underline{x}} &\geq 0 \end{aligned} \tag{A.12}$$

Recall that

$$U_V(\text{UFP, vote}|x) = B + (1 + 2p'(\alpha + \beta_V) - 2\beta_V)x - (1 + p'(\alpha + \beta_V) - \beta_V)d - p'\alpha W \quad \text{if } x \leq \frac{W + d}{2} \tag{A.13}$$

Note also that $U_V(\text{CP, DNV}|y = 0) = U_V(\text{DNA, DNV}) = B - p\alpha W$. Hence both differences in (A.12) are equal. As a result the utility difference between different offers (UFP and CP, UFP and DNA) for the voter, given UFP x, is

$$\Delta_V^{\text{offer, UFP}} = (1 + 2p'(\alpha + \beta_V) - 2\beta_V)x - (1 + p'(\alpha + \beta_V) - \beta_V)d - (p' - p)\alpha W \tag{A.14}$$

Thus

$$\Delta_V^{\text{offer, UFP}} = \begin{cases} d(1 - \beta_V + p'(\alpha + \beta_V) + (p' - p)\alpha \frac{W}{d}) \times \\ \left[\dfrac{1 - 2\beta_V + 2p(\alpha + \beta_V)}{2(p' - p)(\alpha + \beta_V)}\right] & \text{if } \underline{x} = \underline{x}_2 \\ d(1 - \beta_V + p'(\alpha + \beta_V) + p'\alpha \frac{W}{d}) \left[\dfrac{1 - 2\beta_V}{2p'(\alpha + \beta_V)}\right] \\ +pW \left(\dfrac{(1 - 2\beta_V)\beta_V}{2p'(\alpha + \beta_V)}\beta_V - \alpha\right) & \text{if } \underline{x} = \underline{x}_3 \\ d\left[(p'\beta_V + p\alpha - \beta_V)\frac{W}{d} - \dfrac{1}{2}\right] & \text{if } \underline{x} = \underline{x}_4 \end{cases} \tag{A.15}$$

Sufficient conditions for this utility difference to be positive for each case is given below:

$$\Delta_V^{\text{offer, UFP}} \begin{cases} \geq 0 & \text{if } \beta_V \leq \frac{1}{2} \text{ and } 1 \geq 2(p'-p)(\alpha+\beta_V) \text{ and } p' \neq p \text{ for } \underline{\mathrm{x}} = \underline{\mathrm{x}}_2 \\ \geq 0 & \text{if } \beta_V \leq \frac{1}{2} \text{ and } p' \neq 0 \text{ for } \underline{\mathrm{x}} = \underline{\mathrm{x}}_3 \\ > 0 & \text{if } \beta_V < \frac{1}{2} \text{ and } p'\beta_V \geq p\alpha \text{ for } \underline{\mathrm{x}} = \underline{\mathrm{x}}_4 \end{cases} \tag{A.16}$$

Since these conditions do not contradict with the underlying assumptions, there exists parameters for which the voter accepts UFP.

At the offer making stage the following inequality should hold for the **candidate type j** where j=Selfish, Fair:

$$[U_{C,j}((x=\underline{x}, y=0)|\text{UFP, vote}) - U_{C,j}((.)|\text{DNA, DNV})] = \Delta_{C,j}^{\text{Offer, UFP}} \geq 0 \tag{A.17}$$

Case 1: If the candidate is selfish, then $\Delta_{C,S}^{\text{Offer, UFP}} = (p'-p)W - \underline{\mathrm{x}}_j,\ j \in \{2,3,4\}$. For different cases, this difference equals to:

- **If $\underline{\mathrm{x}} = \underline{\mathrm{x}}_2$,**

$$\begin{aligned} \Delta_{C,S}^{\text{Offer, UFP}} &= (p'-p)W - \frac{[1-\beta_V + p'(\alpha+\beta_V)]\, d + (p'-p)\alpha W}{2(p'-p)(\alpha+\beta_V)} \\ &= \left[1 - \frac{\alpha}{2(p'-p)}\right] W - \frac{(1+(\alpha+\beta_V)p' - \beta_V)}{2(p-p')(\alpha+\beta_V)} d \gtrless 0 \end{aligned} \tag{A.18}$$

- **If $\underline{\mathrm{x}} = \underline{\mathrm{x}}_3$,**

$$\begin{aligned} \Delta_{C,S}^{\text{Offer, UFP}} &= (p'-p)W - \frac{[1-\beta_V + p'(\alpha+\beta_V)]\, d + (p'\alpha + p\beta_V)W}{2p'(\alpha+\beta_V)} \\ &= \frac{p'\alpha(2(p'-p)-1) + 2p'^2\beta_V - p\beta_V(2p'+1)}{2p'(\alpha+\beta_V)} W \\ &\quad - \frac{1+(\alpha+\beta_V)p' - \beta_V}{2p'(\alpha+\beta_V)} d \gtrless 0 \end{aligned} \tag{A.19}$$

- **If $\underline{\mathrm{x}} = \underline{\mathrm{x}}_4$,**

$$\begin{aligned} \Delta_{C,S}^{\text{Offer, UFP}} &= (p'-p)W - \frac{W+d}{2} \\ &= \frac{(2(p'-p)-1)\frac{W}{d} - 1}{2} d \gtrless 0 \end{aligned} \tag{A.20}$$

Thus, if the candidate is selfish, the voter is inequity averse, and these are common knowledge, then there exists combinations of parameters for which $\Delta_{C,S}^{\text{Offer, UFP}} \geq 0$ for the three cases above.

Case 2: If the candidate is inequity averse, then $U_{C,F}((.)|\text{DNA, DNV}) = B + p(1-$

$\beta_C)W$, and

$$U_{C,F}(x|\text{UFP, vote}) = B+p'(1-\beta_C)W-(1+2\alpha-2p'(\alpha+\beta_C))x+(\alpha-p'(\alpha+\beta_C))d \text{ if } x \leq \frac{W+d}{2} \tag{A.21}$$

Thus the utility difference of the inequity averse candidate, $\Delta_{C,F}^{\text{Offer, UFP}}$, is equal to

$$\Delta_{C,F}^{\text{Offer, UFP}} = (p-p')W - \underline{x}_j - \beta_C(p'-p)W - [\alpha - p'(\alpha+\beta_C)][2\underline{x} - d] \text{ if } x \leq \frac{W+d}{2} \tag{A.22}$$

Note that when $\underline{x} = \frac{W+d}{2}$, $\Delta_{C,F}^{\text{Offer, UFP}} = \Delta_{C,S}^{\text{Offer, UFP}} + (p'\alpha + p\beta_C - \alpha)W$. Thus if $(p'\alpha + p\beta_C - \alpha) < 0$, then $\Delta_{C,F}^{\text{Offer, UFP}} \leq \Delta_{C,S}^{\text{Offer, UFP}}$, i.e. if an inequity averse candidate finds it worthwhile to offer positive payment, a selfish candidate does too. If $(p'\alpha + p\beta_C - \alpha) \geq 0$, then the behavior of the selfish candidate becomes indicative of the inequity averse candidate, In other words, for any $\underline{x}$, we can find a subset of parameters for which $\Delta_{C,F}^{\text{Offer}} > 0$. This concludes the first part of the proof that there exists an equilibrium in which vote buying occurs and the candidate offers only UFP.

Next, I show that vote buying cannot occur if the candidate is sufficiently selfish ($0 \leq \beta_C < 0.5$). In this case, the transfer that maximizes the utility function given in (A.1) for $\beta_C < 0.5$ is zero ($t^* = 0$). Hence the candidate will never transfer a positive amount to the voter, regardless of his promises at the offer stage. Since the voter is aware of this fact, any conditional payment offer is cheap talk. Thus, by backward induction, at the voting stage the voter will not vote even if she accepts conditional payment, and at the offer stage she will not accept any conditional payment offer regardless of its size. As a result, an equilibrium where vote buying occurs via conditional payment cannot exist. ■

Proof of Proposition 1.3

Proposition 1.3: If the candidate's sensitivity to advantageous inequity is sufficiently high ($\beta_C \geq 0.5$), then vote buying only occurs with conditional payment.

Proof. Suppose the voter is inequity averse ($0 < \beta_V < 1$) and has utility function (1.1); the candidate is inequity averse and $0.5 \leq \beta_C < 1$. I first show that it is feasible for the candidate to buy vote with conditional payment; I then show that it is also feasible for the candidate to buy vote with up-front payment; and finally I show that the candidate weakly prefers buying vote with conditional payment than with up-front payment. I prove these results first by assuming $\beta_C = 0.5$, and then by assuming $0.5 < \beta_C < 1$.

Case 1: $\beta_C = 0.5$

First, assume that it is feasible for the candidate to buy vote with conditional payment, i.e. the candidate offers positive conditional payment, the voter accepts the conditional payment and votes for the candidate. Since the game is one-shot, I proceed with backward induction.

At the transfer stage the candidate maximizes (A.1) by choosing $t^* \in [0, \frac{W+d}{2}]$.

At the voting stage, $[U_V(\text{vote}|\text{CP}) - U_V(\text{DNV}|\text{CP})]_{t=t^*} = \Delta_v^{\text{CP}} \geq 0$ should hold for the voter to vote.

$$\Delta_V^{\text{CP}} = \begin{cases} (1+2\alpha)(p-p')t^* - (1+\alpha)d + (p'-p)\alpha W & \text{if } t^* \leq \frac{W}{2} \\ [p'-p+2(p'\alpha+p\beta_V)]t^* - (1+\alpha)d + (p'\alpha+p\beta_V)W & \text{if } \frac{W}{2} \leq t^* \leq \frac{W+d}{2} \\ (1-2\beta_V)(p'-p)t^* - (1+\alpha-p'(\alpha+\beta_V))d + (p'-p)\beta_V W & \text{if } t^* \geq \frac{W+d}{2} \end{cases} \tag{A.23}$$

Let $t^* \leq \frac{W}{2}$ ve case (i), $\frac{W}{2} \leq t^* \leq \frac{W+d}{2}$ be case (ii) and $t^* \geq \frac{W+d}{2}$ be case (iii). From (A.23), we can find the minimum accepted CP the voter requires to vote. For case (i) this is

$$t^* \geq \frac{(1+\alpha)d + (p'-p)\alpha W}{(1+2\alpha)(p'-p)} = \underline{t}_1 \tag{A.24}$$

while for case (ii)

$$t^* \geq \frac{(1+\alpha)d + (p'\alpha+p\beta_V)W}{p'-p+2(p'\alpha+p\beta_V)} = \underline{t}_2 \tag{A.25}$$

For case (iii), since $t^* \in \left[0, \frac{W+d}{2}\right]$, we may check directly whether Δ_V^{CP} is positive at the upper bound of the interval:

$$\Delta_V^{\text{CP}}\left(t^* = \frac{W+d}{2}\right) = (1-2\beta_V)(p'-p)\frac{W+d}{2} - (1+\alpha-p'(\alpha+\beta_V))d + (p'-p)\beta_V W \overset{?}{\geq} 0 \tag{A.26}$$

$$= \frac{d}{2}\left[(p'-p)\frac{W}{d} - 1 - (1-p')(1+2\alpha) - p(1-2\beta_V)\right] \gtrless 0 \tag{A.27}$$

Thus if $(p'-p)\frac{W}{d} - 1 - (1-p')(1+2\alpha) - p(1-2\beta_V) \geq 0$, $\underline{t}_3 = \frac{W+d}{2}$. **At the offer choice stage** the following inequalities should hold for the voter (assuming the offer $(x=0,\ y=\underline{t}_j)$):

$$[U_V(\text{CP, vote}) - U_V(\text{UFP, DNV})] \geq 0 \qquad \text{(ov.i)} \tag{A.28}$$

$$[U_V(\text{CP, vote}) - U_V(\text{DNA, DNV})] \geq 0 \qquad \text{(ov.ii)}$$

Recall that $U_V(\text{DNA, DNV}) = U_V(\text{UFP, DNV}; x=0) = B - p\alpha W$ and

$$U_V(\text{CP, vote}|t) = B + p'(1+2\alpha)t - (1+\alpha)d + p'\alpha W \quad \text{if } t \leq \frac{W+d}{2} \tag{A.29}$$

The utility difference between different choices (CP vs. UFP; CP vs. DNA) for the voter is

$$\Delta_V^{\text{offer, CP}} = p'(1+2\alpha)t - (1+\alpha)d - (p'-p)\alpha W \quad \text{if } t \leq \frac{W+d}{2} \tag{A.30}$$

For each case, we can find combinations of parameters for which $\Delta_V^{\text{offer, CP}} \geq 0$.

Finally at the **offer making stage** the following inequality should hold for the candidate:

$$[U_C((x=0, y=\underline{t}_j)|\text{CP, vote}) - U_C((.)|\text{DNA, DNV})] = U_C^{\text{offer, CP}} \geq 0 \tag{A.31}$$

Recall that $U_C((.)|\text{DNA, DNV})) = B + p(1-\beta_C)W$ and

$$U_C((0,t)|\text{CP, vote}) = B + p'(1-\beta_C)W - p'(1-2\beta_C)t - \beta_C d \quad \text{if } t \leq \frac{W+d}{2} \tag{A.32}$$

Thus

$$\begin{aligned}\Delta_C^{\text{offer, CP}} &= (p-p')(1-\beta_C)W - p'(1-2\beta_C)t - \beta_C d \quad \text{if } t \leq \frac{W+d}{2} \\ &\overset{\beta_C=0.5}{=} \frac{d}{2}[(p-p')\frac{W}{d} - 1] \gtreqless 0\end{aligned} \tag{A.33}$$

This shows that making a positive payment promise is rational for the candidate only if $(p-p')\frac{W}{d} - 1 \geq 0$, which is satisfied by a subset of parameters.

Finally we should check if it is feasible for the candidate to buy vote with up-front payment and if so, if vote buying with up-front payment yields higher utility than buying vote with conditional payment for the candidate. Note that the minimum up-front payment required to vote are the same as the case where $\beta_C < 0.5$: $\underline{x} \in \{\underline{x}_2, \underline{x}_3, \underline{x}_4\}$. Assume the candidate offers $(x > 0, y = 0)$.

At the offer selection stage the *sufficient* conditions for the voter to choose UFP and then vote ($\Delta_V^{\text{offer, UFP}} \geq 0$) is

$$\Delta_V^{\text{offer, UFP}} = \begin{cases} \geq 0 & \text{if } p' \neq p \text{ and } 1 \geq 2(p'-p)(\alpha + \frac{1}{2}) \text{ for } \underline{x} = \underline{x}_2 \\ > 0 & \text{if } p', p \neq 0 \text{ for } \underline{x} = \underline{x}_3 \\ > 0 & \text{if } \frac{p'}{2} \geq p\alpha \text{ for } \underline{x} = \underline{x}_4 \end{cases} \tag{A.34}$$

At the offer making stage the candidate's utility is

$$\begin{aligned}U_C((x,0)|\text{UFP, vote}) = B &+ p'(1-\beta_C)W + (\alpha - p'(\alpha+\beta_C))d \\ &- (1+2\alpha-2p'(\alpha+\beta_C))x \quad \text{if } x \leq \frac{W+d}{2}\end{aligned} \tag{A.35}$$

which is positive for a subset of parameters.

We can now compare the utilities of buying vote with up-front and conditional payments. Let $\Delta_C^{\text{UFP-CP}}$ be the candidate's utiilty difference when he buys vote with up-front payment and when he buys vote with conditional payment.

$$\Delta_C^{\text{UFP-CP}} = U_C((\underline{x}, 0)|\text{UFP, vote}) - U_C((0, \underline{t})|\text{CP, vote}) \tag{A.36}$$

Since both $\underline{x}$ and $\underline{t}$ are less than or equal to $\frac{W+d}{2}$,

$$\begin{aligned}
\Delta_C^{\text{UFP-CP}} &= p'(1-2\beta_C)\underline{t} - (1+2\alpha-2p'(\alpha+\beta_C))\underline{x} + (\alpha+\beta_C)(1-p')d \\
&\overset{\beta_C=0.5}{=} -\left[1+2\alpha-2p'\left(\alpha+\frac{1}{2}\right)\right]\underline{x} + \left(\alpha+\frac{1}{2}\right)(1-p')d \\
&= [p'(1+2\alpha)-(1-2\alpha)]\underline{x} + (1+2\alpha)(1-p')\frac{d}{2} \\
&= \underbrace{(p'-1)}_{\leq 0}\underbrace{(1+2\alpha)}_{>0}\underbrace{\left[\underline{x}-\frac{d}{2}\right]}_{>0} \leq 0
\end{aligned} \tag{A.37}$$

This shows that the candidate weakly prefers buying vote with conditional payment over up-front payment if $\beta_C = 0.5$. Moreover this preference is strict when $p' < 1$.

Case 2: $0.5 < \beta_C < 1$

Again, assume that it is feasible for the candidate to buy vote with conditional payment, i.e. the candidate offers positive conditional payment, the voter accepts the conditional payment and votes for the candidate. Since the game is one-shot, I proceed with backward induction.

At the transfer stage the candidate choses $t^* = \frac{W+d}{2}$.

At the voting stage $[U_V(\text{vote}|\text{CP}) - U_V(\text{DNV}|\text{CP})]_{t^*=\frac{W+d}{2}} = \Delta_v^{CP} \geq 0$ should hold:

$$\Delta_V^{\text{CP}} = (1-2\beta_V)(p'-p)t^* - (1+\alpha-p'(\alpha+\beta_V))d + (p'-p)\beta_V W \tag{A.38}$$

$$\begin{aligned}
t^* = \frac{W+d}{2} \Rightarrow \Delta_V^{\text{CP}} &= (1-2\beta_V)(p'-p)\frac{W+d}{2} - (1+\alpha-p'(\alpha+\beta_V))d + (p'-p)\beta W \\
&= \frac{d}{2}\left[(p'-p)\frac{W}{d} - 1 - (1-p')(1+2\alpha) - p(1-2\beta_V)\right] \gtrless 0
\end{aligned}$$

If $(p'-p)\frac{W}{d} - 1 - (1-p')(1+2\alpha) - p(1-2\beta_V) \geq 0$, voter choses to vote.

At the **offer selection stage** assume the offer is $(x = 0,\ y = t^* = \frac{W+d}{2})$. Then the following inequality should hold:

$$U_V(\text{CP, vote}|t^*) - \underbrace{U_V(\text{UFP, DNV})}_{=U_V(\text{DNA, DNV})} = \Delta_V^{\text{offer, CP}} \geq 0 \tag{A.39}$$

Recall that

$$U_V(\text{CP, vote}|t^*) = \text{B} + p'(1+2\alpha)t^* - (1+\alpha)d - p'\alpha W \tag{A.40}$$
$$U_V(\text{DNA, DNV}) = \text{B} - p\alpha W$$

Then

$$\begin{aligned}\Delta_V^{\text{offer, CP}} &= p'(1+2\alpha)\left[\frac{W+d}{2}\right] - (1+\alpha)d - p'\alpha W \\ &= \frac{d}{2}\left[(p'+2\alpha p)\frac{W}{d} - 1 - (1-p')(1+2\alpha)\right] \gtrless 0\end{aligned} \tag{A.41}$$

Again, there are combinations of parameters for which $\Delta_V^{\text{offer, CP}} \geq 0$.

At the **offer making stage**, the following inequality should hold for the candidate:

$$[\underbrace{U_C((x=0, y=t^*)|\text{CP, vote})}_{=\text{B}+p'(1-\beta_C)W - p'(1-2\beta_C)t^* - \beta_C d} - \underbrace{U_C((.)|\text{DNA, DNV})}_{=\text{B}+p(1-\beta_C)W}] = \Delta_C^{\text{offer, CP}} \geq 0 \tag{A.42}$$

$$\begin{aligned}\Delta_C^{\text{offer, CP}}\left(t^* = \frac{W+d}{2}\right) &= (p'-p)(1-\beta_C)W - p'(1-2\beta_C)\left[\frac{W+d}{2}\right] - \beta_C d \\ &= \left[\frac{p'}{2} - p(1-\beta_C)\right]W - [p'(1-2\beta_C)+\beta_C]d \gtrless 0\end{aligned} \tag{A.43}$$

As in cases above, there are combinations of parameters for which $\Delta_C^{\text{offer, CP}} \geq 0$.

Finally we should check if it is feasible for the candidate to buy vote with up-front payment and if so, if vote buying with up-front payment yields higher utility than buying vote with conditional payment for the candidate. Note that the minimum up-front payment required to vote are the same as the case where $\beta_C < 0.5$: $\underline{x} \in \{\underline{x}_2, \underline{x}_3, \underline{x}_4\}$. Assume the candidate offers $(x > 0,\ y = 0)$.

At the voting stage: The voter votes only if the up-front payment is higher than the corresponding minimum accepted payment $\underline{x} \in \{\underline{x}_2, \underline{x}_3, \underline{x}_4\}$ as before.

At the offer selection stage, *sufficient* conditions for the voter to select UFP over DNA are

- For $\underline{x} = \underline{x}_2,\ 1 - 2\beta_C + 2p(\alpha+\beta_V) \geq 0,\ 1 - 2(p'-p)(\alpha+\beta_V) \geq 0,$ and $p' \neq p$.
- For $\underline{x} = \underline{x}_3$, there are no sufficient conditions. Necessary condition:

$$\begin{aligned}\Delta_V^{\text{offer, UFP}} = &\left[\frac{(1+2p'(\alpha+\beta_V)-2\beta_V)(p'\alpha+p\beta_V)}{2p'(\alpha+\beta_V)} - (p'-p)\alpha\right]W \\ &+ (1+p'(\alpha+\beta_V)-\beta_V)\left[\frac{1+2p'(\alpha+\beta_V)-2\beta_V}{2p'(\alpha+\beta_V)} - 1\right]d \geq 0\end{aligned}$$

- For $\underline{x} = \underline{x}_4$, $p'\beta_V - p\alpha \leq 0$

At the offer making stage there exists combination of parameters at which $\Delta_C^{\text{offer, UFP}} \geq 0$. Hence it is feasible for the candidate to buy vote with up-front payment.

Finally, comparison of utilities (UFP-CP):

To show that the candidate prefers to buy vote with CP, I first show that $\max U_C(\text{UFP,vote}) \leq \max U_C(\text{CP,vote})$. Combining this with $t^* = \arg\max U_C(t|CP, vote)$, I reach the conclusion that the candidate's optimal payment method is CP.

Candidate's utility from buying the vote with UFP is

$$\begin{aligned} U_C(x|\text{UFP, vote}) =& B + p'W - x - p'\left[\alpha \max\{2x - W - d, 0\} + \beta_C \max\{W + d - 2x, 0\}\right] \\ & - (1-p')\left[\alpha \max\{2x - d, 0\} + \beta_C \max\{d - 2x, 0\}\right] \end{aligned} \tag{A.44}$$

Note that

$$\frac{\partial U_C(x|\text{UFP, vote})}{\partial x} = \begin{cases} -(1-2\beta_C) > 0 & \text{if } x \in \left[0, \frac{d}{2}\right] \\ -(1+2\alpha - 2p'(\alpha+\beta_C)) \lesseqgtr 0 & \text{if } x \in \left[\frac{d}{2}, \frac{W+d}{2}\right] \\ -(1+2\alpha) < 0 & \text{if } x \geq \frac{W+d}{2} \end{cases} \tag{A.45}$$

Thus, depending on p', $U_C(x|\text{UFP, vote})$ is maximized either at $x = \frac{d}{2}$ or $x = \frac{W+d}{2}$. In contrast, candidate's utility from buying the vote with CP,

$$\begin{aligned} U_C(t|\text{CP, vote}) =& B + p'W - p't - p'\left[\alpha \max\{2t - W - d, 0\} + \beta_C \max\{W + d - 2t, 0\}\right] \\ & - (1-p')\left[\alpha \max\{-d, 0\} + \beta_C \max\{d, 0\}\right] \end{aligned} \tag{A.46}$$

is maximized at $t = \frac{W+d}{2}$, and $\frac{\partial U_C(t|\text{CP, vote})}{\partial t} = -p'(1-2\beta_C)$. Thus

$$\begin{aligned} \frac{\partial U_C(z|\text{CP, vote})}{\partial z} &\leq \frac{\partial U_C(z|\text{UFP, vote})}{\partial z} \text{ if } z \in \left[0, \frac{d}{2}\right] \\ \frac{\partial U_C(z|\text{CP, vote})}{\partial z} &\geq \frac{\partial U_C(z|\text{UFP, vote})}{\partial z} \text{ if } z \in \left[\frac{d}{2}, \frac{W+d}{2}\right] \end{aligned} \tag{A.47}$$

Now suppose p' is such that $\arg\max U_C(x|\text{UFP, vote}) = \frac{d}{2}$. Then candidate's maximum utility from UFP is always less than his maximum utility from CP, i.e. $\max U_c(\text{UFP, vote}) -$

$\max U_c(\text{CP, vote})$ is equal to

$$
\begin{aligned}
&B + p'(1-\beta_C)W - (1-2\beta_C)\left(\frac{d}{2}\right) - \beta_C d \\
&- \left[\mathrm{B} + p'(1-\beta_C)W - p'(1-2\beta_C)\left(\frac{W+d}{2}\right) - \beta_C d\right] \\
&= \underbrace{\left(\frac{p'}{2} - \beta_C\right)}_{<0} W + \underbrace{\left[\frac{p'(1-2\beta_C)}{2} + \beta_C - \frac{1}{2}\right]}_{A\leq 0} d
\end{aligned} \tag{A.48}
$$

Note that A is maximized at 0 when $p' = 1$. Thus $\max U_c(\text{UFP, vote}) < \max U_c(\text{CP, vote})$.

Similarly, suppose p' is such that $\arg\max U_C(x|\text{UFP, vote}) = \frac{W+d}{2}$. Then candidate's maximum utility from UFP is always less than his maximum utility from CP is equal to

$$\max U_c(\text{UFP, vote}) - \max U_c(\text{CP, vote}) =$$

$$
\begin{aligned}
&B + p'(1-\beta_C)W - (1-2p'(\alpha+\beta_C)+2\alpha)\left(\frac{W+d}{2}\right) + ((1-p')\alpha - p'\beta_C)d \\
&- \left[\mathrm{B} + p'(1-\beta_C)W - p'(1-2\beta_C)\left(\frac{W+d}{2}\right) - \beta_C d\right] \\
&= \underbrace{\left[\frac{p'}{2} - \frac{1}{2} + \alpha(p'-1)\right]}_{\leq 0} W + \underbrace{\left[\frac{p'(1-2\beta_C)}{2} + \beta_C - \frac{1}{2}\right]}_{A\leq 0} d
\end{aligned} \tag{A.49}
$$

Thus $U_c(\underline{\mathrm{x}}|\text{UFP, vote}) \leq \max U_c(\text{UFP, vote}) \leq \max U_c(\text{CP, vote}) = U_c(t = t^*|\text{CP, vote})$. This implies that whenever vote buying is rational for the candidate, the candidate is better off using conditional payment rather than up-front payment. ■

A.2 Non-Binding Promises and Guilt Aversion

Proof of Proposition 1.4

Proposition 1.4. Suppose both the candidate and the voter are guilt averse. If the voter's cost of not keeping her promise is greater than the cost of voting, then vote buying occurs with either up-front or conditional payment; if voter's cost of not keeping her promise is less than the cost of voting, then vote buying occurs only with conditional payment.

Proof. Suppose the candidate receives disutility from not keeping his promises. Then **at the transfer stage** the candidate's utility function is

$$U_C(t|y) = B + W - t - \Phi_C C_C(y,t) \tag{A.50}$$

where y denotes the candidate's promise, t denotes the actual transfer to the voter, Φ_C

denotes the candidate's sensitivity to lying and $C_C(.)$ denotes the cost of lying. Let the cost function be

$$C_C(y,t) = \begin{cases} \frac{1}{2}\frac{(y-t)^2}{y} & \text{if } y > 0 \text{ and } y > t \\ 0 & \text{otherwise} \end{cases} \tag{A.51}$$

Note that $\frac{\partial C_C}{\partial y} = \frac{1}{2}\frac{y-t}{y}(y+t) > 0$ if $y > t$, and $\frac{\partial^2 C_C}{\partial y^2} = \frac{t^2}{y^3} > 0$. Note also that $\frac{\partial C_C}{\partial t} = -\frac{y-t}{y} < 0$ if $y > t$, and $\frac{\partial^2 C_C}{\partial t^2} = \frac{1}{y} > 0$,

The first order condition from the candidate's optimization problem is

$$\frac{\partial U_C}{\partial t} = -1 - \Phi_C\left(-\frac{y-t}{y}\right) \leq 0 \tag{A.52}$$

This yields the optimal transfer

$$t^* = \max\left\{\left(\frac{\Phi_C - 1}{\Phi_C}\right) y,\ 0\right\}$$

Suppose that the voter receives disutility from not keeping her promise as well and let her cost of lying be

$$C_V(p,p') = \begin{cases} \frac{(p'-p)^2}{2} & \text{if } p' > p \\ 0 & \text{otherwise} \end{cases} \tag{A.53}$$

At the voting stage the behavior of the voter depends on what she previously chose at the offer selection stage.

- A voter who has chosen **do not accept (DNA)** never votes since

$$\begin{aligned} U_V(\text{vote}|\text{DNA}) &= B - d \\ U_V(\text{DNV}|\text{DNA}) &= B \end{aligned} \tag{A.54}$$

- **Up-front payment (UFP).** The voter's utilities from voting and not voting are

$$\begin{aligned} U_V(\text{vote}|\text{UFP}) &= B + x - d \\ U_V(\text{DNV}|\text{UFP}) &= B + x - \Phi_V C_V(p,p') \end{aligned} \tag{A.55}$$

  The voter will vote if $p' > p$ and $\Delta_V^{\text{UFP}} = \Phi_V\frac{(p'-p)^2}{2} - d > 0$.

- **Conditional payment (CP).** The voter's utilities from voting and not voting are

$$\begin{aligned} U_V(\text{vote}|\text{CP}) &= B + p't^* - d \\ U_V(\text{DNV}|\text{CP}) &= B + pt^* - \Phi_V C_V(p,p') \end{aligned} \tag{A.56}$$

Where $t^* = \max\left\{\left(\frac{\Phi_C - 1}{\Phi_C}\right) y,\ 0\right\}$. Suppose $t^* > 0$. Then the voter will vote if

$$\Delta_V^{\text{CP}} = (p' - p)\left[\left(\frac{\Phi_C - 1}{\Phi_C}\right) y + \Phi_V \frac{(p' - p)}{2}\right] - d > 0 \tag{A.57}$$

Note that if it is rational to vote for the voter who has chosen UFP, then it is also rational to vote for the voter who has chosen CP since $\Delta_V^{\text{UFP}} > 0 \Rightarrow \Delta_V^{\text{CP}} > 0$.

At the offer selection stage there are three possible cases on how the cost of voting and cost of lying are related (assuming $p' > p$):

Case 1. $d < \Phi_V \frac{(p'-p)^2}{2}$: In this case voter's guilt is larger than the cost of voting. Thus the voter votes in the following stage regardless of whether she chooses UFP or CP. When deciding on whether to accept any payment, she compares the following utilities:

$$\begin{aligned} U_V(\text{UFP, vote}|x) &= B + x - d \\ U_V(\text{CP, vote}|y) &= B + p'\left(\frac{\Phi_C - 1}{\Phi_C}\right) y - d \\ U_V(\text{DNA, DNV}) &= B \end{aligned} \tag{A.58}$$

The voter chooses the option that gives her maximum payout among

$$\left\{x - d, p'\left(\frac{\Phi_C - 1}{\Phi_C}\right) y - d, 0\right\}$$

Case 2. $\Phi_V \frac{(p'-p)^2}{2} < d < (p' - p)\left[\left(\frac{\Phi_C - 1}{\Phi_C}\right) y + \Phi_V \frac{(p'-p)}{2}\right]$: In this case the voter's guilt is smaller than the cost of voting but her promised payment motivates her to vote in the voting stage if she accepts CP. When deciding to accept any payment she compares the utilities

$$\begin{aligned} U_V(\text{UFP, DNV}|x) &= B + x - \Phi_V \frac{(p' - p)^2}{2} \\ U_V(\text{CP, vote}|y) &= B + p'\left(\frac{\Phi_C - 1}{\Phi_C}\right) y - d \\ U_V(\text{DNA, DNV}) &= B \end{aligned} \tag{A.59}$$

The voter chooses the option that gives her maximum payout among

$$\left\{x - \Phi_V \frac{(p' - p)^2}{2},\quad p'\left(\frac{\Phi_C - 1}{\Phi_C}\right) y - d,\ 0\right\}$$

Case 3. $(p' - p)\left[\left(\frac{\Phi_C - 1}{\Phi_C}\right) y + \Phi_V \frac{(p'-p)}{2}\right] < d$: In this case the voter never votes regardless of what payment she chooses. When deciding on whether to accept any payment she compares the utilities

$$\begin{aligned} U_V(\text{UFP, DNV}|x) &= B + x - \Phi_V \frac{(p'-p)^2}{2} \\ U_V(\text{CP, DNV}|y) &= B + p\left(\frac{\Phi_C - 1}{\Phi_C}\right) y - \Phi_V \frac{(p'-p)^2}{2} \\ U_V(\text{DNA, DNV}) &= B \end{aligned} \tag{A.60}$$

The voter chooses the option that gives her maximum payout among

$$\left\{ x - \Phi_V \frac{(p'-p)^2}{2}, \quad p\left(\frac{\Phi_C - 1}{\Phi_C}\right) y - \Phi_V \frac{(p'-p)^2}{2}, \quad 0 \right\}$$

At the offer making stage, the candidate's problem can be divided into two cases.

Case 1. $d < \Phi_V \frac{(p'-p)^2}{2}$: Since the voter votes regardless of whether she chooses UFP or CP, the relevant utilities for the candidate are

$$\begin{aligned} U_C(x|\text{UFP, vote}) &= B + p'W - x \quad \text{s. to} \quad x \geq d \\ U_C(y|\text{CP, vote}) &= B + p'\left[W - \left(\frac{\Phi_C - 1}{\Phi_C}\right) y\right] \quad \text{s. to} \quad y \geq \frac{d}{p'}\left(\frac{\Phi_C}{\Phi_C - 1}\right) \end{aligned} \tag{A.61}$$

$$U_C((.)|\text{DNA, DNV}) = B + pW$$

Thus if $(p'-p)W > d$, the candidate chooses $x^* = d$ and $y^* = \frac{d}{p'}\left(\frac{\Phi_C}{\Phi_C - 1}\right)$. Otherwise $x^* = y^* = 0$.

Case 2. $\Phi_V \frac{(p'-p)^2}{2} < d$: Since the voter does not vote if she accepts UFP, the candidate chooses $x^* = 0$. For the optimal CP offer the candidate solves

$$\begin{aligned} \max_y U_C(y|\text{CP, vote}) &= B + p'\left(\frac{\Phi_C - 1}{\Phi_C}\right) - d \\ \text{s. to} \quad & y \geq \frac{d}{p'}\left(\frac{\Phi_C}{\Phi_C - 1}\right) \text{ and} \\ & y \geq \frac{1}{p'-p}\left(\frac{\Phi_C}{\Phi_C - 1}\right)\left[d - \Phi_V \frac{(p'-p)^2}{2}\right] \end{aligned} \tag{A.62}$$

If $(p'-p)W - \frac{p'}{p'-p}\left[d - \Phi_V \frac{(p'-p)^2}{2}\right] > 0$, then the candidate will offer

$$y^* = \left(\frac{\Phi_C}{\Phi_C - 1}\right) \max\left\{\frac{d}{p'}, \frac{2d - \Phi_V(p'-p)^2}{p'-p}\right\} \tag{A.63}$$

■

A.3 Non-Binding Promises and Reciprocity

Proof of Proposition 1.5

Proposition 1.5. If the candidate is selfish and the voter is reciprocal, vote buying occurs only with up-front payment.

Proof. Suppose the candidate cares only about his own material payoff, but the voter is reciprocal. Let the utility function of the voter have the form

$$U_V(\pi_v, \pi_c) = \pi_v + \theta k_c \pi_c \tag{A.64}$$

where π_v, π_c denote the material payoffs of the voter and candidate, respectively, $\theta > 0$ denotes voter's sensitivity towards candidate's payoff, and k_c is candidate's kindness towards the voter. Assume that the voter perceives up-front payment offers greater than the cost of voting as "kind". Then candidate's kindness towards the voter is

$$k_c(x) = I_{x>d}x \tag{A.65}$$

where x denotes the up-front payment offer, $I_{x>d}$ is an indicator variable that takes on the value 1 if $x > d$ and 0 otherwise.

At the voting stage, a voter who has accepted up-front payment, x, compares the following utilities:

$$\begin{aligned} U_V(\text{vote}|x, \text{UFP}) &= B_V + x - d + \theta I_{x>d}x\left[B + p'W - x\right] \\ U_V(\text{DNV}|x, \text{UFP}) &= B_V + x + \theta I_{x>d}x\left[B + pW - x\right] \end{aligned} \tag{A.66}$$

For the voter to vote, the following inequality should hold:

$$U_V(\text{vote}|.) - U_v(\text{DNV}|.) = \theta I_{x>d}x\left[p' - p\right]W - d \geq 0 \tag{A.67}$$

Hence the minimum up-front payment that incentivizes the voter to vote satisfies

$$I_{x>d}x \geq \frac{d}{\theta(p' - p)W} = \underline{\text{x}} \tag{A.68}$$

At the offer selection stage, the voter accepts any positive up-front payment offers. Note that since the voter knows that the candidate is self-interested, voter never accepts conditional payments.

At the offer making stage, candidate compares the following utilities:

$$U_C(.|\text{DNA}) = B_C + pW \tag{A.69}$$
$$U_C(x|\text{UFP, vote}) = B_C + p'W - x^*$$

where $x^* = \max\{\underline{x}, d + \epsilon\}$ and $\epsilon \geq 0$ is a small number. Thus if

$$(p' - p)W \geq \max\left\{\frac{d}{\theta(p' - p)W}, d + \epsilon\right\}$$

then the candidate offers $(m_{\text{UFP}}, m_{\text{CP}}) = (x^*, 0)$ in equilibrium. ∎

A.4 Screenshots from experiment program and instructions

Figure A.1
Candidate screen at the offer stage

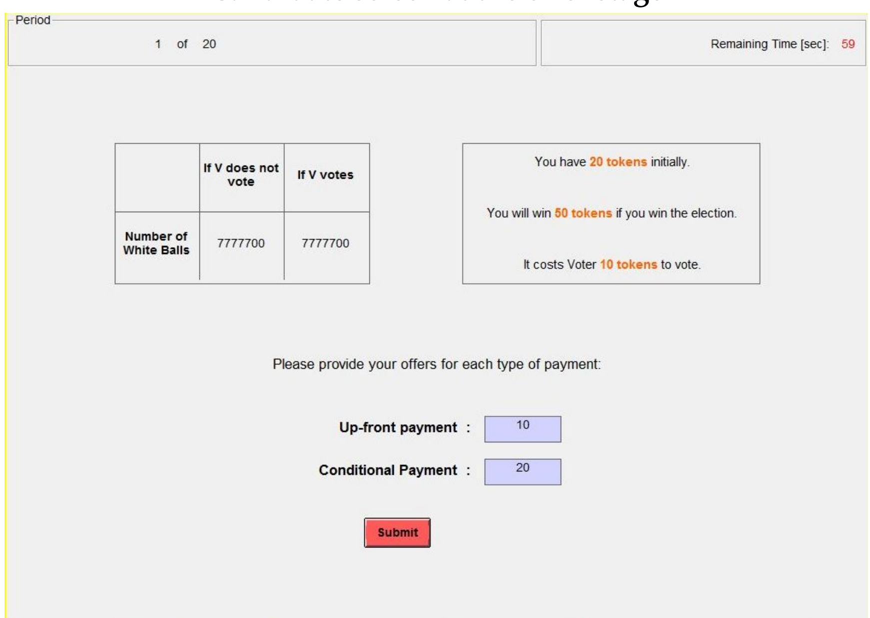


Figure A.2
Voter screen at the offer stage

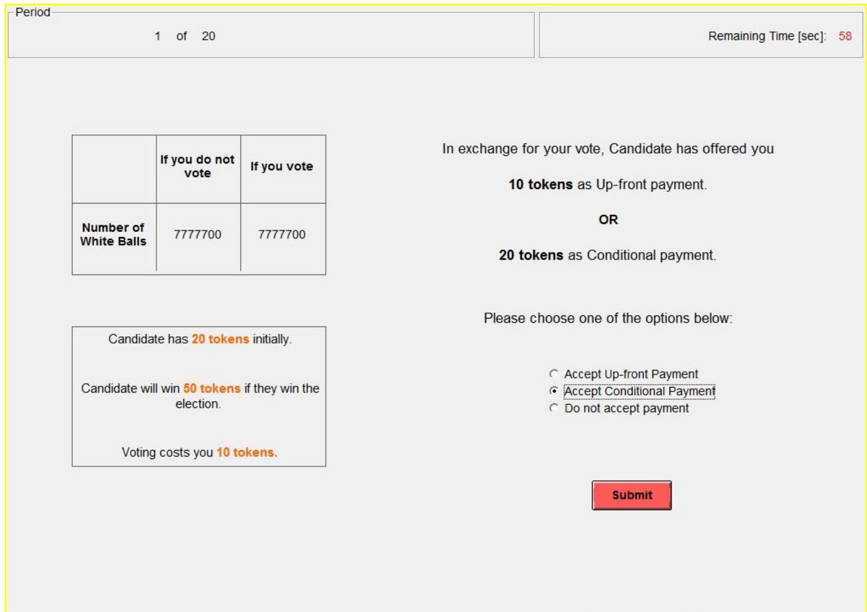


Figure A.3
Voter screen at the voting stage

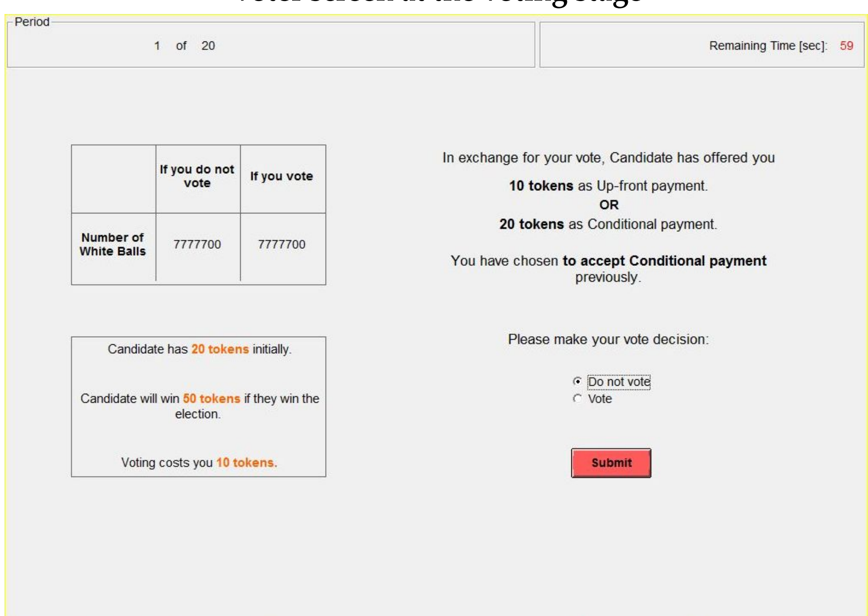
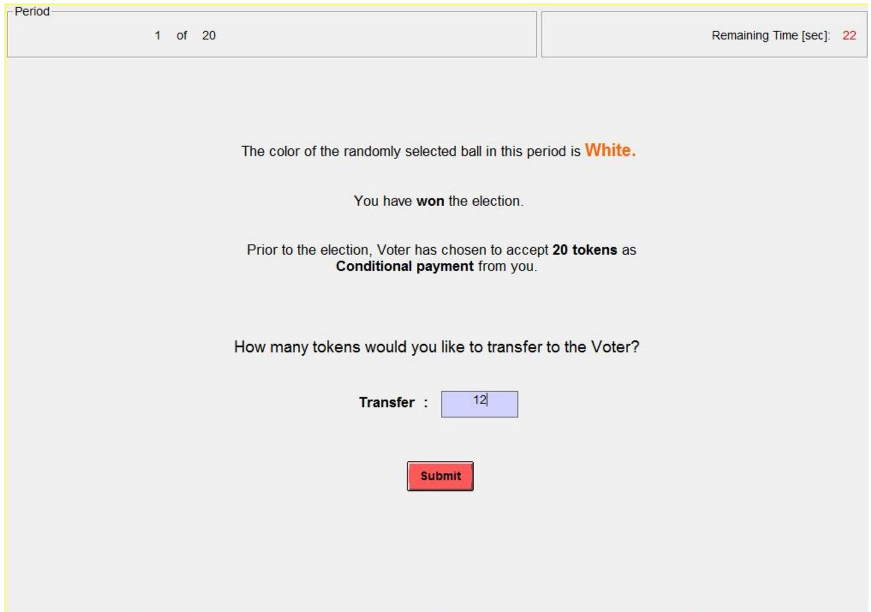


Figure A.4
Candidate screen at the transfer stage



Instructions

General

Welcome and thank you for coming today to participate in this experiment. This is an experiment in decision-making. If you follow the instructions and make good decisions, you can earn a significant amount of money, which will be paid to you at the end of the session. The currency in this experiment is called tokens (10 tokens = $1). The experiment consists of 20 identical decision rounds.

During the experiment it is important that you do not talk to any other subjects. Please either turn off your cell phones or put them on silent. If you have a question, please raise your hand, and an experimenter will answer your question. Failure to comply with these instructions means that you will be asked to leave the experiment and all earnings will be forfeited. The experiment will last about 60 minutes.

Roles

At the beginning of the experiment you will be randomly assigned a role. The two possible roles you can be assigned are `**Voter**' and `**Candidate**'. There will be an equal number of voters and candidates. Your roles will stay fixed for all 20 rounds until the end of the experiment. That is, if at the beginning of the experiment you were assigned the role of a candidate (voter), you will keep this role for the entire experiment.

At the beginning of <u>each round</u>, all participants will be randomly paired, with each pair consisting of one voter and one candidate. Since you are most likely to be matched with a different participant in each round, it will be impossible to track your counterpart between rounds. No participant will ever be informed about the identities of the participants they are paired with, neither during nor after the experiment.

In this experiment, at each round, both the voter and the candidate are assigned **20 tokens**. Each round, **the candidate** has the chance to win **50 additional tokens**. Whether the candidate wins the additional tokens is determined randomly by the computer in the following way: The candidate wins the election (and hence the additional 50 tokens) if the computer draws a **WHITE** ball from an urn that contains RED and WHITE balls. The total number of balls contained in the urn is fixed at 100, but the number of white balls in the urn will change from one round to another.

The voter may increase the number of white balls (by exchanging them with red balls) in the urn by voting for the candidate. However, this costs **10 tokens** to the voter.

Payment Types

A payment is what a candidate can offer the voter in exchange for their vote. The payment is in terms of tokens and it can take two possible forms, "Up-front Payment" and "Conditional Payment".

- An up-front payment, if accepted by the voter, is paid to the voter prior to the election.
- A conditional payment, if accepted by the voter, is paid to the voter **if the candidate wins** (i.e. payment is conditioned on the candidate winning the election) and hence paid after the election.

Development of each round

Each of the 20 rounds consists of an independent election process of 5 steps, which are described below.

Step 1: Information Dissemination. Both the candidate (C) and the voter (V) are informed about

- Number of white balls in the urn
- Number of white balls in the urn **if** the voter votes for the candidate

Step 2: Candidate Offer. In each group, the candidate decides on the number of tokens he/she offers for each type of payment. The offer cannot be greater than what the candidate owns at the time of payment. (Note that this implies that an up-front payment cannot be greater than 20 tokens, and a conditional payment cannot be greater than 70 tokens.)

Step 3: Voter Decision. Once the candidate submits his/her offers, the voter is informed about these offers. The voter is then asked to choose among the following options: (a) Accept Up-front Payment in exchange for Vote, (b) Accept Conditional Payment in exchange for Vote, (c) Do not accept payment. If the voter has accepted Up-front Payment in Step 3, the up-front payment is transferred to the voter's account.

Step 4: Election. The voter decides whether to vote for the candidate or not. If the voter decides to vote, 10 tokens are deducted from his/her account. The number of white balls in the urn is adjusted corresponding to the voter's choice over voting. The computer draws a ball from the urn, and announces its color. Both the candidate and the voter are informed about the result of the election.

(If applicable) Step 5: Post-election transfer. If the voter has accepted Conditional Payment prior to the election and the candidate has won the election, the candidate decides on the number of tokens he/she transfers to the voter.

At the end of each round, each participant will learn only their own payoffs.

Calculation of Earnings

Earnings depend on whether the voter voted for the candidate, whether and which offer he/she accepted an offer from the candidate and the color of the drawn ball. The following tables summarize this information for the voter and the candidate, respectively.

Voter

Earnings		Color of the ball drawn from the urn	
		White	Red
Voter chooses	Up-front payment	$20 + \text{Up-front payment } - \begin{cases} 10 & \text{if votes} \\ 0 & \text{if does not vote} \end{cases}$	$20 + \text{Up-front payment} - \begin{cases} 10 & \text{if votes} \\ 0 & \text{if does not vote} \end{cases}$
	Conditional payment	$20 + \text{Post-election transfer} - \begin{cases} 10 & \text{if votes} \\ 0 & \text{if does not vote} \end{cases}$	$20 - \begin{cases} 10 & \text{if votes} \\ 0 & \text{if does not vote} \end{cases}$
	Do not accept payment	$20 - \begin{cases} 10 & \text{if votes} \\ 0 & \text{if does not vote} \end{cases}$	$20 - \begin{cases} 10 & \text{if votes} \\ 0 & \text{if does not vote} \end{cases}$

Candidate

Earnings		Color of the ball drawn from the urn	
		White	Red
Voter chooses	Up-front payment	20 + 50 – Up-front payment	20 – Up-front payment
	Conditional payment	20 + 50 – Post-election transfer	20
	Do not accept payment	20 + 50	20

Final earnings

Once all 20 rounds are finished, the computer will randomly pick **one** round out of the 20 rounds you have played. The earnings you made on that round will be your final earnings of the experiment. We will convert tokens you earned in this round into US dollars by dividing them by 10. In addition, you will receive a participation fee of $7.

Are there any questions?

Appendix B: Appendix to Chapter 2

B.1 Proof of Proposition 2.1

Proposition 2.1. (Selfish risk neutral preferences). Suppose both players care only about their won material payoffs and are risk neutral. Then vote buying may occur only if $(p'-p)W \geq d$. Moreover, whenever the candidate makes a nonzero offer, he offers both up-front payment and conditional payment which are equal to the cost of voting in expectation.

Proof. A risk neutral candidate submits a non-zero offer $(m_{UFP}, m_{CP}) = (x, y)$ provided that the voter's contribution to the winning probability is sufficiently high. The voter can accept at most one payment type in exchange for her vote, therefore, for any offer (x, y) the voter chooses among her 4 options: (1) Vote without accepting payment (VwP), (2) Accept up-front payment (UFP), (3) Accept conditional payment (CP), and (4) do not vote (DNV). The optimal strategy for a risk neutral voter is to accept a transfer from a candidate only if at least one payment is larger than the cost of voting in expectation. If both payments are larger than the cost of voting, she accepts the transfer that has the largest expected payment:

$$v^*(x,y) = \begin{cases} \text{UFP} & \text{if } \max\{x-d, p'y-d, 0\} = x-d \\ \text{CP} & \text{if } \max\{x-d, p'y-d, 0\} = p'y-d \\ \text{DNV} & \text{if } \max\{x-d, p'y-d, 0\} = 0 \end{cases} \tag{B.1}$$

Given voter's strategy, it is rational for the candidate to buy the vote when its expected contribution is higher than its cost, i.e. i.e. $(p'-p)W \geq d$. Moreover, the candidate is indifferent between offering UFP and CP when vote buying is rational for the candidate. That is, when it is rational to buy the vote, there is no case where CP is not feasible but UFP is. To see this suppose that it is not the case, i.e. $(p'-p)W \geq d$ and $B_c + W < \frac{d}{p'}$. Then the unique optimal offer is $(x, y) = (d, 0)$. However for $p' > 0$ this generates a contradiction:

$$B_c + W < \frac{d}{p'} \leq \frac{p'-p}{p'}W \;\Rightarrow B_c < \frac{-p}{p'}W$$

.

Hence the candidate's SPE strategy is offering $(x^*, y^*) = (d, \frac{d}{p'})$ if $(p'-p)W \geq d$ and $(x^*, y^*) = (0, 0)$ otherwise.

Note that the following offers by the candidate are NE strategies that are not subgame perfect:

$$(x, y) = \begin{cases} \in \left\{ (d, y < \frac{d}{p'}), (x < d, \frac{d}{p'}) \right\} & \text{if } (p' - p)W \geq d \\ (0, 0) & \text{if } (p' - p)W < d \end{cases} \tag{B.2}$$

■

B.2 Proof of Proposition 2.2

Proposition 2.2. (Risk aversion). If the candidate is more (less) risk averse than the voter, vote buying occurs only with conditional (up-front) payment.

Proof. Assume $p' < 1$. Let $(m_{UFP}, m_{CP}) = (x, y)$ and suppose $B_v = B_c = B$. For all possible risk preferences, the minimum accepted UFP by the voter is $x = d$. In turn, the minimum accepted CP by the voter satisfies

$$p' u_v(B + \underline{y} - d) + (1 - p')u_v(B - d) = u_v(B)$$

This equality can be rewritten as

$$\frac{u_v(B) - u_v(B - d)}{u_v(B + \underline{y} - d) - u_v(B)} = \frac{p'}{1 - p'}$$

For the candidate, the utility difference between UFP and CP is given by

$$\begin{aligned} U_v(UFP, x = d) - U_v(CP, y = \underline{y}) &= \left[p' u_c(B + W - d) + (1 - p')u_c(B - d) \right] \\ &\quad - \left[p' u_c(B + W - \underline{y}) + (1 - p')u_c(B) \right] \\ &= p' \left[u_c(B + W - d) - u_c(B + W - \underline{y}) \right] \\ &\quad + (1 - p') \left[u_c(B) - u_c(B - d) \right] \end{aligned} \tag{B.3}$$

The candidate prefers CP over UFP if the utility difference is less than zero, or equivalently if

$$\frac{p'}{1 - p'} \leq \frac{u_c(B) - u_c(B - d)}{u_c(B + W - d) - u_c(B + W - \underline{y})} \tag{B.4}$$

Without loss of generality, suppose the candidate is more risk averse than the voter. Then $u_c(x) = \varphi(u_v(x))$ for all x, where $\varphi' > 0$ and $\varphi'' < 0$, i.e. $u_c(.)$ is a concave transformation of $u_v(.)$. Then the candidate, who is more risk averse than the voter, prefers CP over UFP if

$$\begin{aligned} \frac{u_v(B) - u_v(B - d)}{u_v(B + \underline{y} - d) - u_v(B)} = \frac{p'}{1 - p'} &\leq \frac{u_c(B) - u_c(B - d)}{u_c(B + W - d) - u_c(B + W - \underline{y})} \\ \Rightarrow \frac{u_v(B) - u_v(B - d)}{u_v(B + \underline{y} - d) - u_v(B)} &\leq \frac{\varphi(u_v(B)) - \varphi(u_v(B - d))}{\varphi(u_v(B + W - d)) - \varphi(u_v(B + W - \underline{y}))} \end{aligned} \tag{B.5}$$

Suppose $u_v(.)$ is a continuously differentiable function. Then if (B.5) holds, the following inequality should also hold:

$$\frac{\lim_{d\to 0}\frac{u_v(B)-u_v(B-d)}{d}}{\lim_{\underline{y}\to d}\frac{u_v(B+\underline{y}-d)-u_v(B)}{\underline{y}-d}} \leq \frac{\lim_{d\to 0}\frac{\varphi(u_v(B))-\varphi(u_v(B-d))}{d}}{\lim_{\underline{y}\to d}\frac{\varphi(u_v(B+W-d))-\varphi(u_v(B+W-\underline{y}))}{\underline{y}-d}}$$
$$\Rightarrow \frac{u_v'(B)}{u_v'(B)} \leq \frac{\varphi'(u_v(B))}{\varphi'(u_v(B+W-d))} \tag{B.6}$$
$$\Rightarrow 1 \leq \frac{\varphi'(u_v(B))}{\varphi'(u_v(B+W-d))}$$

The last inequality is satisfied as long as $W > d$ since $u_v(.)$ is an increasing function and $\varphi(.)$ is an increasing and concave function. Note that vote buying is never rational if $W \leq d$. Hence given that vote buying is rational, the candidate prefers buying the vote with CP over UFP in equilibrium if the candidate is more risk averse than the voter.

Conversely, if the voter is more risk averse than the candidate $u_v(x) = \phi(u_c(x))$ for all x, where $\psi' > 0$ and $\psi'' < 0$, i.e. $u_v(.)$ is a concave transformation of $u_c(.)$. Then $u_c(x) = \phi(u_v(x))$ where $\phi = \psi^{-1}(.)$ is an increasing and convex function. The candidate prefers UFP over CP if the utility difference given in (B.3) is greater than zero, or equivalently if

$$\frac{u_v(B)-u_v(B-d)}{u_v(B+\underline{y}-d)-u_v(B)} = \frac{p'}{1-p'} \geq \frac{u_c(B)-u_c(B-d)}{u_c(B+W-d)-u_c(B+W-\underline{y})}$$
$$\frac{u_v(B)-u_v(B-d)}{u_v(B+\underline{y}-d)-u_v(B)} \geq \frac{\phi(u_c(B))-u_c\phi((B-d))}{\phi(u_c(B+W-d))-\phi(u_c(B+W-\underline{y}))} \tag{B.7}$$

Assuming $u_c(.)$ is continuously differentiable, (B.7) implies

$$\frac{u_c'(B)}{u_c'(B)} \geq \frac{\phi'(u_c(B))}{\phi'(u_c(B+W-d))}$$
$$1 \geq \frac{\phi'(u_c(B))}{\phi'(u_c(B+W-d))} \tag{B.8}$$

The last inequality is satisfied as long as $W > d$ since $u_v(.)$ is an increasing function and $\phi(.)$ is an increasing and convex function. Therefore, given that vote buying is rational if the candidate is less risk averse than the voter, the candidate prefers UFP over CP in equilibrium. ■

B.3 Utility Functions of the Candidate and the Voter under FS Preferences

Let $(m_{UFP}, m_{CP}) = (x, y)$ be an offer. Voter's utility from accepting UFP is given by

$$U_v(UFP, x = z) = \begin{cases} B + (1+2\alpha)z - (1+\alpha)d - \alpha p' W & \text{if } z \in \left[0, \frac{d}{2}\right] \\ B + (1 + 2(\alpha p' - \beta(1-p')))\, z & \\ -\left(1 + \alpha p' - \beta(1-p')\right) d - \alpha p' W & \text{if } z \in \left[\frac{d}{2}, \frac{W+d}{2}\right] \\ B + (1-2\beta)\, z - (1-\beta)\, d + \beta p' W & \text{if } z \geq \frac{W+d}{2} \end{cases} \tag{B.9}$$

Note that if $\beta < \frac{1}{2}$ and hence voter's UFP utility is uniquely maximized at B for every $p' \in [0,1]$.

Voter's utility from accepting CP is given by

$$U_v(CP, y = z) = \begin{cases} B + p'(1+2\alpha)z - (1+\alpha)d - \alpha p' W & \text{if } z \leq \frac{W+d}{2} \\ B + p'\,(1-2\beta)\, z & \\ -\left(1 + \alpha(1-p') - \beta p'\right) d + \beta p' W & \text{if } z \geq \frac{W+d}{2} \end{cases} \tag{B.10}$$

For $\beta < \frac{1}{2}$, voter's utility from CP is uniquely maximized at $B + W$.

Candidate's utility from up-front payment is

$$U_c(UFP, x = z) = \begin{cases} B + p'(1-\beta)W - (1-2\beta)z - \beta d & \text{if } z \in \left[0, \frac{d}{2}\right] \\ B + p'(1-\beta)W - (1 + 2(\alpha(1-p') - \beta p'))\, z & \\ +\left(\alpha(1-p') - \beta p'\right) d & \text{if } z \in \left[\frac{d}{2}, \frac{W+d}{2}\right] \\ B + p'(1+\alpha)W - (1+2\alpha)\, z + \alpha d & \text{if } z \geq \frac{W+d}{2} \end{cases} \tag{B.11}$$

For $\beta < \frac{1}{2}$, candidate's UFP utility is uniquely maximized at $z = 0$ for every p'.

Candidate's utility from CP is given by

$$U_c(CP, y = z) = \begin{cases} B + p'(1-\beta)W - p'(1-2\beta)z - \beta d & \text{if } z \leq \frac{W+d}{2} \\ B + p'(1+\alpha)W - p'\,(1+2\alpha)\, z & \\ +(\alpha p' - \beta(1-p'))d & \text{if } z \geq \frac{W+d}{2} \end{cases} \tag{B.12}$$

B.4 Proof of Proposition 2.3

Proposition 2.3. (Inequity aversion). Suppose both players are inequity averse and their preferences can be represented by Fehr-Schmidt preferences. Then, if either $B_C < \frac{W+d}{2}$ or $\frac{d}{W} \leq (1-2\beta)\left(1 + \frac{2\beta}{W}\right)$, vote buying occurs with conditional payment only. If $B_C \geq \frac{W+d}{2}$ and $\frac{d}{W} > (1-2\beta)\left(1 + \frac{2\beta}{W}\right)$ vote buying may occur either with up-front payment or conditional payment. Moreover, the minimum accepted payment of the voter depends on W.

Proof. Since the vote buying game is a finite game with complete information, we will proceed with backward induction.

Voter choice, up-front payment

Let $(m_{UFP}, m_{CP}) = (x, y)$ be the candidate's offer. We will solve for the minimum accepted offer for each payment type for the voter.

For up-front payment, let $\underline{x}$ be the voter's minimum accepted payment. Then

$$U_v(UFP; z = \underline{x}) = U_v(DNV)$$

Note that, up-front payment less than half of the cost of voting, $\frac{d}{2}$ is never can be acceptable:

$$\begin{aligned}
U_v\left(UFP, t < \frac{d}{2}\right) &= B + (1+2\alpha)t - (1+\alpha)d - \alpha p' W \\
&\leq B + (1+2\alpha)\frac{d}{2} - (1+\alpha)d - \alpha p' W \\
&= B - \alpha p' W - \frac{d}{2} \\
&< B - \alpha p W = U_v(DNV)
\end{aligned}$$

Thus assume first that $\underline{x} \in \left[\frac{d}{2}, \frac{W+d}{2}\right]$. Then, $\underline{x}$ satisfies

$$B + \left[1 + 2(\alpha p' - \beta(1-p'))\right]\underline{x} - \left(1 + \alpha p' - \beta(1-p')\right)d - \alpha p' W = B - \alpha p W$$

$$\Rightarrow \underline{x}_1 = \frac{\alpha(p'-p)W + \left(1 + \alpha p' - \beta(1-p')\right)d}{1 + 2(\alpha p' - \beta(1-p'))} \tag{B.13}$$

Note that $\underline{x} \geq \frac{d}{2}$ for all p':

$$\begin{aligned}
2\alpha(p'-p)W + 2(1 + \alpha p' - \beta(1-p'))d &\geq (1 + 2(\alpha p' - \beta(1-p')))d \\
\Rightarrow 2\alpha(p'-p)W + d &\geq 0
\end{aligned}$$

However $\underline{x} \leq \frac{W+d}{2}$ for some p':

$$\begin{aligned}
2\alpha(p'-p)W + 2(1 + \alpha p' - \beta(1-p'))d &\leq (1 + 2(\alpha p' - \beta(1-p')))\frac{W+d}{2} \\
\Rightarrow p' &\geq \frac{(2\beta - 2\alpha p - 1)W + d}{2\beta}
\end{aligned} \tag{B.14}$$

Next, assume that $\underline{x} \geq \frac{W+d}{2}$. Then

$$B + (1-2\beta)\,\underline{x} - (1-\beta)\,d + \beta p' W = B - \alpha p W$$

$$\Rightarrow \underline{x}_2 = \frac{-(\beta p' + \alpha p)W + (1-\beta)d}{1-2\beta} \tag{B.15}$$

For $\underline{x} \geq \frac{W+d}{2}$, p' should satisfy

$$\begin{aligned} -(\beta p' + \alpha p)W + (1-\beta)d &\geq (1-2\beta)\frac{W+d}{2} \\ \Rightarrow p' &\leq \frac{(2\beta - 2\alpha p - 1)W + d}{2\beta} \end{aligned} \tag{B.16}$$

Combining (B.14) and (B.16), we get the following minimum accepted offers for the voter, based on the candidate's probability of winning with the vote:

$$\underline{x} = \begin{cases} \underline{x}_1 & \text{if } p' \geq \frac{(2\beta-2\alpha p-1)W+d}{2\beta} \\ \underline{x}_2 & \text{if } p' \leq \frac{(2\beta-2\alpha p-1)W+d}{2\beta} \end{cases} \tag{B.17}$$

Candidate's participation constraint for vote buying with up-front payment

The candidate prefers to buy vote with UFP over not buying vote if $U_c(z = \underline{x}; UFP) \geq U_c(.; \text{DNV})$. Assume first that $\underline{x} \in \left[\frac{d}{2}, \frac{W+d}{2}\right]$. Then individual rationality condition is satisfied if

$$\begin{aligned} &\underbrace{\frac{(1+\alpha-\beta)}{1+2(\alpha p' - \beta(1-p'))}}_{\geq 0}\left[\underbrace{(p'-p)}_{\geq 0}\underbrace{(1-2(\beta+\alpha)(1-p'))}_{?}W - d\right] \geq 0 \\ &\Rightarrow p'W - d - pW - 2(p'-p)(\alpha+\beta)(1-p')W \geq 0 \end{aligned} \tag{B.18}$$

Assume next that $\underline{x} \geq \frac{W+d}{2}$. Then the candidate prefers buying vote with up-front payment to not buying vote if $U_c(z = \underline{x}_2; UFP) \geq U_c(.; \text{DNV})$

$$\begin{aligned} B + p'(1+\alpha)W - (1+2\alpha)\left[\frac{-(\beta p' + \alpha p)W + (1-\beta)d}{1-2\beta}\right] + \alpha d &\geq B + p(1-\beta)W \\ \Rightarrow \left[p'(1+\alpha) - p(1-\beta) + \frac{1+2\alpha}{1-2\beta}(\beta p' + \alpha p)\right]W + \left[\alpha - \frac{1+2\alpha}{1-2\beta}(1-\beta)\right]d &\geq 0 \\ \Rightarrow \frac{1+\alpha-\beta}{1-2\beta}\left[p'W - (1-2(\alpha+\beta))pW - d\right] &\geq 0 \end{aligned} \tag{B.19}$$

Combining this with (B.15), we get that UFP$\geq \frac{W+d}{2}$ is individually rational for the candidate if

$$p' \in \left[(1-2(\alpha+\beta))p + \frac{d}{W}, \frac{(2\beta - 2\alpha p - 1)W + d}{2\beta}\right] \tag{B.20}$$

As the final step notice that if $p'W - d < 0$, neither (B.18) not (B.19) can be satisfied.

Voter choice, conditional payment

For finding the minimum accepted conditional payment by the voter, $\underline{y}$, assume first that $\underline{y} \in \left[0, \frac{W+d}{2}\right]$. Then

$$\begin{gathered}
U_v\left(CP, z = \underline{y} \leq \frac{W+d}{2}\right) = U_v(DNV) \\
B + p'(1+2\alpha)\underline{y} - (1+\alpha)d - \alpha p'W = B - \alpha pW
\end{gathered}$$

$$\underline{y}_1 = \frac{\alpha(p'-p)W + (1+\alpha)\,d}{p'(1+2\alpha)} \tag{B.21}$$

However, note that the found $\underline{y}$ may not be in the assumed interval, so the following inequality also has to be satisfied

$$\begin{aligned}
\underline{y}_1 = \frac{\alpha(p'-p)W + (1+\alpha)\,d}{p'(1+2\alpha)} &\stackrel{?}{\leq} \frac{W+d}{2} \\
\Rightarrow \left[2\alpha(p'-p) - p'(1+2\alpha)\right]W + \left[2(1+\alpha) - p'(1+2\alpha)\right]d &\stackrel{?}{\leq} 0
\end{aligned} \tag{B.22}$$

If we assume $\underline{y} \in \left[\frac{W+d}{2}, B+W\right]$, then

$$\begin{gathered}
U_v\left(CP, z = \underline{y} \geq \frac{W+d}{2}\right) = U_v(DNV) \\
B + p'(1-2\beta)\underline{y} - (1+\alpha(1-p') - \beta p')d + \beta p'W = B - \alpha pW
\end{gathered}$$

$$\underline{y}_2 = \frac{-(\beta p' + \alpha p)W + (1+\alpha(1-p') - \beta p')d}{p'(1-2\beta)} \tag{B.23}$$

Again the found $\underline{y}_2$ has to be in the assumed interval:

$$\begin{aligned}
\underline{y}_2 = \frac{-(\beta p' + \alpha p)W + (1+\alpha(1-p') - \beta p')d}{p'(1-2\beta)} &\stackrel{?}{\geq} \frac{W+d}{2} \\
\Rightarrow \left[-2(\beta p' + \alpha p) - p'(1-2\beta)\right]W + \left[2(1+\alpha(1-p') - \beta p') - p'(1-2\beta)\right]d &\stackrel{?}{\geq} 0
\end{aligned} \tag{B.24}$$

Combining (B.22) and (B.24) we get

$$\underline{y} = \begin{cases} \underline{y}_1 & \text{if } p' \geq \frac{2[(1+\alpha)d-\alpha pW]}{(2\alpha+1)d+W} \\ \underline{y}_2 & \text{if } p' \leq \frac{2[(1+\alpha)d-\alpha pW]}{(2\alpha+1)d+W} \end{cases} \tag{B.25}$$

Voter: Relation between up-front and conditional payment

Lemma B.1. *Let y_x be the utility equivalent conditional payment to an up-front payment of x for the voter. Then $y_x \geq x$.*

Proof. If conditional payment of y_x is equivalent to an up-front payment of x then $U_v(CP, z = y_x) = U_v(UFP, z = x)$. Note that the slope of $U_v(UFP)$ is greater than or equal to that of $U_v(CP)$ for all $z \in R$ and $p' \in [0, 1]$:

$$\frac{\partial U_v(UFP)}{\partial z} - \frac{\partial U_v(CP)}{\partial z} = \begin{cases} (1+2\alpha)(1-p') & \text{if } z \leq \frac{d}{2} \\ (1-2\beta)(1-p') & \text{if } z \geq \frac{d}{2} \end{cases}$$

Observe also that $U_v(CP, z = 0) = U_v(UFP, z = 0) = B - (1+\alpha)d - \alpha p'W$. It follows that $y_x \geq x$. ∎

Candidate: Choice between buying vote with up-front and conditional payment

Suppose both UFP and CP are rational for the candidate. Then the optimal offer of the candidate depends on the utility difference $U_c(z = \underline{x}; UFP,) - U_c(z = \underline{y}; CP)$. We will consider 3 cases: (1) $\underline{x} = \underline{x}_1$ and $\underline{y} = \underline{y}_1$, where $\underline{x}_1, \underline{y}_1 \leq \frac{W+d}{2}$, (2) $\underline{x} = \underline{x}_1$ and $\underline{y} = \underline{y}_2$, where $\underline{x}_1 \leq \frac{W+d}{2}$ and $\underline{y}_1 \geq \frac{W+d}{2}$, (3) $\underline{x} = \underline{x}_2$ and $\underline{y} = \underline{y}_2$, where $\underline{x}_2, \underline{y}_2 \geq \frac{W+d}{2}$.

Case 1: Suppose first that $\underline{y} = \underline{y}_1 \leq \frac{W+d}{2}$. Then by Lemma B.1, $\underline{x} \leq \underline{y} \leq \frac{W+d}{2}$, i.e. $\underline{x} = \underline{x}_1$. By (B.17) and (B.25), $p' \geq \max\left\{\frac{2[(1+\alpha)d-\alpha pW]}{(2\alpha+1)d+W}, \frac{(2\beta-2\alpha p-1)W+d}{2\beta}\right\}$. In this case the utility difference $U_c(UFP) - U_c(CP)$ is given by

$$B + p'(1-\beta)W - (1 + 2(\alpha(1-p') - \beta p'))\left[\frac{\alpha(p'-p)W + (1+\alpha p' - \beta(1-p'))d}{1 + 2(\alpha p' - \beta(1-p'))}\right] \tag{B.26}$$
$$+ (\alpha(1-p') - \beta p')d - \left[B + p'(1-\beta)W - p'(1-2\beta)\left[\frac{\alpha(p'-p)W + (1+\alpha)d}{p'(1+2\alpha)}\right] - \beta d\right]$$

Rearranging (B.26), we find

$$\frac{2(\alpha+\beta)(1+\alpha-\beta)(p'-1)}{(1+2\alpha)(1+2(\alpha p' - \beta(1-p')))}\left[2\alpha(p'-p)W + d\right] \leq 0 \tag{B.27}$$

Therefore CP dominates UFP if $\underline{x} = \underline{x}_1$ and $\underline{y} = \underline{y}_1$.

Case 2: Suppose now that $\underline{y} = \underline{y}_2$ and $\underline{x} = \underline{x}_1$. Then by (B.17) and (B.25),

$$p' \in \left[\frac{(2\beta - 2\alpha p - 1)W + d}{2\beta}, \frac{2[(1+\alpha)d - \alpha p W]}{(2\alpha+1)d + W}\right]$$

Then the utility difference is

$$\begin{aligned}
&B + p'(1-\beta)W - (1 + 2(\alpha(1-p') - \beta p'))\left[\frac{\alpha(p'-p)W + (1 + \alpha p' - \beta(1-p'))d}{1 + 2(\alpha p' - \beta(1-p'))}\right] \\
&\quad + (\alpha(1-p') - \beta p')d - B - p'(1+\alpha)W \\
&\quad + p'(1+2\alpha)\left[\frac{-(\beta p' + \alpha p)W + (1 + \alpha(1-p') - \beta p')d}{p'(1-2\beta)}\right] - (\alpha p' - \beta(1-p'))d
\end{aligned}$$

This expression simplifies to

$$K\left[\left[1 + 2\alpha p - 2\beta(1-p')\right]p'W - \left[1 - 2\beta(1-p')^2 + 2\alpha(1-p')p'\right]d\right]$$

where

$$K = \frac{-2(\alpha+\beta)(1+\alpha-\beta)}{(1-2\beta)(1+2(\alpha+\beta)p' - 2\beta)}$$

Note that W's coefficient is strictly less than zero. This is because $(1+2\alpha p - 2\beta(1-p')) \leq 0 \Leftrightarrow p' \leq 1 - \frac{1+2\alpha p}{2\beta}$, but p' is less than a number between 0 and 1 only if $\frac{1+2\alpha p}{2\beta} \leq 1$, which implies that $1 \leq 2(\beta - \alpha p)$. For $0 < \beta \leq \alpha$ and $\alpha + \beta < 1$ the previous inequality cannot hold. Thus it must be that $(1 + 2\alpha p - 2\beta(1-p')) > 0$. Hence the utility difference $U_c(UFP) - U_c(CP)$ decreasing in W. Denote the prize level that satisfies $U_c(UFP) = U_c(CP)$ as $\tilde{W}$. Then for $W < \tilde{W}$, UFP dominates CP and vice versa. From (**??**), we find $\tilde{W}$ as

$$\tilde{W} = \frac{1 - 2\beta(1-p')^2 + 2\alpha(1-p')p'}{1 + 2\alpha p - 2\beta(1-p')}\frac{d}{p'} \tag{B.28}$$

Now consider the candidate's individual rationality for UFP. The utility difference between buying vote with UFP and not buying vote, $U_c(UFP) - U_c(\text{No Offer})$ with $W = \tilde{W}$ is given by

$$\begin{aligned}
&(p' - p(1-\beta)\tilde{W} - \frac{1 + 2(\alpha(1-p') - \beta p'}{1 + 2(\alpha p' - \beta(1-p'))}\left[\alpha(p'-p)\tilde{W} + (1 + \alpha p' - \beta(1-p'))d\right] \\
&\quad + (\alpha(1-p') - \beta p')d
\end{aligned}$$

which simplifies to

$$\frac{1 + \alpha - \beta}{1 + 2(\alpha p' - \beta(1-p'))}\left[(p'-p)(1 - 2(\alpha+\beta))(1-p')\tilde{W} - d\right] \tag{B.29}$$

$1 + 2(\alpha p' - \beta(1-p'))$ is always positive for $\beta < \frac{1}{2}$. Thus the sign of this expression depends on the sign of the parenthesis. Combining (B.28) and (B.29), we get

$$\frac{1+\alpha-\beta}{1+2(\alpha p'-\beta(1-p'))} d \left[\frac{p'-p}{p'} (1-2(\alpha+\beta)(1-p')) \frac{1-2\beta(1-p')^2+2\alpha(1-p')p'}{1+2\alpha p - 2\beta(1-p')} - 1 \right]$$

Now note that $U_c(UFP) - U_c(\text{No Offer}) \leq 0$ at $W = \tilde{W}$, since the expression inside the parenthesis above is negative due to

$$(p'-p)\left[1-2(\alpha+\beta)(1-p')\right]\left[1-2\beta(1-p')^2+2\alpha(1-p')p'\right] \leq p'\left[1+2\alpha p-2\beta(1-p')\right]$$
$$\Rightarrow -\underbrace{(1+2(\alpha+\beta)p'-2\beta)}_{>0}\left[\underbrace{p+2(\alpha+\beta)(1-p')^2(p'-p)}_{\geq 0}\right] \leq 0 \tag{B.30}$$

As a result, we show that if UFP dominates CP in case 2, it is also the case that UFP is not rational. Hence vote buying with UFP should not occur in case 2.

Case 3: Suppose now that $\underline{y} = \underline{y}_2$ and $\underline{x} = \underline{x}_2$. Then by (B.17) and (B.25),

$$p' \leq \min\left\{ \frac{(2\beta-2\alpha p-1)W+d}{2\beta}, \frac{2[(1+\alpha)d-\alpha pW]}{(2\alpha+1)d+W} \right\}$$

The utility difference is

$$B + p'(1+\alpha)W - (1+2\alpha)\left[\frac{-(\beta p'+\alpha p)W+(1-\beta)d}{1-2\beta}\right] + \alpha d - B - p'(1+\alpha)W$$
$$+ p'(1+2\alpha)\left[\frac{-(\beta p'+\alpha p)W+(1+\alpha(1-p')-\beta p')d}{p'(1-2\beta}\right] - (\alpha p'-\beta(1-p'))d$$

which simplifies to

$$\frac{1+2\alpha}{1-2\beta}(\alpha+\beta)(1-p')d \geq 0 \tag{B.31}$$

implying that the candidate prefers UFP over CP in this case. However if $B < \frac{W+d}{2}$, the candidate will be unable to offer $\underline{x}_2$ to the voter due to his budget constraint as the largest possible UFP offer is B.

Rationality of UFP in Case 3 if $B > \frac{W+d}{2}$

Note that Case 3 occurs if $p' \leq \min\left\{\frac{(2\beta-2\alpha p-1)W+d}{2\beta}, \frac{2[(1+\alpha)d-\alpha pW]}{(2\alpha+1)d+W}\right\}$. Thus for case 3 to exist, both $\frac{(2\beta-2\alpha p-1)W+d}{2\beta}$ and $\frac{2[(1+\alpha)d-\alpha pW]}{(2\alpha+1)d+W}$ need to be positive. This can occur only if $(2\beta-2\alpha p-1)W+d > 0$ and $(1+\alpha)d-\alpha pW > 0$, which implies that

$$\frac{d}{W} > \max\left\{1+2\alpha p-2\beta, \frac{\alpha}{\alpha+1}p\right\} = 1+2\alpha p-2\beta$$

for $\alpha \geq \beta > 0$ and $\alpha+\beta < 1$. Note also that we need $\alpha p < \beta$, since $\frac{d}{W}$ cannot be strictly greater than 1 for $d < W$.

Individual rationality condition of the candidate for UFP= $\underline{x}_2$ is given by

$$B + p'(1+\alpha)W - \frac{1+2\alpha}{1-2\beta}\left[-(\beta p' + \alpha p)W(1-\beta)d\right] + \alpha d - B - p(1-\beta)d \geq 0$$

which simplifies to

$$(1+\alpha-\beta)\left[(p' - (1-2(\alpha+\beta))p)W - d\right] \geq 0 \tag{B.32}$$

(B.32) is satisfied only if $[(p' - (1-2(\alpha+\beta))p)W - d] \geq 0$, or equivalently

$$p' - p \geq \frac{d}{W} - 2(\alpha+\beta)p$$

The expression above implies that vote buying might be rational for an inequity averse candidate for some p and p' such that $p' - p < \frac{d}{W}$ (but it is never rational for a selfish candidate).

Thus the following conditions need to hold for UFP= $\underline{x}_2$ to be rational:

a. $\frac{d}{W} > 1 + 2\alpha p - 2\beta$

b. $\alpha p < \beta$

c. $p' \leq \min\left\{\frac{(2\beta-2\alpha p-1)W+d}{2\beta}, \frac{2[(1+\alpha)d-\alpha pW]}{(2\alpha+1)d+W}\right\}$

d. $p' - p \geq \frac{d}{W} - 2(\alpha+\beta)p$

Can all of these conditions hold at the same time? By combining (a) and (d) above we find that $p' > (1-2\beta)(1+p)$ (e). Combining this with (c) yields the following inequalities

$$(1-2\beta)(1+p) < p' \leq \min\left\{\frac{(2\beta-2\alpha p-1)W+d}{2\beta}, \frac{2[(1+\alpha)d-\alpha pW]}{(2\alpha+1)d+W}\right\} \tag{B.33}$$

which implies

(i) $(1-2\beta)(1+p) < \frac{(2\beta-2\alpha p-1)W+d}{2\beta} \Rightarrow p < \frac{d-(1-2\beta)(W+2\beta)}{2\alpha W+2\beta(1-2\beta)}$

(ii) $(1-2\beta)(1+p) < \frac{2[(1+\alpha)d-\alpha pW]}{(2\alpha+1)d+W} \Rightarrow p < \frac{(1+4\alpha\beta+2\beta)d-(1-2\beta)W}{(1-2\beta)[(2\alpha+1)d+W]+2\alpha}$

Hence

$$p < \min\left\{\frac{d-(1-2\beta)(W+2\beta)}{2\alpha W+2\beta(1-2\beta)}, \frac{(1+4\alpha\beta+2\beta)d-(1-2\beta)W}{(1-2\beta)\left[(2\alpha+1)d+W\right]+2\alpha}\right\} \tag{B.34}$$

Thus if either $d-(1-2\beta)(W+2\beta)\leq 0$ or $(1+4\alpha\beta+2\beta)d-(1-2\beta)W\leq 0$, UFP= $\underline{\mathrm{x}}_2$ is never rational. Conversely, UFP= $\underline{\mathrm{x}}_2$ is rational only if $d-(1-2\beta)(W+2\beta)>0$ and $(1+4\alpha\beta+2\beta)d-(1-2\beta)W>0$ which implies

$$\frac{d}{W}>\max\left\{1-2\beta+\frac{(1-2\beta)2\beta}{W},\frac{1-2\beta}{1+4\alpha\beta+2\beta}\right\}=1-2\beta+\frac{(1-2\beta)2\beta}{W} \tag{B.35}$$

We find that UFP= $\underline{\mathrm{x}}_2$ is rational for a candidate for whom $\frac{d}{W}>(1-2\beta)\left[1+\frac{2\beta}{W}\right]$. Otherwise UFP= $\underline{\mathrm{x}}_2$ is never rational. Note that the number on the right is decreasing in β, i.e. higher inequity aversion is correlated with higher likelihood of the candidate finding UFP= $\underline{\mathrm{x}}_2$ rational. Also, the higher the ratio of cost of voting to the prize, the more likely that a candidate will find UFP= $\underline{\mathrm{x}}_2$ rational.

Rationality of vote buying with conditional payment

We finally need to show that there are cases in which the candidate prefers vote buying with conditional payment to not buying vote.

Suppose that $\underline{\mathrm{y}}=\underline{\mathrm{y}}_1\leq\frac{W+d}{2}$ (which implies $p'\geq\frac{2[(1+\alpha)d-\alpha pW]}{(2\alpha+1)d+W}$). Then buying vote with conditional payment is individually rational for the candidate if

$$\begin{aligned} &B+p'(1-\beta)W-p'(1-2\beta)\left[\frac{\alpha(p'-p)W+(1+\alpha)d}{p'(1+2\alpha)}\right]-\beta d-B-p(1-\beta)W\geq 0\\ &\quad\Rightarrow\frac{1+\alpha-\beta}{1+2\alpha}\left[(p'-p)W-d\right]\geq 0 \end{aligned} \tag{B.36}$$

Combining the $\underline{\mathrm{y}}=\underline{\mathrm{y}}_1$ condition on p' and the individual rationality constraint given above we find

$$p\leq\frac{d(W-d)}{W(W+d)}$$

Thus, paying $\underline{\mathrm{y}}_1\leq\frac{W+d}{2}$ is rational if $(p'-p)W-d\geq 0$ and $p\leq\frac{d(W-d)}{W(W+d)}$.

Next, suppose that $\underline{\mathrm{y}}=\underline{\mathrm{y}}_2\geq\frac{W+d}{2}$ (which occurs if $p'\leq\frac{2[(1+\alpha)d-\alpha pW]}{(2\alpha+1)d+W}$). Then buying vote with conditional payment is individually rational for the candidate if

$$
\begin{aligned}
&B + p'(1+\alpha)W - p'(1+2\alpha)\left[\frac{-(\beta p' + \alpha p)W + (1+\alpha(1-p') - \beta p')d}{p'(1-2\beta)}\right] \\
&\quad + (\alpha p' - \beta(1-p'))d - B - p(1-\beta)W \geq 0 \\
&\Rightarrow \frac{1+\alpha-\beta}{1-2\beta}\left[(p' - (1-2(\alpha+\beta))p)W - (1+2(\alpha+\beta)(1-p'))d\right] \geq 0 \\
&\Rightarrow \frac{1+\alpha-\beta}{1-2\beta}\left[(p'-p)W - d + 2(\alpha+\beta)\left(pW - (1-p')d\right)\right] \geq 0 \\
&\Rightarrow p' \geq \frac{(1-2(\alpha+\beta))pW + (1+2(\alpha+\beta))d}{W + 2(\alpha+\beta)d}
\end{aligned} \tag{B.37}
$$

Note that if $1-2(\alpha+\beta) > 0$, $p'W - d < 0$ is sufficient for nonrationality of CP$= \underline{y}_2$. Thus, for a candidate who has sufficiently strong inequity aversion it might be possible that paying $\underline{y}_2$ is rational. To see if this is indeed the case, we combine the inequalities on p' obtained from the individual rationality constraint and the condition on p' for $\underline{y} = \underline{y}_2$. Thus if CP $= \underline{y}_2$ is rational, p' should satisfy

$$
\frac{(1-2(\alpha+\beta))pW + (1+2(\alpha+\beta))d}{W + 2(\alpha+\beta)d} \leq p' \leq \frac{2\left[(1+\alpha)d - \alpha pW\right]}{(2\alpha+1)d + W} \tag{B.38}
$$

There are three cases for which (B.38) cannot hold:

1. We have $p' \geq k > 1$ if the number on the LHS is strictly greater than 1. This is the case if $1-2(\alpha+\beta) > \frac{W-d}{pW} > 0$.

2. We have $p' \leq k < 0$ if the number on the RHS is strictly less than 0. This is the case if $\alpha > \frac{d}{pW-d}$. Note that if $pW - d < 0$, the condition is trivially satisfied since $\alpha > 0 > \frac{d}{pW-d}$.

3. Assuming $1-2(\alpha+\beta) < \frac{W-d}{pW}$ and $\alpha < \frac{d}{pW-d}$, the number on the RHS is smaller than the number on the LHS if $(1-2\beta)(d^2 + dW(p-1) + pW^2) > 0$, or equivalently if $p > \frac{d(W-d)}{W(W+d)}$.

Thus if $1-2(\alpha+\beta) < \frac{W-d}{pW}$, $\alpha < \frac{d}{pW-d}$ and $p \leq \frac{d(W-d)}{W(W+d)}$, CP$= \underline{y}_2 \geq \frac{W+d}{2}$ is rational.

For more specific conditions under which CP is rational, consider the following subcases:

$p = 0$ **:** Assume first that $\underline{y} = \underline{y}_1$. Then by (B.25), $p' \geq \frac{2[(1+\alpha)d - \alpha pW]}{(2\alpha+1)d+W} = \frac{2(1+\alpha)d}{(2\alpha+1)d+W}$. Note that the number on the right handside is lest than 1 if and only if $d < W$. Moreover the individual rationality constraint given by (B.36) implies $p'W \geq d$. Assuming $d < W$ and combining the inequalities above, we find that CP$\leq \frac{W+d}{2}$ is rational if

$$
p' \geq \max\left\{\frac{d}{W}, \frac{2(1+\alpha)d}{(2\alpha+1)d+W}\right\} \underbrace{=}_{\text{if } d<W} \frac{2(1+\alpha)d}{(2\alpha+1)d+W} \tag{B.39}
$$

Next, assume that $\underline{y} = \underline{y}_2$. Then by (**??**), $p' \leq \frac{2(1+\alpha)d}{(2\alpha+1)d+W}$. The IR constraint given by (B.37) implies $p' \geq \frac{(1+2(\alpha+\beta))d}{W+2(\alpha+\beta)d}$. Combining the two inequalities yields

$$\frac{(1+2(\alpha+\beta))d}{W+2(\alpha+\beta)d} \leq p' \leq \frac{2(1+\alpha)d}{(2\alpha+1)d+W} \tag{B.40}$$

These inequalities constitute a meaning interval for p' if the number on LHS is less than the number on the RHS, i.e. if $(1-2\beta)(d-W) \leq 0$, which holds for all $d < W$. Therefore, assuming $d < W$, CP$\geq \frac{W+d}{2}$ is rational if p' satisfies (B.40).

$p' = p$: Assume first that $\underline{y} = \underline{y}_1$. Then (B.36) implies $-d \geq 0$, which is a contradiction. Hence CP$\leq \frac{W+d}{2}$ is never rational if $p' = p$.

Next, assume that $\underline{y} = \underline{y}_2$. The individual rationality constraint implies $p' \geq \frac{[1+2(\alpha+\beta)]d}{2(\alpha+\beta)(W+d)}$. Note that if

- $d > 2(\alpha+\beta)W$, we have a contradiction since the individual rationality constraint implies $p' > 1$.
- $d = 2(\alpha+\beta)W$, individual rationality constraint implies that $p' = 1$. But note that $p' = p = 1$ is consistent with the $[y] = \underline{y}_2$ condition on p' given in (**??**) only if $d \geq W$.
- $d < 2(\alpha+\beta)W$, combining the individual rationality constraint and $\underline{y} = \underline{y}_2$ condition we get

$$\frac{[1+2(\alpha+\beta)]\,d}{2(\alpha+\beta)(W+d)} \leq p' \leq \frac{2(1+\alpha)d}{(2\alpha+1)(d+W)} \tag{B.41}$$

  For the number on the left hand side of the inequality to be less than the number on the RHS above, we need $1-2\beta \leq 0$ which is a contradiction since $\beta < \frac{1}{2}$.

Therefore CP$\geq \frac{W+d}{2}$ is never rational if $p' = p$ as well.

$p' = 1$: Assume first that $\underline{y} = \underline{y}_1$. Then by (B.25), $p \leq \frac{1}{2\alpha}\left(\frac{W-d}{W}\right)$. The individual rationality constraint implies $p \leq \frac{W-d}{W}$. Combining these two inequalities, we find that CP$\leq \frac{W+d}{2}$ is rational if

$$p \leq \min\left\{\frac{W-d}{W}, \frac{1}{2\alpha}\left(\frac{W-d}{W}\right)\right\} = \frac{W-d}{W} \tag{B.42}$$

Next, assume that $\underline{y} = \underline{y}_2$. The individual rationality constraint implies

$$p \leq \frac{1}{1-2(\alpha+\beta)}\left(\frac{W-d}{W}\right)$$

Note that we have a contradiction if $1-2(\alpha+\beta) \leq 0$, thus assume that $1-2(\alpha+\beta) > 0$.

Combining the individual rationality constraint and the $\underline{y} = \underline{y}_2$ constraint given by (B.25) we obtain

$$\frac{1}{2\alpha}\left(\frac{W-d}{W}\right) \leq p \leq \frac{1}{1-2(\alpha+\beta)}\left(\frac{W-d}{W}\right) \tag{B.43}$$

For the number on the left hand side to be less than the number on the right hand side above, we need $(2\alpha+\beta) \geq \frac{1}{2}$. For these inequalities to reflect a meaningful interval for probability, we also need the upper bound to be at most 1, implying $\alpha \geq \frac{W-d}{2W}$. Combining these with $1-2(\alpha+\beta) > 0$ and $\alpha \geq \beta$, we find that α must be in the interval $\left[\frac{W-d}{2W}, \frac{1}{2}\right)$. If α satisfies this constraint, CP$\geq \frac{W+d}{2}$ is rational for p satisfying (B.43).

■

B.5 Screenshots from experiment program and instructions

Figure B.1
Candidate screen for offer selection

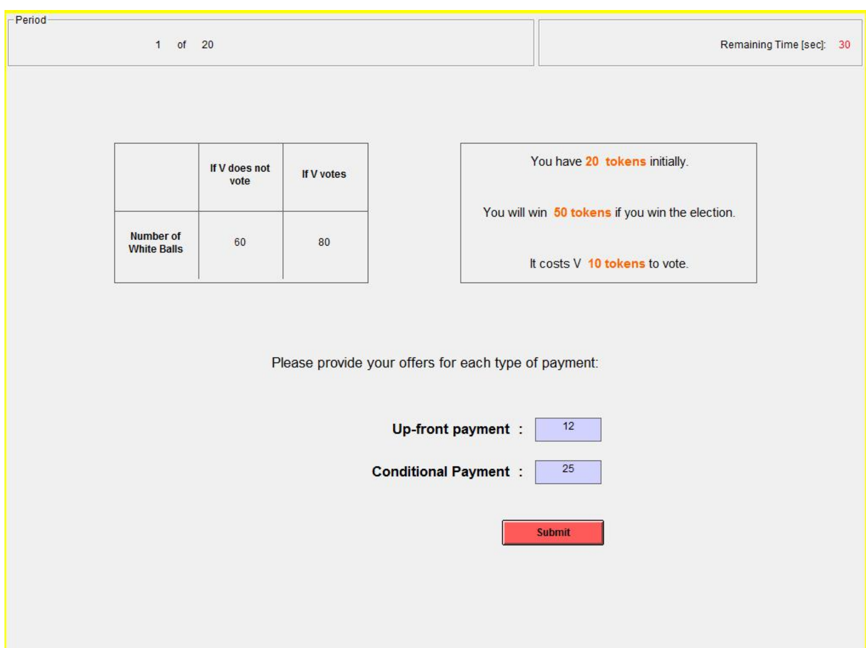
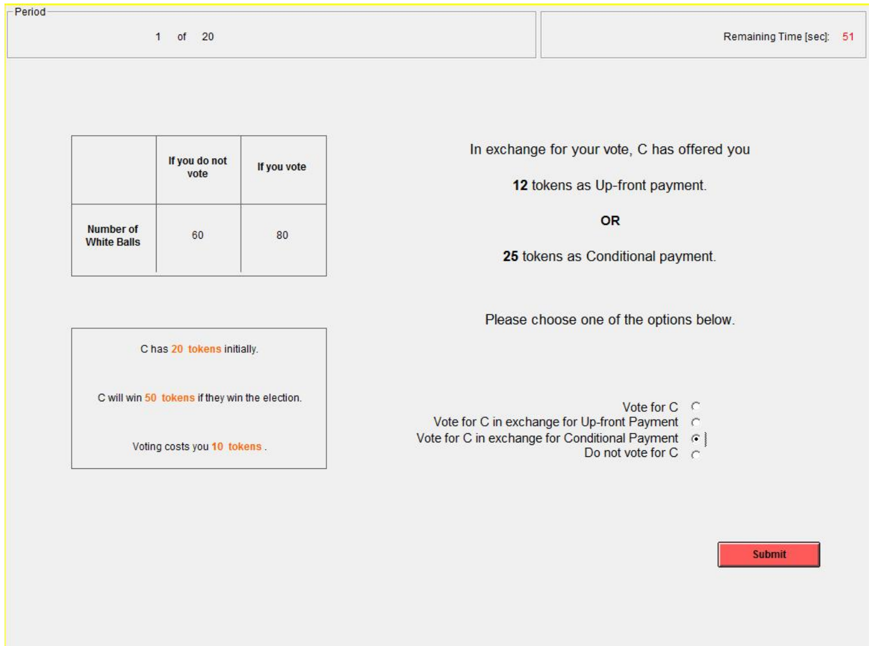


Figure B.2
Voter screen for offer selection



Instructions

General

Welcome and thank you for coming today to participate in this experiment. This is an experiment in decision-making. If you follow the instructions and make good decisions, you can earn a significant amount of money, which will be paid to you at the end of the session. The currency in this experiment is called tokens (10 tokens = 1USD). The experiment consists of 20 identical decision rounds.

During the experiment it is important that you do not talk to any other subjects. Please either turn off your cell phones or put them on silent. If you have a question, please raise your hand, and an experimenter will answer your question. Failure to comply with these instructions means that you will be asked to leave the experiment and all earnings will be forfeited. The experiment will last about 60 minutes.

Roles

At the beginning of the experiment you will be randomly assigned a role. The two possible roles you can be assigned are `**Voter**' and `**Candidate**'. There will be an equal number of voters and candidates. Your roles will stay fixed for all 20 rounds until the end of the experiment. That is, if at the beginning of the experiment you were assigned the role of a candidate (voter), you will keep this role for the entire experiment.

At the beginning of <u>each round</u>, all participants will be randomly paired, with each pair consisting of one voter and one candidate. Since you are most likely to be matched with a different participant in each round, it will be impossible to track your counterpart between rounds. No participant will ever be informed about the identities of the participants they are paired with, neither during nor after the experiment.

In this experiment, at each round, both the voter and the candidate are assigned **20 tokens**. Each round, **the candidate** has the chance to win **200 additional tokens**. Whether the candidate wins the additional tokens is determined randomly by the computer in the following way: The candidate wins the election (and hence the additional 200 tokens)if the computer draws a **WHITE** ball from an urn that contains RED and WHITE balls. The total number of balls contained in the urn is fixed at 100, but the number of white balls in the urn will change from one round to another.

The voter can increase the number of white balls (by exchanging them with red balls) in the urn by voting for the candidate. However, this costs **10 tokens** to the voter.

Payment Types

A payment is what a candidate can offer the voter in exchange for their vote. The payment is in terms of tokens and it can take two possible forms, "Up-front Payment" and "Conditional Payment".

- An up-front payment, if accepted by the voter, is paid to the voter prior to the election.
- A conditional payment, if accepted by the voter, is paid to the voter **if the candidate wins** (i.e. payment is conditioned on the candidate winning the election) and hence paid after the election.

Development of each round

For each group, each of the 20 rounds consists of an election process with the following sequence of events:

1. Both the candidate(C) and the voter (V) are informed about the following:
   - Number of white balls in the urn
   - Number of white balls in the urn if the voter votes for the candidate

2. In each group, the candidate decides on the number of tokens he/she offers for each type of payment. The offer cannot be greater than what the candidate owns at the time of payment.

   Note that this implies that an up-front payment cannot be greater than 20 tokens, and a conditional payment cannot be greater than 220 tokens.

3. Once the candidate submits his/her offers, the voter is informed about these offers. The voter is then asked to choose among the following options: (a) Accept Up-front Payment in exchange for Vote, (b) Accept Conditional Payment in exchange for Vote, (c) Do not accept payment.

4. Both V and C learn about voter's choice over the candidate's offer. If the voter has accepted Up-front Payment, the amount accepted is transferred to the voter's account.

5. Voter decides whether to vote or not. Number of white balls is adjusted corresponding to the voter's choice over voting or not voting for C.

6. The computer draws a ball from the urn, and announces its color. Both V and C are informed about the result of the election.

7. If the voter has accepted Conditional Payment and the candidate has won the election, the candidate decides whether or not to make the agreed payment.

8. Payoffs realize.

Earnings

Earnings depend on whether the voter voted for the candidate, which offer he/she accepted an offerfrom the candidate and the color of the drawn ball. The following tables summarize this information for the voter and the candidate, respectively.

Voter

Earnings		Color of the ball drawn from the urn	
		White	Red
Voter chooses	Up-front payment	20 + Up-front payment – 10	20+ Up-front payment – 10
	Conditional payment	20 + Conditional payment – 10	20–10
	Voting w/o payment	20–10 = 10	20–10
	Not to vote	20	20

Candidate

Earnings		Color of the ball drawn from the urn	
		White	Red
Voter chooses	Up-front payment	20+200 – Up-front payment	20 – Up-front payment
	Conditional payment	20+200 – Conditional payment	20
	Voting w/o payment	20+200 = 220	20
	Not to vote	20+200	20

Final earnings

Once all 20 rounds are finished, the computer will randomly pick **one** round out of the 20 rounds you have played. The earnings you made on that round will be your final earnings of the experiment. We will convert tokens you earned in this round into US dollars by dividing them by 10. In addition, you will receive a participation fee of 5 USD.

Are there any questions?

Appendix C: Appendix to Chapter 3

C.1 Inequity Aversion – Proof of Proposition 3.2

Proposition 3.2. (Inequity aversion). If Player B is inequity averse, she may decline a transfer from Player A. More specifically, if

(i) $\beta \leq \frac{3}{4}$ and $\beta < \frac{1}{k+1}$, then Player B accepts Player A's transfer and sends back $b^* = 0$;

(ii) $\beta \in \left[\frac{3}{4}, \frac{1}{k+1}\right)$, then Player B rejects Player A's transfer;

(iii) $\beta \geq \frac{1}{k+1}$ and $k \geq \frac{1}{3}$, then Player B accepts Player A's transfer and sends back $b^* \in \left[0, \frac{400}{k+1}\right]$.

Proof. Suppose Player B is inequity averse ($0 < \beta < 1$) and has utility function (3.1). Since the game is played only once, I proceed with backward induction.

In stage 3, Player B's utility is given by

$$u(b; k) = 400 - b - \alpha \max\{kb - (400 - b), 0\} - \beta \max\{400 - (k+1)b, 0\} \tag{C.1}$$

First note that if $(k+1)b \geq 400$,

$$u(b; k) = (1 + \alpha)400 - (1 + \alpha + \alpha k)b \tag{C.2}$$

and $\frac{\partial u}{\partial b} < 0 \; \forall \alpha, k \geq 0$. Thus Player B's optimal giving has to satisfy $b_k \leq \frac{400}{k+1}$.

Second, if $(k+1)b \leq 400$

$$u(b; k) = (1 - \beta)400 - (1 - \beta - \beta k)b \tag{C.3}$$

and $\frac{\partial u}{\partial b} = \beta k + \beta - 1$. Thus Player B's optimal giving is given by

$$b_k \begin{cases} = 0 & \text{if } \beta < \frac{1}{k+1} \\ \in \left[0, \frac{400}{k+1}\right] & \text{if } \beta = \frac{1}{k+1} \\ = \frac{400}{k+1} & \text{if } \beta > \frac{1}{k+1} \end{cases} \tag{C.4}$$

In stage 2, Player B decides whether to accept or reject. Note that $u(\text{Reject}) = 100$.

- Suppose $\beta < \frac{1}{k+1}$. Then, $u(\text{Accept}, b_k = 0) = (1-\beta)400$. Player B rejects if

$$\Delta U = u(\text{Accept}, b_k) - u(\text{Reject}) = (1-\beta)400 \leq 100 \quad \Leftrightarrow \quad \beta \geq \frac{3}{4} \tag{C.5}$$

  and accepts if $\beta \leq \frac{3}{4}$.

- Now suppose $\beta > \frac{1}{k+1}$. Then, $u(\text{Accept}, b_k = \frac{400}{k+1}) = \frac{k}{k+1}400$. Player B rejects if

$$\Delta U = \frac{k}{k+1}400 - 100 \leq 0 \quad \Leftrightarrow \quad k \leq \frac{1}{3} \tag{C.6}$$

- Now suppose $\beta = \frac{1}{k+1}$. Then, $u\left(\text{Accept}, b_k \in \left[0, \frac{400}{k+1}\right]\right) = \frac{k}{k+1}400$. Player B rejects if

$$\Delta U = \frac{k}{k+1}400 - 100 \leq 0 \quad \Leftrightarrow \quad k \leq \frac{1}{3} \tag{C.7}$$

■

C.2 Guilt Aversion – Proof of Proposition 3.3

Proposition 3.3. (Guilt aversion). If Player B is guilt averse, she may decline a transfer from Player A, i.e. there exists $k \geq 0$, $e_B \geq 0$ and $\Phi \geq 0$ such that utility of rejecting is higher than accepting a transfer from Player A. Moreover, Player B's utility difference between accepting and rejecting weakly increases in k and weakly decreases in e_B. For some e_B, this utility difference is lower when Player B cannot transfer e_B to Player A than when she can transfer e_B to Player A. If Player B accepts, her giving back weakly decreases in k and weakly increases in e_B.

Proof. Suppose Player B is guilt averse and has utility function (3.2). Let $e_B \geq 0$ be Player B's second-order belief. **In stage 3**, Player B's utility is given by

$$u(b; k, e_B) = 400 - b - \Phi \max\{0, e_B - kb\} \tag{C.8}$$

Assuming $e_B - kb \geq 0$ (since Player B would not want to transfer an amount that exceeds e_B),

$$\frac{\partial u}{\partial b} = -(1 - \Phi k) \begin{cases} = 0 & \text{if } \Phi k = 1 \quad \Rightarrow b_k \in \left[0, \min\left\{400, \frac{e_B}{k}\right\}\right] \\ > 0 & \text{if } \Phi k > 1 \quad \Rightarrow b_k = \min\left\{400, \frac{e_B}{k}\right\} \\ < 0 & \text{if } \Phi k < 1 \quad \Rightarrow b_k = 0 \end{cases} \tag{C.9}$$

In **stage 2**, Player B decides whether to accept or reject. Note that $u(\text{Reject}) = 100 - \Phi \max\{0, e_B - 100\}$. **Case 1.** Suppose $\Phi k \geq 1$. Then,

- **(i)** if $e_B \leq 400k$ and $e_B \leq 100$

$$u\left(\text{Accept}, \frac{e_B}{k}; k, e_B\right) = 400 - \frac{e_B}{k} \quad \text{and} \quad u(\text{Reject}) = 100 \tag{C.10}$$

Then, the utility difference between "Accept" and "Reject" is negative if

$$\Delta U = 300 - \frac{e_B}{k} \leq 0 \quad \Leftrightarrow \quad 300k \leq e_B \tag{C.11}$$

This yields the conditions: $300k \leq e_B \leq 400k$ and $e_B < 100$

Also note that $\frac{\partial \Delta U}{\partial k} > 0$ and $\frac{\partial \Delta U}{\partial e_B} < 0$.

- **(ii)** if $e_B \leq 400k$ and $e_B > 100$,

$$u\left(\text{Accept}, \frac{e_B}{k}; k, e_B\right) = 400 - \frac{e_B}{k} \quad \text{and} \quad u(\text{Reject}) = (1+\Phi)100 - \Phi e_B \tag{C.12}$$

Then, the utility difference between "Accept" and "Reject" is negative if

$$\Delta = 300 + 100\Phi - \Phi e_B \leq 0 \quad \Leftrightarrow \quad e_B \geq \frac{300 + 100\Phi}{\Phi} \tag{C.13}$$

This yields the conditions: $\frac{300+100\Phi}{\Phi} \leq e_B \leq 400k$ and $e_B > 100$.

Also note that $\frac{\partial \Delta U}{\partial k} = 0$ and $\frac{\partial \Delta U}{\partial e_B} < 0$.

- **(iii)** if $e_B > 400k$ and $e_B \leq 100$,

$$u\left(\text{Accept}, 400; k, e_B\right) = \Phi(400k - e_B) \quad \text{and} \quad u(\text{Reject}) = 100 \tag{C.14}$$

Then, the utility difference between "Accept" and "Reject" is negative if

$$\Delta = \Phi 400k - \Phi e_B - 100 \leq 0 \quad \Leftrightarrow \quad \frac{100(4\Phi k - 1)}{\Phi} \leq e_B \tag{C.15}$$

This yields the conditions: $\frac{100(4\Phi k-1)}{\Phi} \leq e_B < 100$ and $e_B > 400k$. However note that $400k < \frac{100(4\Phi k-1)}{\Phi} \quad \Rightarrow \quad 0 < -1$. Hence we can conclude that the utility difference is positive in this case.

Also note that $\frac{\partial \Delta U}{\partial k} > 0$ and $\frac{\partial \Delta U}{\partial e_B} < 0$.

- **(iv)** if $e_B > 400k$ and $e_B > 100$,

$$u\left(\text{Accept}, 400; k, e_B\right) = \Phi(400k - e_B) \quad \text{and} \quad u(\text{Reject}) = (1+\Phi)100 - \Phi e_B \tag{C.16}$$

Then, the utility difference between "Accept" and "Reject" is negative if

$$\Delta = 100[4\Phi k - \Phi - 1] \leq 0 \quad \Leftrightarrow \quad \Phi \leq \frac{1}{4k-1} \tag{C.17}$$

This yields the conditions: $\frac{1}{k} \leq \Phi \leq \frac{1}{4k-1}$ and $k < \frac{1}{3}$

Also note that $\frac{\partial \Delta U}{\partial k} > 0$ and $\frac{\partial \Delta U}{\partial e_B} = 0$.

Case 2. Suppose $\Phi k \leq 1$. Then, for all $k \geq 0$, $b_k = 0$.

- **(i)** if $e_B \leq 400k$ and $e_B \leq 100$

$$u\left(\text{Accept}, 0; k, e_B\right) = 400 - \Phi e_B \quad \text{and} \quad u(\text{Reject}) = 100 \tag{C.18}$$

Then, the utility difference between "Accept" and "Reject" is negative if

$$\Delta U = 300 - \Phi e_B \leq 0 \quad \Leftrightarrow \quad e_B \leq \frac{300}{\Phi} \tag{C.19}$$

This yields the conditions: $e_B \leq 400k$, $e_B < 100$ and $e_B \leq \frac{300}{\Phi} \Rightarrow \Phi > 3$.

Also note that $\frac{\partial \Delta U}{\partial k} = 0$ and $\frac{\partial \Delta U}{\partial e_B} < 0$.

- **(ii)** if $e_B \leq 400k$ and $e_B > 100$,

$$u\left(\text{Accept}, 0; k, e_B\right) = 400 - \Phi e_B \quad \text{and} \quad u(\text{Reject}) = (1 + \Phi)100 - \Phi e_B \tag{C.20}$$

Then, the utility difference between "Accept" and "Reject" is always positive:

$$\Delta = 300 + 100\Phi > 0 \tag{C.21}$$

Also note that $\frac{\partial \Delta U}{\partial k} = 0$ and $\frac{\partial \Delta U}{\partial e_B} = 0$.

- **(iii)** if $e_B > 400k$ and $e_B \leq 100$,

$$u\left(\text{Accept}, 0; k, e_B\right) = 400 - \Phi e_B \quad \text{and} \quad u(\text{Reject}) = 100 \tag{C.22}$$

Then, the utility difference between "Accept" and "Reject" is negative if

$$\Delta = 300 - \Phi e_B \leq 0 \quad \Leftrightarrow \quad e_B \leq \frac{300}{\Phi} \tag{C.23}$$

This yields the conditions: $400k < e_B \leq \frac{300}{\Phi} < 100$ where $\Phi > 3$ and $k < \frac{1}{4}$.

Also note that $\frac{\partial \Delta U}{\partial k} = 0$ and $\frac{\partial \Delta U}{\partial e_B} < 0$.

- **(iv)** if $e_B > 400k$ and $e_B > 100$,

$$u\left(\text{Accept}, 0; k, e_B\right) = 400 - \Phi e_B \quad \text{and} \quad u(\text{Reject}) = (1 + \Phi)100 - \Phi e_B \tag{C.24}$$

Then, the utility difference between "Accept" and "Reject" is always positive:

$$\Delta = 300 + 100\Phi > 0 \tag{C.25}$$

Also note that $\frac{\partial \Delta U}{\partial k} = 0$ and $\frac{\partial \Delta U}{\partial e_B} = 0$.

Now to show that Player B's likelihood of rejection may be higher when she cannot transfer her second-order belief to Player A, than when she can transfer her second-order belief to Player A, consider the following case. Let $\Phi k \geq 1$ and $e_B \leq 100$. Note that the utility difference between accepting and rejecting is $\Delta = 300 - \frac{e_B}{k}$ if $e_B \leq 400k$, and $\Delta = 400\Phi k - \Phi e_B - 100$ if $e_B > 400k$. Note that

$$300 - \frac{e_B}{k} < 0 \quad \Rightarrow \quad 400\Phi k - \Phi e_B - 100 = \Phi k \left(300 - \frac{e_B}{k}\right) - 100(1 - \Phi k) < 0 \tag{C.26}$$

Therefore, when $e_B \leq 100$, the likelihood of Player B to reject a transfer from Player A is higher than when she cannot transfer e_B to Player A.

Now suppose $\Phi k \geq 1$ and $e_B > 100$. In this case, the utility difference between accepting and rejecting is $\Delta = 300 + 100\Phi - \Phi e_B$ if $e_B \leq 400k$, and $\Delta = 400\Phi k - 100\Phi - 100$ if $e_B > 400k$. Denote the first utility difference with Δ_1 and the second utility difference with Δ_2. Then,

$$\Delta_2 - \Delta_1 = 400(\Phi k - 1) + \Phi(e_B - 200) \lesseqgtr 0 \tag{C.27}$$

Therefore, there are some $e_B > 100$ for which the likelihood of Player B to reject a transfer from Player A is higher than when she cannot transfer e_B to Player A.

■

C.3 Reciprocity – Proof of Proposition 3.4

Proposition 3.2. (Reciprocity). If Player B is reciprocal, she may decline a transfer from Player A. More specifically, let $\Delta_B(s_A = \text{send}, s_B = \text{accept}) = \Delta_B$. If

(i) $e_B \leq \bar{e}$ and $\theta k \geq \frac{1}{(\bar{e}-e_B)\Delta_B}$, then Player B accepts Player A's transfer and sends back $b^* \in [0, 400]$;

(ii) $e_B \leq \bar{e}$ and $\theta k < \frac{1}{(\bar{e}-e_B)\Delta_B}$ and

- $\theta > \frac{1}{e_B(\bar{e}-e_B)}$, then Player B will reject Player A's transfer;
- $\theta \leq \frac{1}{e_B(\bar{e}-e_B)}$, then Player B will accepts Player A's transfer and sends back $b^* = 0$;

(iii) $e_B > \bar{e}$, then Player B accepts Player A's transfer and sends back $b^* = 0$.

Proof. Suppose Player B is reciprocal and has utility function (3.3) with $\lambda_A = (\bar{e}-e_B)\Delta_B(s_A, s_B)$ and $\lambda_B = (kb - e_B)$.

In stage 3, Player B's utility is given by

$$u(b;k,e_B,\bar{e}) = 400 - b - \theta(\bar{e}-e_B)(kb-e_B)\underbrace{\Delta_B(\text{send, accept})}_{400-100} \tag{C.28}$$

- Suppose first that $e_B \leq \bar{e}$. Then, Player B may send a positive amount since

$$\frac{\partial u}{\partial b} = -1 + \theta(\bar{e}-e_B)300k \lesseqgtr 0 \tag{C.29}$$

  Note that $\frac{\partial^2 u}{\partial b \partial k} = \theta\underbrace{(\bar{e}-e_B)}_{\geq 0} \geq 0$ and $\frac{\partial^2 u}{\partial b \partial e_B} = -\theta k \leq 0$. If the condition below holds for θ, then $\forall k > 0 \quad b_k \in [0, 400]$.

$$\theta k \geq \frac{1}{300(\bar{e}-e_B)} \tag{C.30}$$

  However note that if $\theta(\bar{e}-e_B)300k < 1 \quad \Leftrightarrow \quad \theta k < \frac{1}{300(\bar{e}-e_B)}$, then $b_k = 0$.

- Now suppose that $e_B > \bar{e}$. Then, Player B would never send a positive amount:

$$\frac{\partial u}{\partial b} = -1 + \theta\underbrace{(\bar{e}-e_B)}_{<0}300k < 0 \quad \Rightarrow b_k = 0\ \forall k \geq 0 \tag{C.31}$$

In stage 2, Player B's utility from rejecting is given by $u(\text{Reject}) = 100$.

- If $e_B \leq \bar{e}$, the utility difference between accepting and rejecting is

$$\Delta U = 300 - b + 300\theta(\bar{e}-e_B)(kb-e_B) \lesseqgtr 0 \tag{C.32}$$

  However note that $\frac{(\partial \Delta U)}{\partial k} = 300\theta\underbrace{(\bar{e}-e_B)}_{\geq 0} \geq 0$ and $\frac{(\partial \Delta U)}{\partial e_B} = -300\theta(kb+\bar{e}-2e_B) \lesseqgtr 0$.

  The first partial derivative results implies that the likelihood of Acceptance (Rejection) increases (decreases) in transfer rate, k.

  Specifically, if $\theta k < \frac{1}{300(\bar{e}-e_B)}$, then $\Delta U = 300[1-\theta(\bar{e}-e_B)e_B]$ since $b_k = 0$ under this condition. Thus if $\theta > \frac{1}{e_B(\bar{e}-e_B)}$, Player B rejects.

  The second partial derivative implies that for low levels of second-order beliefs, the likelihood of Rejection increases in e_B and for high levels of e_B, likelihood of Rejection decreases in e_B. For example, if $e_B \leq 0.5\bar{e}$ then $\frac{(\partial \Delta U)}{\partial e_B} \leq 0$.

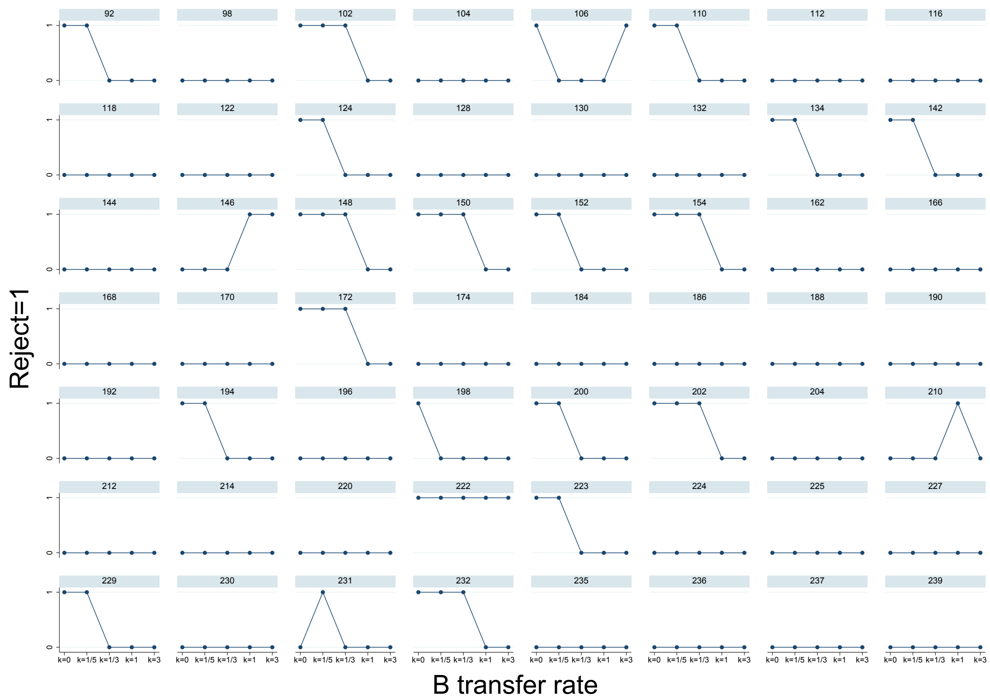
- If $e_B > \bar{e}$, the utility difference between accepting and rejecting is positive for all $k0$, hence Player B always accepts a transfer:

$$\Delta U = 400 - 300\theta(\bar{e} - e_B)e_B = 300\left[\frac{4}{3} - \theta\underbrace{(\bar{e} - e_B)}_{<0}e_B\right] > 0 \tag{C.33}$$

■

C.4 Decisions of Individual Subjects

Figure C.1
Invidual Responses: Player B, Reject=1



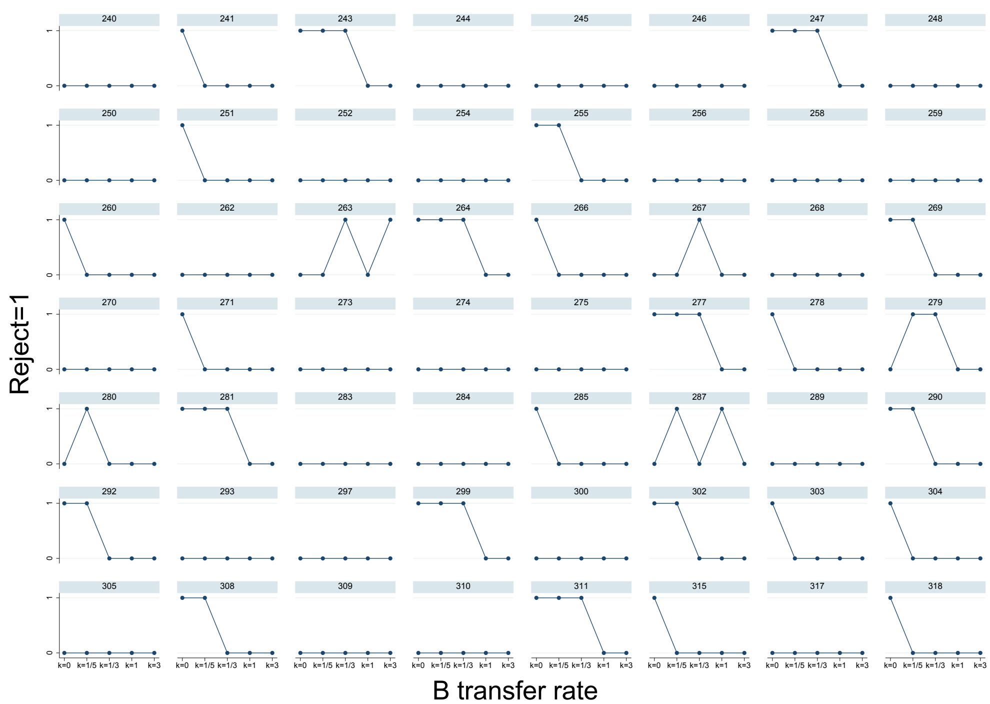
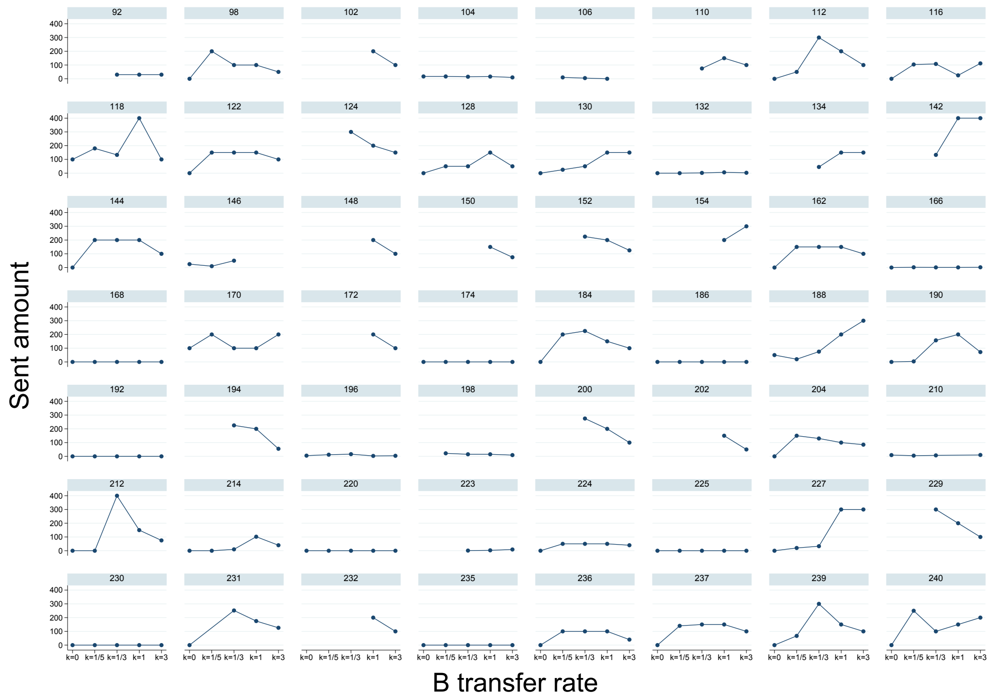
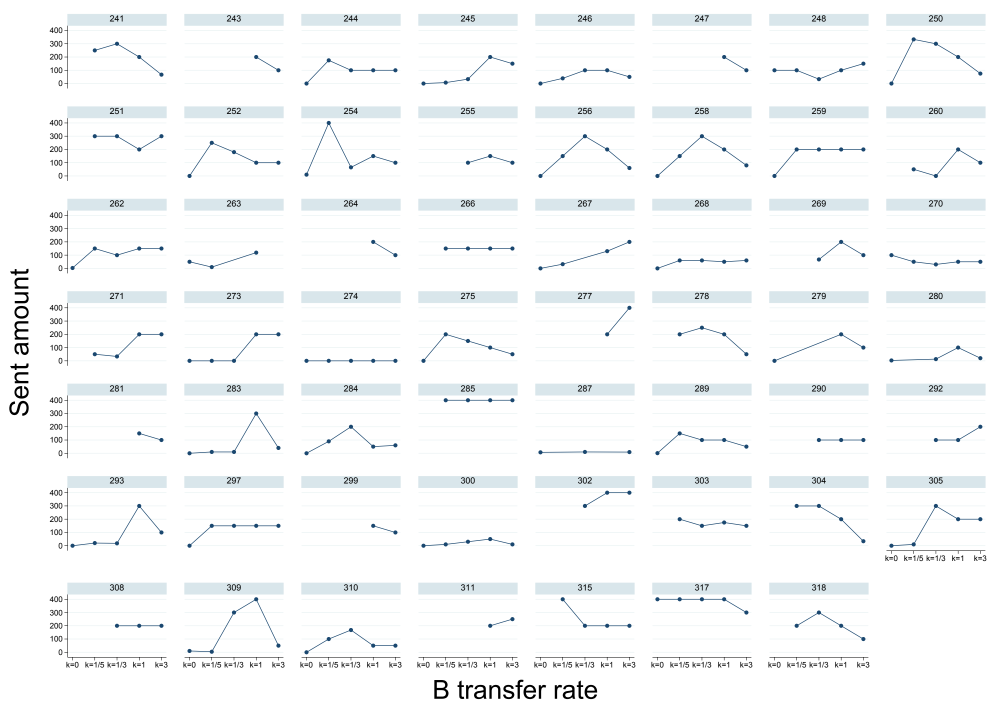


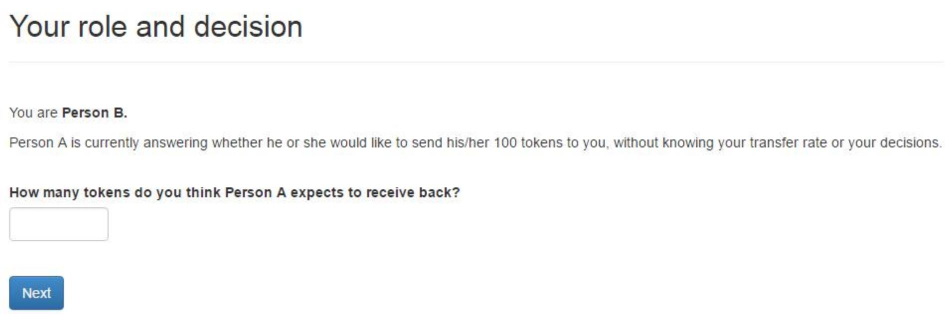
Figure C.3
Invidual Responses: Player B Giving Back





C.5 Screenshots from experiment program and instructions

Figure C.5
Player B Belief Elicitation



Your role and decision

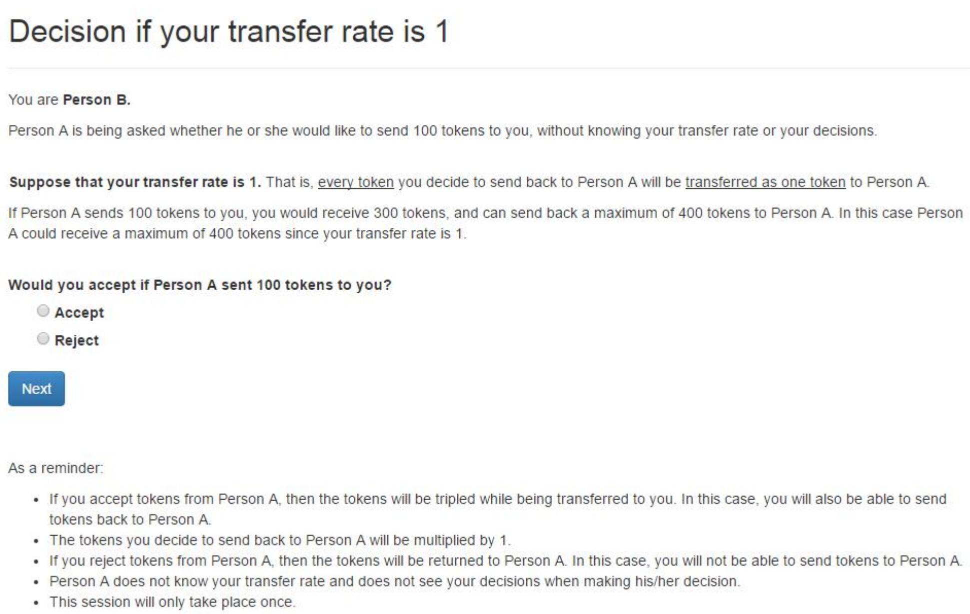
You are **Person B.**

Person A is currently answering whether he or she would like to send his/her 100 tokens to you, without knowing your transfer rate or your decisions.

How many tokens do you think Person A expects to receive back?

Next

Figure C.6
Player B Transfer Acceptance



Decision if your transfer rate is 1

You are **Person B.**

Person A is being asked whether he or she would like to send 100 tokens to you, without knowing your transfer rate or your decisions.

Suppose that your transfer rate is 1. That is, every token you decide to send back to Person A will be transferred as one token to Person A.

If Person A sends 100 tokens to you, you would receive 300 tokens, and can send back a maximum of 400 tokens to Person A. In this case Person A could receive a maximum of 400 tokens since your transfer rate is 1.

Would you accept if Person A sent 100 tokens to you?

Accept

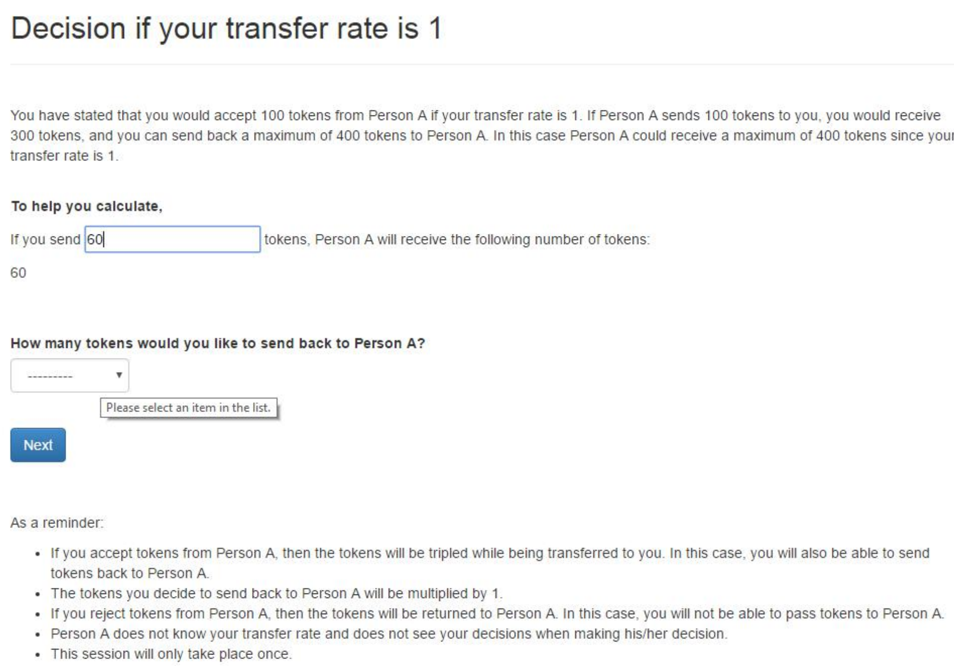
Reject

Next

As a reminder:

- If you accept tokens from Person A, then the tokens will be tripled while being transferred to you. In this case, you will also be able to send tokens back to Person A.
- The tokens you decide to send back to Person A will be multiplied by 1.
- If you reject tokens from Person A, then the tokens will be returned to Person A. In this case, you will not be able to send tokens to Person A.
- Person A does not know your transfer rate and does not see your decisions when making his/her decision.
- This session will only take place once.

Figure C.7
Player B Giving Back



Decision if your transfer rate is 1

You have stated that you would accept 100 tokens from Person A if your transfer rate is 1. If Person A sends 100 tokens to you, you would receive 300 tokens, and you can send back a maximum of 400 tokens to Person A. In this case Person A could receive a maximum of 400 tokens since your transfer rate is 1.

To help you calculate,

If you send 60 tokens, Person A will receive the following number of tokens:

60

How many tokens would you like to send back to Person A?

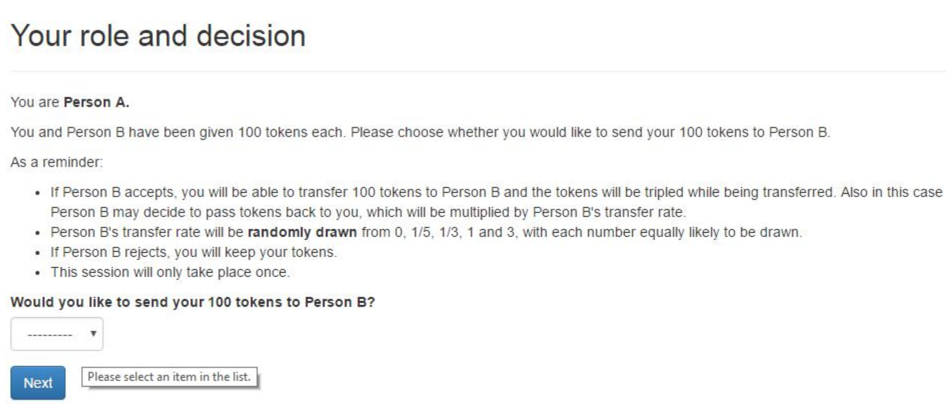
Please select an item in the list.

Next

As a reminder:

- If you accept tokens from Person A, then the tokens will be tripled while being transferred to you. In this case, you will also be able to send tokens back to Person A.
- The tokens you decide to send back to Person A will be multiplied by 1.
- If you reject tokens from Person A, then the tokens will be returned to Person A. In this case, you will not be able to pass tokens to Person A.
- Person A does not know your transfer rate and does not see your decisions when making his/her decision.
- This session will only take place once.

Figure C.8
Player A Decision Screen



Your role and decision

You are **Person A.**

You and Person B have been given 100 tokens each. Please choose whether you would like to send your 100 tokens to Person B.

As a reminder:

- If Person B accepts, you will be able to transfer 100 tokens to Person B and the tokens will be tripled while being transferred. Also in this case Person B may decide to pass tokens back to you, which will be multiplied by Person B's transfer rate.
- Person B's transfer rate will be **randomly drawn** from 0, 1/5, 1/3, 1 and 3, with each number equally likely to be drawn.
- If Person B rejects, you will keep your tokens.
- This session will only take place once.

Would you like to send your 100 tokens to Person B?

Next

Please select an item in the list.

Instructions

You will be randomly matched with one other participant to form a group.

In a group, each participant will have a different role: Person A and Person B. Your role will be randomly assigned and displayed on the next page.

Both Person A and Person B will be given **100 tokens** each initially. If Person B accepts it, Person A will be able to send 100 tokens to Person B and the tokens will be **tripled** while being transferred to Person B. If Person B rejects, the tokens will be returned to Person A. That is, Person A will decide whether he or she would like to send tokens to Person B, and Person B will decide whether he or she would like to accept tokens from Person A.

Additionally, if Person B accepts tokens from Person A, he or she will be able to send tokens back to Person A. The tokens Person B decides to send back to Person A will be **multiplied by Person B's transfer rate.** Person A will not be able to reject a transfer from Person B. Person B's transfer rate will be randomly determined from the following list of numbers: 0, 1/5, 1/3, 1 or 3, where each value is equally likely to be drawn. Person A will not know Person B's transfer rate while making his/her decision on whether to send tokens to Person B. However Person B will be able to condition his/her decisions based on Person B's transfer rate value.

More specifically, **for every possible value of Person B's transfer rate,** Person B will fill out a form indicating whether he or she would accept or reject tokens from Person A and,

- If Person B states that he/she would accept tokens from Person A, then Person B will be asked how many tokens he/she would like to send tokens back to Person A.
- If Person B states that he/she would reject tokens from Person A, then Person B will **not be asked** whether he or she would like to send tokens back to Person A.

After Person A and Person B complete their respective decisions, a number will be drawn **randomly** from 0, 1/5, 1/3, 1 and 3 for Person B's transfer rate, and Person A's decision and Person B's choices from the form will be combined and carried out.

The session will only take place once.

You will receive **$0.25** simply for your participation in this study.

In addition, any tokens you receive will be converted to monetary earnings at a rate of **10 tokens to $0.05.**

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