The Impact of Hard Information on Resource Allocation, Communication, and Social Gains: An Experiment

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ABSTRACT

Information hardness is a fundamental attribute of modern accounting that presumably lessens disagreements about economic outcomes and the causes. We extend the multi-period investment-trust game experiment of Basu et al. (2009) to incorporate uncertainty and manipulate the availability of hard information in settings where direct communication through chat is possible. Our experiment demonstrates how hard information is a force in powerfully shaping resource allocation and communication in the presence of uncertainty. Exchange in economies that lack hard information is characterized by marginally greater private gains to self-dealing and strategic behavior to conceal such behavior. Complex concealment strategies involve a combination of ambiguous resource division, profit skimming, and manipulation of information through either silence or inaccurate disclosure in chat. In contrast, a norm of egalitarian resource sharing emerges more strongly in economies with hard information. Surprisingly, we find that economies lacking hard information generate total social gains comparable to economies with hard information when soft communication is possible. This likely occurs because multi-period interaction requires that at least minimal trust be sustained, even with an exchange partner that is being deceived. The consequence is that those likely being deceived still earn positive returns on investment that are only marginally lower than those earned by similarly situated individuals in economies with hard information.
INTRODUCTION

Hard information provides a fact-based foundation for modern accounting that makes “it difficult to for people to disagree” (Ijiri 1975, 36). Regular accounting reports anchor corporate reporting and considerable effort is expended to increase their hardness through accounting standards and mandatory audits. Hard accounting reports presumably reduce self-dealing and dishonest communication to conceal such conduct (Gigler and Hemmer 1998; Ball 2001; Arya et al. 2004).\(^1\) Gathering evidence on this issue is difficult since (1) successfully concealed self-dealing and the actions that conceal it are unobservable, and (2) a counterfactual world where hard accounting reports do not exist is difficult to observe (Ball 2008, 431). Our contribution is an experiment that avoids these difficulties and thus allows us to glimpse how economic behavior is altered by the availability of hard information.\(^2\)

The one-shot investment-trust game of Berg et al. (1995) is the building block for our experimental economies. We adapt the investment-trust game to incorporate several features of the naturally occurring settings where corporate reporting takes place. These features include uncertainty that renders behavior opaque, information asymmetry that favors one party at the expense of another, and multi-period economic interaction where reputation can be an important determinant of trust. We consider two forms of information transmission: (1) communication of soft, unverifiable information through a “chat” mechanism (aka “cheap talk”), and (2) an institution that allows the individual with an informational advantage to have hard information on outcomes supplied to her trading partner.

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\(^1\) Financial scandals often involve falsified accounting records and financial statements in order to sustain the perpetrator’s scheme to defraud investors. Henriques (2011), McLean and Elkind (2003) and Cooper (2009) describe how potential investors and regulators were deceived in the Madoff Ponzi, Enron, and WorldCom frauds.

\(^2\) An experiment provides controlled variation to examine behavior under economic institutions in counterfactual worlds that cannot be directly observed in the field (Smith 2004; Falk and Heckman 2009).
We investigate how the availability of hard information affects (1) private gains from self-dealing, (2) strategic concealment of self-dealing through ambiguous resource allocation and deceptive soft communication, and (3) social gains from exchange, which are determined by trust in an exchange partner. Prior experiments have explored the impact of cheap talk communication (Cai and Wang 2006), the role of promises in securing trust (Charness and Dufwenberg 2006; Schniter et al. 2011), and incentives favoring deception (Gneezy 2005; Vanberg 2008). We build on this literature using a multi-period experiment where self-dealing emerges endogenously along with a concealment strategy and can persist because uncertainty impedes detection and provides a partial cover for self-dealing.

Our experiment involves multi-period interactions between an “investor” and a “trustee.” The investor has an endowment of resources that can be invested to generate gains, which are subsequently divided between the parties by the trustee. The total wealth produced in a period depends on the investment level and an uncertain multiplier observed only by the trustee. The trustee in a NoInfo economy has no way to communicate the multiplier realization to the investor. A HardInfo economy is identical except that the trustee can choose to have hard information on the realized gains provided to the investor at the end of the period. To directly examine how hard information affects self-dealing and the honesty of soft communication, we replicate the NoInfo and HardInfo economies with a chat mechanism that allows for unstructured two-way communication between the investor and trustee after each period. Our main focus is on differences between NoInfo-Chat and HardInfo-Chat economies in trustee gains, concealment actions by the trustee, and overall economic gains.

The fact that a NoInfo-Chat trustee divides the total gains available and also that her decision is opaque to the investor provides an opportunity for her to keep a larger share of the gains than would be possible if the investor had hard information on the amount that the
trustee had received. At the same time, a self-dealing NoInfo-Chat trustee’s ability to obtain larger private benefits depends on whether she can successfully convince the investor that she fairly divided the total gains from exchange. Thus, a NoInfo-Chat trustee seeking greater private benefit likely will use a strategy that includes both return decisions subject to ambiguous interpretation and distorted soft communication intended to induce false beliefs on the part of the investor. A NoInfo-Chat investor cannot know for certain whether her trustee partner has taken a greater share of the total gains, but suspicions of self-dealing can arise if the trustee repeatedly returns an amount lower than the investor expects. The trustee’s ability to successfully balance the temptation of short-term private gains against long-term gains from cooperation is central to sustaining investor trust and profiting from future exchanges.

Our experiment yields direct evidence of a rich set of behaviors that lie beneath the surface of economic interactions where self-dealing is possible, but must be concealed to be profitable. First, our NoInfo-Chat trustee subjects gain marginally greater private benefits by exploiting their information advantage. These gains are secured in part through strategic behavior that combines the making and breaching of promises of future resource sharing, skimming of profits, resource sharing decisions that can be subject to ambiguous interpretation, and information manipulation through misrepresentation or advantageous silence. When hard information can be supplied, these behaviors are largely eliminated and a norm of egalitarian resource sharing emerges. However, NoInfo-Chat investors invest amounts that are comparable to those of HardInfo-Chat investors, which suggests that NoInfo-Chat trustees are able to sustain their partners’ trust even though they are skewing resource allocation in their favor. The likely reason for this is that overall returns to NoInfo-Chat investors are substantial and only marginally lower than (and statistically indistinguishable from) returns to HardInfo-Chat investors.
Our evidence has important implications for how we think about the mechanisms by which hard information affects the extent and costs of concealed self-dealing. One implication is that potential self-dealers may constrain their own behavior to less egregious forms of self-serving behavior to avoid drawing suspicion from their partner and risk that a partner will terminate a beneficial exchange relationship. That is, the risk of losing future gains from cooperating with trading partners may beneficially limit the social costs of deception even in settings where it is frequent. This is broadly consistent with research suggesting that accounting manipulation may be benign in some cases (Arya, Glover, and Sunder 2003). Of course, our study is subject to the usual caveat that no laboratory experiment is capable of incorporating every complexity present in naturally occurring settings. Additional research will be required to evaluate the extent to which our evidence broadly generalizes.

The rest of the paper is organized as follows. We describe the structure of our experiment and develop our hypotheses in the next section. Data collection is discussed in the third section and experimental results are reported in the fourth section. A final section provides concluding remarks.

**EXPERIMENT STRUCTURE AND HYPOTHESIS DEVELOPMENT**

Our experiment is structured to provide evidence on how the ability to provide hard information on economic outcomes alters the extent of self-dealing, strategic actions undertaken by self-dealers to successfully conceal their behavior, and the extent to which concealed self-dealing generates social losses due to lessened trust. In this section we first describe the structure of our experiment and then develop our hypotheses.

**Experiment Structure**
Two considerations drive our experimental design. First, we are interested in the effect of hard information on successfully concealed self-dealing and its social costs. Thus, our subjects are provided opportunities to self-deal and strategically conceal such behavior within our experiment. Second, we want self-dealing to arise endogenously in a setting where subjects face a trade-off between short-term gain from self-dealing and potential long-term gain from cooperation. For these reasons, our experiment allows subjects to discover ways that unstructured communication can be used to secure personal benefits through self-dealing, cooperative behavior, or both.

Our experiment is a multi-period investment-trust game derived from the simple one-period game in Berg et al. (1995), and is built primarily from the multi-period, multi-player investment-trust game used by Basu et al. (2009). The structure of our experiment differs from that of Basu et al. (2009) because we incorporate payoff uncertainty as in Lunawat (2012, 2013).

Each economy includes four persons; two play the role of “investor” and two play the role of “trustee” (see Panel A of Figure 1). Each period begins when an investor receives an initial separate endowment of ten currency units (lira) for each trustee. All or part of this endowment can be sent to that trustee in whole numbers (see Panel B of Figure 1). Uncertainty is introduced through the trustee receiving a varying amount equal to the investment times a multiplier that ranges from one to five in whole numbers with each being equally likely. Thus, if an investor invests all ten lira with a trustee, that trustee will receive 10, 20, 30, 40, or 50 lira.

The trustee is told the amount sent by the investor and the amount she has received. In contrast, the investor is not told the amount received by the trustee or the realized multiplier. Thus, information is asymmetric since the trustee knows the realized value of the multiplier but

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3 Each economy in Basu et al. (2009) included five investors and five trustees. We reduced that number to two investors and two trustees to preserve interactions with multiple partners while reducing the likelihood that the task would be excessively complex.
the investor does not. A separate multiplier is randomly drawn (with replacement) in every period for each of the four dyads in the economy. This precludes the possibility that the investor can infer the multiplier based on her interactions with the other trustee. After learning the investment level and total amount received, the trustee divides resources by deciding how much to send back to the investor.

We implement a multi-period game by repeating this process ten times (King-Casas et al. 2005; Basu et al. 2009). In order to lessen end game behavior, subjects are not told how many periods the game will be repeated. Subject anonymity is maintained throughout. This benchmark economy is referred to as the NoInfo economy.

Our two experimental manipulations vary whether and how the trustee can provide information on the realized multiplier to the investor. The first manipulation is whether an institution is present that allows the trustee to choose whether the investor will be informed as to the total amount received by the trustee. In this HardInfo economy, each trustee (B1 or B2) is asked at the start of each period (before the investor’s decision and the draw of the multiplier) whether she wants the experimenter to inform a given investor (A1 or A2) of the actual amount received by the trustee from that investor. Because this institution provides hard information, the investor knows for certain the actual amount received by the trustee after her investment and can infer the realized multiplier. Thus, the trustee’s return decision is transparent to the investor when the trustee chooses to have the amount she received reported to the investor.

Our second manipulation allows the trustee and investor to communicate through a chat mechanism. We allow investors and trustees to communicate by sending text messages via computer interface at the end of each period prior to the final period of the game. Subjects have
access to a text-based electronic notebook on their computer screens for a three-minute interval and could type anything except personal information.\(^4\)

Messages could be sent only to individual trading partners. The same message could not be simultaneously sent to multiple partners, although the subject could send an identical message to both partners at different points in time. To avoid collusion, text messages could not be sent to subjects playing the same role during the experimental session – i.e., an investor could not send messages to the other investor, and a trustee could not send messages to the other trustee. We refer to economies where only the chat institution is available to provide information as \textit{NoInfo-Chat} economies. Economies where trustees could have hard information revealed to their partners and also communicate through the chat mechanism are referred to as \textit{HardInfo-Chat} economies.

Our experimental economies share several features with prior experimental research. For instance, there is a sizable experimental literature on the benefits of communication between individuals and whether individuals will deceive others for personal gain. Prior research demonstrates that communication generally promotes cooperation and increases social welfare (Dawes \textit{et al.} 1977; Crawford 1998; Ledyard 1995; Ochs 1995; Camerer 2003). Gains from communication can arise in part from non-binding promises made by subjects that prefer to “keep their word” and do so (Ben-Nera \textit{et al.} 2011; Bochet \textit{et al.} 2006; Charness and Dufwenberg 2006 & 2010; Charness and Grosskopf 2004; Cohen \textit{et al.} 2010; Duffy and Feltovich 2002; Ellingsen and Johannesson 2004; Vanberg 2008).

Other studies suggest that while individuals prefer not to deceive, they will do so for private gains when the opportunity is available. Gneezy (2005) documents that a minority of subjects will deceive a trading partner for a modest private benefit when the other person’s loss

\(^4\) Communication via chat involves only text-based communication to avoid confounds due to facial expression and vocal changes (Ekman 2006; Hobson \textit{et al.} 2012).
is also modest, but fewer will do so when the other’s loss is large. Croson et al. (2003) document deception that affects bargaining behavior and outcomes in an ultimatum game experiment and Sanchez-Pages and Vorsatz (2007) demonstrate that not everyone prefers truth telling. Sutter (2009) demonstrates sophisticated deception in a sender-receiver experiment that includes truth telling in circumstances where the sender of a message expects the receiver will not follow the receiver’s true message. Within the accounting literature, Hales, et al. (2011) identify conditions where individual investors’ beliefs will be more sensitive to vivid (i.e., “hyped”) information.

The closest analog to ours is the experiment by Charness and Dufwenberg (2006), who study a trust game with the intent of measuring guilt aversion as a basis for cooperative behavior. They consider a single-period trust game where the trustee could send a written message to the investor. The investor’s payoff was uncertain and depended on an action by the trustee, which was not observable and could not be inferred indirectly by the investor.

Two features of our experimental design underlie the contribution of our paper in relation to existing literature. First, our design enables the potential for simultaneous emergence of self-dealing and complex concealment strategies implicating both resource allocation and communication in a setting where reputation matters. This has not been explored in prior experiments. For instance, the closest analog to our design is that of Charness and Dufwenberg (2006), but their setting is restricted to a single period because of the question they pose. Second, and more important, we directly manipulate the availability of hard information. This manipulation allows us to directly compare a world with hard information to a counterfactual world where hard information is unavailable. Both of these features of our design could not be replicated with naturally occurring data since (1) successfully concealed self-

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5 Charness and Dufwenberg also conducted their experiment allowing the investor to send a message to the trustee, but did not allow for two-way communication between subjects.
dealing is by its nature not observable to others, and (2) a counterfactual world without hard accounting information does not exist and likely has never existed in history.

**Hypothesis Development**

Yuji Ijiri describes hard accounting information as resulting from “the processing of verifiable facts by justifiable rules in a rigid system which allows only a unique set of rules for a given situation.” Hard information “makes it difficult for people to disagree” whereas soft information “can easily be pushed in one direction or the other” (Ijiri 1975, 36). The origins of modern accounting date back approximately 10,000 years to the clay tokens of ancient Mesopotamia (Schmandt-Besserat 1996). Over the course of human history, several innovations likely have increased the hardness of transaction records – e.g., the use of witnesses and the preparation and storage of records in ways that lessened *ex post* alteration or destruction (Basu and Waymire 2006, 213-217).

Hard information is useful in part because it allows individuals to establish a history of honest conduct, which fosters reputation formation and trust in complex exchanges entailing future performance obligations (Basu and Waymire 2006). For example, the purchase of a durable good on credit can require that the seller correct any product defects that are observed *ex post* and obligate the buyer to make a series of future payments. All else equal, harder information enables evaluation of the results from economic exchange by comparing *ex post* performance with *ex ante* promises, which can help structure present and future exchanges when information (and individual reputations) is transmitted with fidelity across time and place (Dickhaut *et al.* 2010).

Within the context of our experiment, the lack of hard information in a *NoInfo-Chat* economy will allow trustees to extract greater private benefits when they divide amounts
received from investment. That is, the division of resources will be less egalitarian in a NoInfo-Chat economy compared to a HardInfo-Chat economy. Our first hypothesis is:

Hypothesis 1 (in Alternate Form): Because hard information is lacking, NoInfo-Chat trustees will obtain relatively greater private benefits than investors in dividing gains from exchange compared to the division of gains by HardInfo-Chat trustees.

Ball (2001, 135-136) suggests that reliable earnings measures provide incentives for more honest soft communication by managers.\(^6\) Prior theoretical research explores how verifiable accounting reports influence the frequency and content of managers’ other disclosures (e.g., Christensen 1981; Baiman and Evans 1983; Dye 1983, among others). Gigler and Hemmer (1998) show that more frequent mandatory reporting can lessen the informational value of voluntary soft disclosures. More relevant to our study, Arya et al. (2004) demonstrate that the discipline provided by regular verifiable reports can increase the value of soft information disclosure because of accounting’s longer-run measurement focus. Collectively, this work suggests that one likely effect of hard information is to promote more honest soft communication by managers. Ultimately, this limits the extent to which a manager can expropriate resources and conceal such behavior.

To illustrate such behavior within our experiment, consider a NoInfo-Chat investor who invests the maximum of 10 lira and the realized multiplier equals 5 (i.e., the trustee receives 50 units). If the trustee divides the 50 units by giving half to the investor and keeping half, the investor will likely send the same maximum amount in the next period. However, the investor would likely continue investing the maximum if she receives only 20 units and falsely believed

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\(^6\) Specifically, Ball (2001, 135-136) writes: “Having a reliable system of timely and accurate reporting of independently observable outcomes (cash flows or independently observable predictors of cash flows) exerts a discipline on managers’ privately held expectations and on their publicly stated expectations (in the form of plans and forecasts). Knowing that they ultimately will be held to account for “delivering the goods” has a sobering effect on managers’ nonfinancial expectational disclosures and on the expectations themselves...”
that the realized multiplier was 4. In the extreme, the trustee could send back only five units and claim falsely that the realized multiplier was 1. This however may be difficult to do repeatedly without leading to investor mistrust and reduced investment. The key point here is that concealment of self-dealing requires an ambiguous return subject to differing plausible interpretations by the investor and communication that leads the investor to believe that the realized multiplier was lower than it actually was.

This example suggests when a trustee gains greater personal rewards through self-dealing it will be accompanied by a strategy to conceal such behavior to the extent that the trustee wants to gain benefits from future investments. Such complex forms of deception are “Machiavellian” in that they involve “social manipulation to achieve individual benefits at the expense of group members, but without causing such disruption that the individual’s membership of the group is put in jeopardy” (Byrne and Whiten 1997, 2). Thus, we hypothesize that NoInfo-Chat trustees will make ambiguous return decisions and bias soft communication (through either non-disclosure or untruthful disclosure) to conceal self-dealing:

Hypothesis 2 (in Alternate Form): Because hard information cannot be provided, NoInfo-Chat trustees will be more likely than HardInfo-Chat trustees to engage in complex strategies to conceal self-dealing that involve both ambiguous returns and biased soft communication.

NoInfo-Chat trustees are hypothesized to conceal self-dealing because they could face a real cost if their investor partner grows suspicious and withholds investments in future periods. That is, NoInfo-Chat investors will likely be more skeptical about trustees’ resource division decisions and will be likely to make lower investments than their HardInfo-Chat counterparts:

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7 Research in evolutionary psychology suggests that humans have abilities to detect cheating behavior (Cosmides and Tooby 1992).
8 An alternative term applied to such behavior is “social intelligence” (Dunbar and Schultz 2007).
Hypothesis 3 (in Alternate Form): \textit{NoInfo-Chat} investors make smaller investments than \textit{HardInfo-Chat} investors because the absence of hard information fosters greater general mistrust.

**DATA COLLECTION**

We conducted our experiments at the Center for Interuniversity Research and Analysis on Organization (CIRANO) in Montreal, Canada. CIRANO staff recruited subjects and ran 32 sessions (eight sessions for each of the four experimental conditions). One hundred twenty-eight subjects were recruited from CIRANO’s standard subject pool and remain completely anonymous to the authors.\(^9\)

Each condition-specific experiment-session included four subjects. Each subject was randomly assigned to either an investor or a trustee role (with the restriction that every session contain two investors and two trustees). While subjects were not informed of the number of periods to mitigate end game effects, they were informed via recruiting materials that the experiment would last approximately two hours.

Subjects interacted anonymously over a local computer network facilitated by \textit{z-Tree} (Zurich Toolbox for Readymade Economic Experiments) software (Fischbacher 2007). The program kept track of all amounts sent and received by each subject in every period, provided feedback information to subjects, and tracked the time at which each subject confirmed investment or return decisions.

Subjects first received and read written experiment instructions, and then took a quiz to ensure sufficient understanding of experiment instructions. The experiment facilitator checked

\(^9\) At the time of our experiment, the entire subject pool at CIRANO included 3,223 individuals, of which 52% were females. Over 90% are students at local universities like Concordia and McGill. Because our experimental materials were in English, this meant that persons in the subject pool who spoke only French (slightly over 40% of the CIRANO subject pool) could not serve as subjects in our experiment.
quiz answers and resolved discrepancies privately before the beginning of the first period. A

copy of the experiment instructions for the HardInfo-Chat economies is shown in the Appendix.

A text-based electronic notebook was provided to subjects in NoInfo-Chat and HardInfo-
Chat economies. The notebook is a blank textbox, situated at the right side of the computer
screen. The Textbox program recorded the contents of every message sent by subjects for the
length of the experiment-session. These chat messages provide the basic data on the timing and
content of soft communication by individual subjects. Textbox was the only method of
communication available to subjects. Subjects did not have access to paper and pencils, nor
could they use computer programs other than z-Tree and Textbox (the latter available for only
those subjects in the NoInfo-Chat and HardInfo-Chat conditions). Our analysis of chat data is
based on chat after rounds 1 through 9, inclusive.

Play within any given period of a HardInfo or HardInfo-Chat economy began when each
trustee (B1 or B2) was asked whether she wishes to have the amount received from a given
investor (A1 or A2) revealed to the investor at the end of the period. The investor was then
informed whether the trustee had chosen to have the amount she received revealed to the
investor at the end of the period. Next, each investor decided how much of their ten units of
experimental currency (i.e., lira) endowment to invest with each trustee. All investors’
investment decisions were required before trustees were notified of the amounts they had
received. Trustees then decided how much to send back to each investor from the amount that
had been received from that investor. All trustees’ return decisions were required before
investors learned of the amounts that had been sent back by trustees.

After receipt of returns by the investor, subjects paired in a NoInfo-Chat or a HardInfo-
Chat economy could send online text messages to each of their two partners individually for a
three-minute interval. The next trading period began after all subjects had completed the chat
session and were finished reviewing feedback from the prior round. At the end of the tenth trading period, the *lira* earned for all periods was summed and converted to Canadian dollars at a rate of four cents per *lira*.

We replicated each of the four economies eight times.\(^{10}\) The eight replications for each type of economy generated data for 32 subjects (16 investors and 16 trustees). Within each replication, interactions occur in four distinct dyads, or 32 total dyads across all eight replications of a given economy.

In one session for the *HardInfo-Chat* economy, we experienced a computer malfunction that resulted in the loss of chat data after the fourth round for that specific session only. The other data from the session (e.g., investor investments, trustee returns, hard information provision) were not affected. Consequently, we include data from this specific session in all of our analyses except where we examine variables that require coded chat data. For variables based on coded chat data, we exclude data from this session.

**EXPERIMENTAL EVIDENCE**

**Hypothesis 1: Trustee Resource Division in *NoInfo-Chat* and *HardInfo-Chat* Economies**

Our first hypothesis is that *NoInfo-Chat* trustees will be able to extract greater private benefits through their resource division decisions than *HardInfo-Chat* trustees. Panel A of Table 1 shows summary statistics on the magnitude of private benefits for *NoInfo-Chat* and *HardInfo-Chat* trustee. The mean and median of the economy-wide average amount returned by the trustee as a percentage of the amount received by the trustee are shown in the first two rows. The economy-wide average percent returned equals the simple average of the percent returned

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\(^{10}\) We had one subject leave the experiment during its administration. Because the data from this session could not be used, we ran an additional session with four new subjects.
by a trustee calculated across all dyad-period combinations for a given economy.\textsuperscript{11} The mean (median) of the eight economy-wide average percent returned equals 45.8% (46.0%) for the \textit{NoInfo-Chat} economies compared to 47.4% (49.3%) for the \textit{HardInfo-Chat} economies.

The lower three rows in panel A of Table 1 show the frequency with which the trustee’s percent return was less than, equal to, or greater than half the amount received. The frequency of observations where the percent returned is less than (equal to) half is 34.1% (57.8%) for \textit{NoInfo-Chat} trustees and 24.9% (65.1%) for the \textit{HardInfo-Chat} trustees. Overall, the summary measures in Panel A of Table 1 suggest that \textit{NoInfo-Chat} trustees return lower amounts to investors than \textit{HardInfo-Chat} trustees, but these differences are not particularly striking.\textsuperscript{12}

Aggregation across periods in Panel A of Table 1 masks important intertemporal changes in trustee return behavior across the two types of economies. Panel B of Table 1 shows that the frequency with which \textit{HardInfo-Chat} trustees send back exactly half of what they receive increases from 15.6\% in period 1 to 68.8\% by period 5, and 93.3\% by period 10. Comparable frequencies for \textit{NoInfo-Chat} trustees show less change across time (37.5\%, 51.7\%, and 62.5\% in periods 1, 5, and 10, respectively). One potential interpretation of this difference is that \textit{HardInfo-Chat} trustees are more likely to adopt a norm of equal resource division as play unfolds.

To directly evaluate whether \textit{NoInfo-Chat} trustees obtain greater private benefits than \textit{HardInfo-Chat} trustees, we estimated the following model, which accounts for differing

\textsuperscript{11} In some cases the investor makes a zero investment. This occurs three times in \textit{NoInfo-Chat} economies and six times in \textit{HardInfo-Chat} economies. We exclude these observations in calculating the economy-wide percent returned.

\textsuperscript{12} Formal statistical tests support this view. A one-tailed Mann-Whitney test comparing the economy-wide average percent returned in the \textit{NoInfo-Chat} and the \textit{HardInfo-Chat} economies does not reject the null of equal distributions at $p < 0.10$. An identical test applied to the economy-wide frequency of returns less than 50\% does reject at $p = 0.046$. 
sensitivities of trustee returns to the realized multiplier across the NoInfo-Chat and HardInfo-Chat economies and over time:

\[
\%\text{RET}_{ijt} = \alpha + \beta_1 \text{INV}_{ijt} + \beta_2 \text{MULT}_{ijt} + \beta_3 \text{PERIOD}_t + \beta_4 \text{MULT}_{ijt} \text{PERIOD}_t + \beta_5 \text{NoInfo-Chat}_{ij} + \\
\beta_6 \text{INV}_{ijt} \text{NoInfo-Chat}_{ij} + \beta_7 \text{MULT}_{ijt} \text{NoInfo-Chat}_{ij} + \beta_8 \text{PERIOD}_t \text{NoInfo-Chat}_{ij} + \\
\beta_9 \text{MULT}_{ijt} \text{PERIOD}_t \text{NoInfo-Chat}_{ij} + \varepsilon_{ijt} \tag{1}
\]

The dependent variable is the percentage of the total received by trustee j in period t that is returned to investor i (%RET_{ijt}). Independent variables include the level of investment by investor i with trustee j in period t (INV_{ijt}), the multiplier realized in period t for the dyad of investor i and trustee j (MULT_{ijt}), the period of the experiment (PERIOD_t), and a 0-1 variable equal to 1 for NoInfo-Chat economies and 0 for HardInfo-Chat economies. We estimate (1) using Ordinary Least Squares with standard errors clustered by trustee. The sample used to estimate equation (1) excludes the nine observations where the trustee did not make a return decision because the investor had invested zero lira.

If NoInfo-Chat trustees try to extract greater private gains than HardInfo-Chat trustees, we expect this effect to be most pronounced for larger multiplier realizations. If a trustee returns a lower share to the investor (i.e., takes a larger share for herself) when the realized multiplier is greater, the coefficient on MULT_{ijt} (\beta_2) will be negative. If the extent to which a trustee takes a greater share for larger multipliers is on average more pronounced in NoInfo-Chat economies, the coefficient on the interaction between MULT and NoInfo-Chat (\beta_7) will be negative. Finally, if NoInfo-Chat trustees’ differential ability to extract private gains widens over time relative to HardInfo-Chat trustees, the coefficient on the interaction between MULT, NoInfo-Chat, and PERIOD (\beta_9) will be negative.

Panel C of Table 1 shows the estimated values of coefficients with corresponding t-statistics and Panel D of Table 1 plots the marginal impact of multiplier variation on the percent
returned as a function of time for the *Hard Info-Chat* economies \([\beta_2 + (\beta_4 \times \text{PERIOD})]\) and *NoInfo-Chat* economies \([(\beta_2 + \beta_7 + (\beta_4 + \beta_9) \times \text{PERIOD})]\). Note first that the coefficient on MULT is reliably negative \((\beta_2 = -0.076, t = -2.86)\). The positive coefficient on the interaction between MULT and *NoInfo-Chat* \((\beta_7 = 0.061)\) suggests that the multiplier effect for *NoInfo-Chat* economies in the first period (equal to \(\beta_2 + \beta_4 + \beta_7 + \beta_9\)) is moderately negative \((= -0.019)\) while the multiplier effect for *Hard Info-Chat* economies in the first period \((\beta_2 + \beta_4)\) is several times larger \((= -0.068)\).

Most importantly, the coefficient on the three-way interaction between MULT, *NoInfo-Chat*, and PERIOD is reliably negative \((\beta_7 = -0.012, p < 0.001)\), which suggests that the effect of the multiplier returns varies with time markedly across the two economies. Panel D of Table 1 shows that by the tenth period, variation in the realized multiplier level is having no discernible impact on trustee return percentage in *Hard Info-Chat* economies (sum of relevant coefficients = 0.004) whereas the return percentage for *NoInfo-Chat* trustees is consistently lower for higher multipliers (coefficient sum = -0.055). This supports our earlier evidence indicating that *Hard Info-Chat* trustees make return decisions that increasingly favor egalitarianism.

An inspection of the chat transcripts indicated that one factor likely contributing to egalitarian resource division was that trustees used chat sessions to make explicit promises about their future returns. While we made no specific predictions about whether and how trustee subjects might use the chat mechanism, prior research suggests that it is plausible that trustees would make explicit promises about their future return decisions to gain the trust of investors (Charness and Dufwenberg 2006). An examination of the chat data indicated that both *NoInfo-Chat* and *Hard Info-Chat* trustees make promises about their future return decisions, but that promises by *Hard Info-Chat* trustees were less likely to be subsequently breached.
To illustrate, a NoInfo-Chat trustee and an investor exchanged the following messages after the first period:

Trustee: if you continue to send me the maximum, I'll continue to send you exactly half of the total earnings
Investor: good i think its better to send the maximum its good for both of us because of the multiplier between a and b
Trustee: agreed
Investor: good

In these messages, the trustee proposes that she will return half of the amount she receives conditional upon the investor investing her entire endowment of ten lira, and the final two messages indicate that they have agreed to behave as proposed.

Panel E of Table 1 indicates that return promises by trustees are pervasive in both the NoInfo-Chat and HardInfo-Chat economies, although they are somewhat less frequent in the latter. The typical agreement requires the investor to invest her full endowment and the trustee to send back half of the total received to the investor (i.e., “invest all and split 50-50”).

Panel E of Table 1 shows trustee compliance rates. We define a compliant trustee return as one where the trustee returns an amount greater than or equal to what she has promised under the agreement in force at the start of that period. The mean economy-wide trustee compliance rate is 74.7% for NoInfo-Chat economies and 96.1% for HardInfo-Chat economies (significant at p < 0.001 for a one-tailed Mann-Whitney test). While NoInfo-Chat trustee compliance is negatively associated with realized multiplier levels, it is still noteworthy that

13 Four of the five cases where HardInfo-Chat trustee promises were not made occurred in a single session. This suggests that trustee promises are not independent across dyads.
14 Trustee return promises are often made in the first chat period possible and usually take the form of “invest 10 and split 50-50” in both initial and final agreements. Revisions to agreements occurred in approximately 5% of the periods where a prior agreement was in force.
15 Compliance frequency by HardInfo-Chat trustees also often included promises to provide hard information. Of the 28 HardInfo-Chat dyads with chat data available for all ten periods, 18 dyads discussed hard information provision. Trustees initiated 11 of these 18 discussions. Discussions about hard information provision occurred in the majority of cases during the same periods that subjects were proposing agreements (15 of 18, or 83%).
compliance is still non-trivial for these trustees – e.g., NoInfo-Chat trustees adhere to a prior promise in 48% of the cases when the realized multiplier equals five.

Overall, the evidence in Table 1 is consistent with our first hypothesis that NoInfo-Chat trustees use their information advantage to extract greater private gains by returning lower amounts when the realized multiplier is higher. This differential also grows in later periods of the experiment suggesting that HardInfo-Chat trustees’ returns exhibit a norm of egalitarianism. In part, this occurs because HardInfo-Chat trustees make and subsequently adhere to promises to share resources equally.

**Hypothesis 2: NoInfo-Chat Trustee Concealment Strategies**

Our second hypothesis is that NoInfo-Chat trustees will be more likely than HardInfo-Chat trustees to strategically conceal self-dealing through ambiguous return decisions and potentially deceptive soft communication. This prediction implicitly assumes that HardInfo-Chat trustees actually choose to provide hard information to their partners, which in fact is the case (HardInfo-Chat trustees provide hard information to investors in 87.2% of the 320 periods).

Our tests of hypothesis 2 require first that we define an “ambiguous return.” Our construct for ambiguous return is a return by the trustee where the investor would more likely be led to a false belief (based solely on the amount returned) that the multiplier was lower than it actually was. This requires a benchmark for what the investor expects the trustee to return and that the amount returned implies a multiplier that is both feasible (i.e., a whole number) and lower than that actually realized.

To illustrate, assume that the investor has invested all ten lira in a given period, the realized multiplier is equal to 5, and the investor expects the trustee to equally divide the

---

16 As a benchmark, the frequency of hard information provision by HardInfo trustees equals 73.4%.
amount that she receives. Suppose the trustee actually returns 22 lira to the investor. The multiplier implicit in the trustee’s return equals 4.4 (i.e., \((22 \times 2)/10\)). This implicit multiplier is lower than the actual multiplier of 5, but it is infeasible since the multiplier is constrained to be a whole number. In contrast, a return of 20 lira implies a feasible realized multiplier of 4. We define an ambiguous return as one where the trustee has returned an amount that implies a feasible multiplier that is lower than that actually realized under the assumption that the investor expects that the trustee to send back half of the total amount she received.\(^{17}\)

We calculated the frequency of ambiguous returns for a given economy as the number of trustee returns that meet the definition of an ambiguous return divided by the number of non-zero investments made across all dyad-period observations for that economy. For the eight \textit{NoInfo-Chat} economies, the percentage of ambiguous returns ranged from a high 47.5\% to a low of 8.1\% with an average of 22.6\% (see Panel A of Table 2). The same calculation for the eight \textit{HardInfo-Chat} economies showed a maximum of 21.6\%, a minimum of 0.0\%, and a mean of 7.1\%. The difference in the frequency of ambiguous returns across the two types of economies is significant at \(p = 0.003\) using a one-tailed Mann-Whitney test.\(^{18}\)

Interestingly, ambiguous returns made by \textit{NoInfo-Chat} trustees typically represent a “skimming” of profits rather than taking the maximum possible. For instance, assume a \textit{NoInfo-Chat} investor sends 10 lira to the trustee, the realized multiplier equals 5, and the \textit{NoInfo-Chat} trustee seeks to induce a belief by the investor that half was returned. If so, the \textit{NoInfo-Chat} trustee could send back 5 lira to the investor and claim that the realized multiplier had been 1. Alternatively, the trustee could take only half the maximum possible by sending back 15 lira to the investor and claiming that the multiplier equaled 3. This alternative may be advantageous in

---

\(^{17}\) Assuming that the investor expects the trustee to return half the amount received is consistent with the promises typically made by trustees (see Panel E of Table 1).

\(^{18}\) Comparable mean frequencies of ambiguous returns for the \textit{NoInfo} and \textit{HardInfo} economies are 21.7\% and 25.8\%, respectively.
that the trustee still obtains greater private benefits (compared to an equal division) while likely causing less suspicion by the investor that the gains had been divided gains unequally.\footnote{Skimming is a form of subtle cheating that is harder to detect. Subtle cheating has been asserted to be a widespread feature of human behavior (Trivers 1971, 46-47).}

For the 72 ambiguous returns made by \textit{NolInfo-Chat} trustees, we calculate the percentage skim as the difference between the realized and implicit multipliers divided by the difference between the realized multiplier and 1. To illustrate, assume again a realized multiplier of 5, an investment of ten \textit{lira}, and a return by the trustee of 15 \textit{lira} (i.e., an implicit multiplier of 3). In this case, the percentage skim is the difference between the implicit and actual multipliers (5 – 3) divided by the difference between the actual multiplier and the minimum possible implicit multiplier of 1, or 50\% \left[ (5 - 3) / 5 - 1 \right]. Panel B of Table 2 shows that the mean/median/mode percentage skim equals 48.6\%/50.0\%/50.0\% for the 72 ambiguous returns observed in the \textit{NolInfo-Chat} economies. In other words, \textit{NolInfo-Chat} trustees are on average taking about half of the maximum they could take and still maintain plausible deniability by falsely claiming a realized multiplier of 1.\footnote{Examining only cases where the actual multiplier was equal to 3, 4, or 5 illustrates more clearly the choices made by \textit{NolInfo-Chat} trustees in skimming returns. In these 69 cases, \textit{NolInfo-Chat} trustees choose an implicit multiplier of one only 6 times (8.7\%). That is, they elected to take the maximum possible in less than one in ten cases.}

We next investigated the extent to which \textit{NolInfo-Chat} trustees used chat to potentially manipulate investor beliefs about the realized multiplier. A direct comparison of soft communication by \textit{NolInfo-Chat} and \textit{HardInfo-Chat} trustees is likely meaningless since the provision of hard information by a \textit{HardInfo-Chat} trustee renders the disclosure of multipliers through chat superfluous.\footnote{Consistent with this, specific multiplier disclosures occurred in 15.1\% of the chat periods for \textit{HardInfo-Chat} economies compared to 45.5\% of the chat periods for \textit{NolInfo-Chat} economies.} Consequently, we focus this analysis on how soft disclosure of realized multipliers during chat by \textit{NolInfo-Chat} trustees varies as a function of the realized multiplier. We expect that \textit{NolInfo-Chat} trustees will be more likely to make no specific multiplier
disclosure or make an inaccurate multiplier disclosure during chat when the realized multiplier is larger.\textsuperscript{22}

Conducting this test requires that we identify specific instances in the chat transcripts where NoInfo-Chat trustees make a statement about the realized multiplier for the period just completed. During any given chat session, a trustee faces a choice between three types of soft disclosure: (1) no statement about the realized multiplier or a statement lacking as to the specific value realized, (2) an accurate statement about the realized multiplier, or (3) an inaccurate statement about the realized multiplier.

The following is an example of the first type where a NoInfo-Chat trustee mentions the multiplier in chat after the fifth period, but provides no specific statement about its level:

Investor: this one was a little better
Trustee: snif this round I good 😊...
Investor: aaww😊
Trustee: lol
Trustee: we need luck
Trustee: lol
Investor: I I I decreased the amount for you, maybe its your multiplier
Trustee: yup I dotn know lol
Trustee: he is not working for me this multiplier
Trustee: lol
Investor: its in a bad mood lol

The following messages are illustrative of an accurate multiplier disclosure:

Trustee: I got exactly 7 from you. Nothing multiplied. But it was more generous!
Investor: what?
Investor: you got only 7?
Investor: ok so it got multiplied by one
Trustee: You sent 7 right?
Trustee: Yeah, A1 sent me 6 and it was also only multiplied by 1.
Investor: yes, i sent 7
Trustee: Yeah... times one.
Investor: I'll sent 7 this time again

\textsuperscript{22} Hauser (1997) describes information manipulation in support of deception as occurring either through advantageous silence or outright misrepresentation.
The following is an example of inaccurate disclosure by a NoInfo-Chat trustee:

Trustee: no luck this time multiplier 1
Investor: It’s OK
Investor: I trust you
Investor: 'And now we have a mutual trust exercise' - Ali G indahouse
Investor::)
Investor: I sent this to the other receiver too
Trustee: perfect
Trustee: trust is the most important thing

This disclosure is inaccurate in that the trustee explicitly states that the realized multiplier equaled one when in fact it equaled three. Further, the trustee returned 10 lira, which likely induced the investor to falsely believe that the trustee was generous by returning the investor’s entire investment and keeping nothing for herself.

Panel C of Table 2 shows that the combined frequency of non-disclosure and inaccurate disclosure by NoInfo-Chat trustees is generally increasing in the realized multiplier.\textsuperscript{23} When the multiplier realization equals one, the mean economy-wide percentage of chat periods where no multiplier disclosure or a false disclosure is made equals 36.4%. In contrast, when the multiplier equals the maximum of five, the mean economy-wide percentage of chat periods with non-disclosure or a false disclosure equals 76.0%. A one-tailed Mann-Whitney test comparing the economy-wide mean frequencies of non-disclosure and inaccurate disclosures between low multipliers (values of 1 and 2) and high multipliers (values of 4 and 5) indicates that this difference is significant at $p = 0.001$.

To summarize, the evidence in Table 2 supports our second hypothesis that NoInfo-Chat trustees try to strategically conceal self-dealing. They are more likely to make ambiguous returns when taking larger personal gains and these returns represent profit skimming rather than taking the maximum amount possible. Further, NoInfo-Chat trustees are more likely to

\textsuperscript{23} Consistent with the notion that inaccurate disclosure supports trustee decisions to extract greater private gains, all but one of the inaccurate disclosures was lower than the realized multiplier. This one case was likely a mistake by the trustee that generated multiple messages to correct the mistake.
remain silent about the realized multiplier or make inaccurate disclosures when the realized multiplier is larger.

**Hypothesis 3: Social Gains in NoInfo-Chat and HardInfo-Chat Economies**

Social gains in the investment-trust game derive entirely from the willingness of an investor to invest resources that will be subject to multiplication. This depends on whether the investor trusts that her partner will share the gains from trade that arise from multiplication. Our third hypothesis is that the potential for self-dealing by NoInfo-Chat trustees fosters skepticism by NoInfo-Chat investors leading to lower overall investment in NoInfo-Chat economies than in HardInfo-Chat economies.

Observed differences in investment level (as a percentage of endowment) across the NoInfo-Chat and HardInfo-Chat economies do not support our third hypothesis (see Panel A of Table 3). The mean (median) percentage of endowment invested for the eight NoInfo-Chat economies equals 88.1% (92.9%) compared to 85.5% (87.8%) for the eight HardInfo-Chat economies (difference is not significant at $p < 0.10$). The roughly equal investment in NoInfo-Chat economies and HardInfo-Chat economies does not extend to a comparison between NoInfo economies and HardInfo economies. The mean (median) percentage of endowment invested for the eight NoInfo economies equals 47.7% (48.0%) compared to 65.3% (65.0%) for the eight HardInfo economies (difference significant at $p = 0.014$). This evidence suggests that hard information availability increases investment only in the absence of the chat mechanism.

Panel B of Table 3 plots the percentage of endowment invested for each type of economy by period. This plot shows that the high investment levels in the NoInfo-Chat and HardInfo-Chat economies are sustained throughout the experiment. These economies as well the HardInfo economies show total investment in period 1 of approximately 60% of total
endowment compared to about 45% for the NoInfo economies. The NoInfo-Chat and HardInfo-Chat economies show large increases in investment after the first period whereas the HardInfo and NoInfo economies mean percent invested show no material increase.

These results suggest that NoInfo-Chat trustees are able to secure and sustain the trust of their investor partners even though they engage in and conceal self-serving resource allocations. This naturally raises the question of how NoInfo-Chat trustees accomplish this. In part, this may be related to NoInfo-Chat trustees’ promises about future returns. It may also be due in part to NoInfo-Chat trustees’ decisions to skim profits rather than trying to extract the maximum possible private benefit. If so, the effect of profit skimming might still leave overall returns to NoInfo-Chat investors that are sufficient to sustain their repeated high investment levels.

We compared overall returns earned by NoInfo-Chat investors with those of HardInfo-Chat investors. We calculated the rate of return on endowment (ROE$_{ijt}$) earned by investor $i$ with trustee $j$ in period $t$ as the sum of the amount received from the trustee plus any amount that the investor did not send to the trustee less the initial endowment of ten $lira$, all divided by the initial endowment of ten $lira$. The average economy-wide mean ROE for each of the eight NoInfo-Chat economies is calculated by taking the simple average of ROE across all 40 dyad-period observations.

Panel C of Table 3 indicates that the average (median) of the economy-wide mean per-period ROE across the eight NoInfo-Chat economies equals 30.3% (32.8%). This is somewhat lower than the mean (median) of 32.5% (40.0%) for the eight HardInfo-Chat economies, but the difference in ROE across the two types of economies is not statistically distinguishable from zero. A similar result holds in a comparison between the NoInfo and HardInfo economies (means
of 11.2% and 13.3%, respectively), even though investor ROEs in both the NoInfo and HardInfo economies are substantially lower than in the NoInfo-Chat and HardInfo-Chat economies.

To summarize, the evidence does not support our third hypothesis that the potential for trustee self-dealing leads to greater mistrust, and hence lower investment, by NoInfo-Chat investors compared to HardInfo-Chat investors. This is likely due to behavior by NoInfo-Chat trustees where they strategically conceal self-dealing and provide sufficient returns to NoInfo-Chat investors to sustain continuing investment.

CONCLUSIONS AND SUGGESTIONS FOR FUTURE RESEARCH

The experiment presented in this paper provides a unique glimpse into how resource sharing, communication, and social gains from exchange are affected by the presence of hard information on economic outcomes. The economic role of hard information is a central issue given the long historical quest to harden accounting information across the millennia and make them more reliable (Basu and Waymire 2006; Dickhaut et al. 2010). Our contribution is to directly compare how resource allocation, communication, and social gains from exchange vary between a world where hard information and direct communication are possible and a counterfactual world where hard information is not available.

Our experimental evidence lends support for the view that hard information powerfully shapes economic exchange in ways that are likely not apparent on the surface. First, it can alter resource allocation by fostering the emergence of norms favoring more egalitarian resource division. In this sense, “fair” resource allocations are the result of accountability in settings characterized by potential conflicts among actors with differing objectives (Ijiri 1983). More importantly, hard information fosters accountability because it removes the shroud of opacity made possible by uncertainty and exploited through strategic actions that conceal self-dealing.
At the same time, the benefits from long-term interaction provide a powerful incentive for actors to constrain self-dealing so as to sustain the trust of their trading partners. This suggests that information manipulation and self-dealing can be widespread, and still have relatively modest effects on social welfare.

The issues addressed in this paper are foundational for modern accounting. Our understanding of accounting foundations can be further improved by additional research that addresses (1) crisper identification of the boundary conditions under which economic interaction cannot be sustained in the absence of hard information, (2) the process by which accounting data evolves from soft information into hard information, and (3) the role of hard information in supporting multi-period interactions characterized by permanent capital investment like that undertaken by the modern corporation. Extensions to our experiment can provide important evidence about how the evolution from simple economies into complex economies is associated with economic institutions that promote trust and sustain beneficial economic interaction.
References


FIGURE 1
Multi-Dyad Investment-Trust Game with Uncertainty

Panel A: Each economy consists of four persons, two of whom are assigned to be investors and two to be trustees. Each investor receives an endowment of ten monetary units to invest with Trustee 1 and another ten units to invest with Trustee 2 each period.

Panel B: Each period of play begins by endowing the investor with ten monetary units that can be sent to the trustee in whole numbers ranging from zero to ten units. Any amount invested is subject to multiplication at a rate $\lambda$ that ranges from 1 to 5 in whole numbers. The trustee receives an amount equal to $\lambda$ times investment ($X$), and then decides how much to keep ($M$) and how much to return to the investor ($\lambda X - M$). (C) The investor does not know the multiplier or the amount retained by the trustee. The trustee likewise does not directly observe the realized multiplier or the amount invested by the investor although that can be inferred in many cases.
TABLE 1
Characteristics of Trustee Resource Sharing Decisions

A: Economy-Wide Measures of % Returned by Trustees
Economy-Wide Average % Sent Back by Trustee

<table>
<thead>
<tr>
<th></th>
<th>NoInfo-Chat</th>
<th>HardInfo-Chat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>45.8%</td>
<td>47.4%</td>
</tr>
<tr>
<td>Median</td>
<td>46.0%</td>
<td>49.3%</td>
</tr>
<tr>
<td>% &lt; 50%</td>
<td>34.1%</td>
<td>24.9%</td>
</tr>
<tr>
<td>% = 50%</td>
<td>57.8%</td>
<td>65.1%</td>
</tr>
<tr>
<td>% &gt; 50%</td>
<td>8.0%</td>
<td>10.0%</td>
</tr>
</tbody>
</table>

B: % of Cases Exactly = 1/2 by Period

C: Regression Analysis of the Sensitivity of NoInfo-Chat Trustees
Returns to the Realized Multiplier
Dependent Variable: %RET_{jt}

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Coefficient (t-statistic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant ((\alpha))</td>
<td>0.590 (4.74)</td>
</tr>
<tr>
<td>Investment ((\beta_1))</td>
<td>0.013 (2.31)</td>
</tr>
<tr>
<td>Multiplier ((\beta_2))</td>
<td>-0.076 (-2.86)</td>
</tr>
<tr>
<td>Period ((\beta_3))</td>
<td>-0.024 (-2.29)</td>
</tr>
<tr>
<td>Multiplier*Period ((\beta_4))</td>
<td>0.008 (2.47)</td>
</tr>
<tr>
<td>NoInfoChat ((\beta_5))</td>
<td>-0.181 (-1.19)</td>
</tr>
<tr>
<td>Investment* NoInfoChat ((\beta_6))</td>
<td>-0.001 (-0.16)</td>
</tr>
<tr>
<td>Multiplier* NoInfoChat ((\beta_7))</td>
<td>0.061 (2.08)</td>
</tr>
<tr>
<td>Period* NoInfoChat ((\beta_8))</td>
<td>0.033 (2.50)</td>
</tr>
<tr>
<td>Multiplier<em>Period</em> NoInfoChat ((\beta_9))</td>
<td>-0.012 (-2.79)</td>
</tr>
<tr>
<td>N</td>
<td>631</td>
</tr>
<tr>
<td>Adjusted R^2</td>
<td>0.151</td>
</tr>
</tbody>
</table>

D: Effect of Realized Multiplier by Period
Table 1 (cont.)

<table>
<thead>
<tr>
<th>E: Frequency of Trustee Promises &amp; Compliance Rates</th>
<th>NoInfo-Chat</th>
<th>HardInfo-Chat</th>
</tr>
</thead>
<tbody>
<tr>
<td># Dyads Where Promise Made</td>
<td>31 of 32 (97%)</td>
<td>23 of 28 (82%)</td>
</tr>
<tr>
<td># “Invest All &amp; Split 50-50”</td>
<td>28 of 31 (90%)</td>
<td>16 of 23 (70%)</td>
</tr>
<tr>
<td>Average Economy-Wide % Compliance Rate</td>
<td>NoInfo-Chat</td>
<td>HardInfo-Chat</td>
</tr>
<tr>
<td>Mann-Whitney p-value (one-tailed)</td>
<td>74.7%</td>
<td>96.1%</td>
</tr>
</tbody>
</table>

NoInfo-Chat Trustee Compliance Rates by Multiplier

<table>
<thead>
<tr>
<th>Multiplier</th>
<th>Compliance Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100.0% (53 of 53)</td>
</tr>
<tr>
<td>2</td>
<td>88.1% (37 of 42)</td>
</tr>
<tr>
<td>3</td>
<td>75.0% (39 of 52)</td>
</tr>
<tr>
<td>4</td>
<td>67.3% (35 of 52)</td>
</tr>
<tr>
<td>5</td>
<td>48.3% (28 of 58)</td>
</tr>
</tbody>
</table>

Panel A: The first two rows show the mean and median of the economy-wide percent sent back by trustees in the NoInfo-Chat and the HardInfo-Chat economies. The percent sent back by trustee j in period t is the amount sent by the trustee to investor i divided by the total previously received by the trustee (equal to investment times the realized multiplier). The economy-wide average of this measure is the simple average across all dyad-period observations for a particular run of the economy. The next three rows show the total percentage of cases where the trustee sends back an amount less than/equal to/greater than half of what was received.

Panel B: This plot shows the percentage of observations in the NoInfo-Chat and the HardInfo-Chat economies where the trustee sent back exactly half of what was received for each period of the experiment ranging from 1 to 10.

Panel C: This panel provides coefficient estimates based on the following model:

\[
\%\text{RET}_{ijt} = \alpha + \beta_1 \text{INV}_{ijt} + \beta_2 \text{MULT}_{ijt} + \beta_3 \text{PERIOD}_t + \beta_4 \text{MULT}_{ijt} \text{PERIOD}_t + \beta_5 \text{NoInfo-Chat}_{ijt} + \beta_6 \text{INV}_{ijt} \text{NoInfo-Chat}_{ijt} + \beta_7 \text{MULT}_{ijt} \text{NoInfo-Chat}_{ijt} + \beta_8 \text{PERIOD}_t \text{NoInfo-Chat}_{ijt} + \beta_9 \text{MULT}_{ijt} \text{PERIOD}_t \text{NoInfo-Chat}_{ijt} + \epsilon_{ijt}
\]

\%\text{RET}_{ijt} is the percentage returned to investor i by trustee j in period t, INV_{ijt} equals the level of investment by investor i with trustee j in period t, MULT_{ijt} is realized multiplier in period t for the dyad of investor i and trustee j, PERIOD_t is the period of the experiment, and NoInfo-Chat_{ijt} is a 0-1 variable equal to 1 for NoInfo-Chat economies and 0 for HardInfo-Chat economies. The model is estimated using OLS with standard errors clustered by trustee applied to the full sample excluding nine observations where the trustee did not make a return because the investor had invested zero lira.

Panel D: This figure plots how the realized multiplier affects the percent returned as PERIOD increases from 1 to 10 for the NoInfo-Chat economies \([\beta_2 + (\beta_4 \times \text{PERIOD})]\) and HardInfo-Chat economies \([\beta_2 + \beta_7 + ((\beta_4 + \beta_9) \times \text{PERIOD})]\).

Panel E: The uppermost section of this panel shows the frequency with which trustees make future return promises to investors and the frequency with which these promises are reciprocal and of the form “invest all & split 50-50.” The middle part shows average economy-wide compliance rate by trustees for NoInfo-Chat and the HardInfo-Chat economies. The bottom portion shows NoInfo-Chat trustee compliance rates as a function of the realized multiplier.
Table 2
Differences in Trustee Return Ambiguity and Information Manipulation in NoInfo-Chat and HardInfo-Chat Economies

A: Average of Economy-Wide Percentage of Ambiguous Returns in NoInfo-Chat and HardInfo-Chat Economies

<table>
<thead>
<tr>
<th></th>
<th>NoInfo-Chat (n=8)</th>
<th>HardInfo-Chat (n=8)</th>
<th>Mann-Whitney p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average of Economy</td>
<td>22.6% (n = 72 total)</td>
<td>7.1% (n = 22 total)</td>
<td>0.003</td>
</tr>
<tr>
<td>Wide Percentage of</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambiguous Returns</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B. Extent of Skimming by NoInfo-Chat Trustees

<table>
<thead>
<tr>
<th></th>
<th># Cases of Ambiguous Returns</th>
<th>% Skim (Max = 100%)</th>
<th>Mean/Median/Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>72</td>
<td></td>
<td>48.6%/50.0%/50.0%</td>
</tr>
</tbody>
</table>

C. Economy-Wide Frequency of Non-Disclosure and Inaccurate Disclosure for NoInfo-Chat Trustees by Multiplier

<table>
<thead>
<tr>
<th></th>
<th>Mult = 1</th>
<th>Mult = 2</th>
<th>Mult = 3</th>
<th>Mult = 4</th>
<th>Mult = 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Disclosure</td>
<td>36.4%</td>
<td>47.1%</td>
<td>59.7%</td>
<td>66.5%</td>
<td>63.7%</td>
</tr>
<tr>
<td>Inaccurate Disclosure</td>
<td>0.0%</td>
<td>7.0%</td>
<td>8.0%</td>
<td>14.1%</td>
<td>12.2%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>36.4%</td>
<td>48.7%</td>
<td>67.7%</td>
<td>80.6%</td>
<td>75.9%</td>
</tr>
</tbody>
</table>

Mann-Whitney p-value

<table>
<thead>
<tr>
<th></th>
<th>Mult 1 or 2</th>
<th>Mult 4 or 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall %</td>
<td>44.3%</td>
<td>77.1%</td>
</tr>
<tr>
<td>value</td>
<td></td>
<td>0.001</td>
</tr>
</tbody>
</table>

Panel A: The first two rows show the mean economy-wide percentage of ambiguous trustee returns in NoInfo-Chat and the HardInfo-Chat economies. An ambiguous return is one where the trustee returns an amount that implies a feasible multiplier that is lower than that actually realized under the assumption that the investor expects that the trustee to send back half of the total amount she received.

Panel B: This panel shows the mean, median, and mode amount of “skim” inherent in the 72 ambiguous returns by NoInfo-Chat trustees. The percentage skim is the difference between the implicit and actual multipliers divided by the difference between the actual multiplier and the minimum possible implicit multiplier of 1. The implicit multiplier equals twice the amount sent back by the trustee divided by the investor’s investment.

Panel C: This panel shows the incidence of both non-disclosure and inaccurate disclosure of multipliers during chat periods for NoInfo-Chat economies. Frequencies are shown according to the multiplier realized in the period just completed.
TABLE 3
Total Investment and Investor Returns in Alternative Economies

A: Economy-Wide Average Per-Period Investment

<table>
<thead>
<tr>
<th></th>
<th>NoInfo-Chat</th>
<th>HardInfo-Chat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>88.1%</td>
<td>85.5%</td>
</tr>
<tr>
<td>Median</td>
<td>92.9%</td>
<td>87.8%</td>
</tr>
<tr>
<td>p-value Mann-Whitney (one-tailed)</td>
<td>ns at p ≤ 0.05</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>NoInfo</th>
<th>HardInfo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>47.7%</td>
<td>65.3%</td>
</tr>
<tr>
<td>Median</td>
<td>48.0%</td>
<td>65.0%</td>
</tr>
<tr>
<td>p-value Mann-Whitney (one-tailed)</td>
<td>0.014</td>
<td></td>
</tr>
</tbody>
</table>

B: Investment by Period

Panel A: The first half of the panel shows the mean and median investment as a % of endowment for the eight NoInfo-Chat economies and the eight HardInfo-Chat economies. The lower part of the panel is identical except that it applies to the eight NoInfo economies and the eight HardInfo economies.

Panel B: This plot shows the average percentage of endowment invested for each type of economy (NoInfo-Chat, HardInfo-Chat, NoInfo, and HardInfo) by period.

Panel C: The first half of the panel shows the mean and median of investor ROE across the eight NoInfo-Chat economies and the eight HardInfo-Chat economies. Investor ROE for a given dyad-period observation is the amount sent back by the trustee plus the amount not invested initially divided by the initial endowment less one. The Mann-Whitney test is applied to eight specific values for the two types of economies. The lower part of the panel is identical except that it applies to the eight NoInfo economies and the eight HardInfo economies.
APPENDIX

Experiment Instructions for HardInfo-Chat Economy

Introduction
You have been invited to participate in a decision making experiment. This experiment will last approximately two hours. During today’s session, you will earn income in an experimental currency called Lira. At the end of the session, this currency will be converted to dollars at a rate of $0.04 (4 cents) per Lira, and you will be paid in cash. In addition to this income, you will also receive a show-up fee of $10.

Please read these instructions very carefully. You will be required to complete a quiz, in order to demonstrate that you have a complete and accurate understanding of these instructions. After you have completed the quiz, the administrator will check your answers and discuss with you any questions that have been answered incorrectly.

You are free to withdraw from the experiment at any time, for any reason. If you choose to do so, please raise your hand. In this case, you will be paid your $10 show-up fee as you leave.

Session Overview
This session will be run entirely over the computer. Please do not talk with any of the other participants. If you have a question, you may raise your hand, and the administrator will answer the question privately.

Roles and Procedures
Every participant will be assigned to the role of either an A-player or a B-player. You will be organized into groups of 4 players, consisting of 2 A-players and 2 B-players. Each A-player in the group will be simultaneously paired with the 2 B-players in the group. Similarly, each B-player will be simultaneously paired with the 2 A-players. For example, if the 2 A-players in a group are designated A1-A2, and the 2 B-players are designated B1-B2, the following diagram demonstrates all pairings in the group.

```
  A-Players          B-Players
   A1 -- X -- B1
     |     |     |
     | X   |     |
     |     |     |
   A2 -- X -- B2
```

These roles will be completely anonymous. That is, you will know your own role, but you will not know the role of any other participant.

You will be asked to make decisions in a number of identical rounds. Each round proceeds through five stages. In Stage 1, each B-player decides whether private information will get revealed to each A-player. In Stage 2, each A-player receives an endowment of 10 liras per B-player. The A-player then decides how many of the 10 lira to send to each B-player. In Stage 3, the amount sent by each A-player is multiplied. These multiplied amounts are received by each
of the B players. B players then decide how much to return to each A player. In Stage 4, the A and B players are told their payoffs. In Stage 5, the players can chat with each other.

**Stage 1 – B-Players’ Disclosure Decisions**
In Stage 1, B-Players will have the choice of deciding whether they want to let the A players receive the same information that the B players will see. B players will see the following:

**Screen 1**

Each B-player may click either ‘Yes’ or ‘No’ for each of the 2 A-players he is paired with.

**Stage 2 – A-Players’ Decisions**
Each A-player sees the decisions made in Stage 1 by the B-players he is paired with.

Each A-player also receives an initial endowment of 10 Lira for each paired B-player. That is, each A-player will receive 10 Lira for B1 and 10 Lira for B2, for a total of 20 Lira.
In the second stage, each A-player will be prompted by the computer to decide how much of the initial endowment to keep and how much to send to a paired B-player. For example, A1 will decide what amount (from 0 to 10 Lira) to send to B1. Similarly, A1 will decide what amount to send to B2. The amount sent will always be in whole Lira. The A-Player will keep any money s/he has not sent to each B-Player.

The A-Player’s Stage 2 decision will be entered on the Screen 2, pictured below.

![Screen 2](image-url)

**Stage 3 – B-players’ Decisions**

For every pair of players, the amount sent by the A-Player is multiplied by 1 or 2 or 3 or 4 or 5 (referred to as ‘the multiplier’) before the B-Player receives it. Each B player will see the following screen (namely, Screen 3). Please note that different multipliers may be applied to different amounts sent. For each pair, every multiplier is equally likely in each round.
The B-player decides how much of the total amount to return to each A-player. Thus, each B-Player will send 2 amounts (from 0 to the total amount received) to the 2 different A-Players. The amount returned will always be in whole Lira.

The B-Player’s Stage 3 decisions will be entered on Screen 3, pictured above.

**Stage 4 - Disclosure and Payoffs**

In each round, each A-Player’s payoff will be the sum of the 2 total amounts that s/he did not send to the B-Players plus the sum of the 2 amounts returned by the B-Players.

In each round, each B-Player’s payoff will be the sum of the 2 total amounts that s/he received minus the sum of the 2 amounts s/he returned to each of the A-Players.

Following each round, each A-Player will receive the information presented on Screen 4, pictured below.
Following each round, each B-Player will receive the information presented on Screen 5, pictured below.
Screen 5

**Stage 5 - Chat Box**
After payoffs are shown, each A player will be able to chat privately with each of the 2 B players and each B player will be able to chat privately with each of the 2 A players. The chat will last for 3 minutes.

Do not use any profanities and do not disclose your name or any other personal information during the chat. You may type your message in the ‘Type Message’ box and then click send to send your message. The ‘Chat Window’ will show the messages send and received by you.
For instance, the chat screen of player A1 will appear as pictured in Screen 6 above. The ‘Message Window’ will be on your screen in Stages 1 through 4 also. However, you will be able to use this ‘Message Window’ for chatting only in Stage 5. (In Screen 6, ‘G’ indicates your group. For example, G1 means Group 1, G2 means Group 2, G3 means Group 3, and so on. You may ignore this.)

Completion of Rounds
After completing each round, the computer will proceed to the next round, which will be conducted identically to the previous round.

Once all rounds have been completed, you will be paid your cumulative income.

Summary
The following timeline summarizes what will happen in each round of the experiment:
Please answer the following questions. In a few minutes, the administrator will check your answers and discuss with you any questions that have been answered incorrectly.

1. How many B-players will each A-player be paired with?

2. How many liras will each A-player receive for each B-player that s/he is paired with?

3. Will the amount sent by an A-player to a B-player be multiplied en route before it reaches the respective B-player (Yes / No)?

4. Is each multiplier equally likely for each pair in each round (Yes / No)?

5. Suppose player A1 sent to player B1 6 liras and then received from B1 10 liras. What will be player A1’s profit from the pairing with B1?

6. Suppose player A2 sent 3 liras to player B2. Player B2 received 9 liras and sent back 2 liras to player A2. What will be Player B2’s profit from pairing with A1?

7. The Message Window will be on your screen through Stages 1-5. What are the stages in which you can chat?