

# **Leadership, Information Transmission and Group Size**

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## **Abstract:**

We consider an information based model of leadership in an environment where the free riding problem and coordination failures prevent efficient group cooperation. Leaders are leaders merely by occupying the leadership position and their legitimacy comes from superior information (about the value of the project in hand). When the project is beneficial to the group, the leader sends a discrete and costly signal to persuade cooperation. One key feature is that the signal is only partially revealing: it sends some positive information about the project in hand but does not reveal the exact value of the project. Followers follow the leader only if they trust him, and they trust him only if the discrepancy between their incentives and those of the leader is not too large. Otherwise, followers will expect to be led often into circumstances that they individually prefer to avoid and thus will react by ignoring the leader's signal. This discrepancy grows as group size increases. On one hand, leaders become more pivotal in larger groups and thus eager to participate. On the other hand, followers become more marginal in larger groups and thus more eager to free ride. Followers will mistrust the leaders when their incentives diverge too much. Under these circumstances, leaders' encouraging signals become too weak to overcome the followers' strong incentives to free ride.

Keywords: Leadership, Information, Incentives, Trust, Group size.

## I. Introduction

Leadership has been long studied in management and political science but has only recently received attention in economics<sup>1</sup>. Notable examples are Hermalin (1998; 2007), Wilson and Rhodes (1997), Foss (2001), Arce (2001), Rotemberg and Saloner (1993; 2000), Meidinger and Villeval (2002), Romano and Yildirim (2001), Moxnes and Van Der Heijden (2003), Guth, Levati, Sutter, and Van Der Heijden (2007), Vesterlund (2003), Andreoni (2006), Kobayashi and Suehiro (2005), Huck and Biel (2006), Potters, Sefton, and Vesterlund (2005, 2006), and Brandts, Cooper, and Fatas (2006)<sup>2</sup>. In some of these articles leaders are simply first movers with visible actions<sup>3</sup>. In the others, leaders' legitimacy arises from superior information. For example, Hermalin (1998) suggests that followers voluntarily follow a leader because followers believe that the leader has better information about what they should do than they themselves have. Thus leadership is partly about transmitting information. Hermalin considers a team leader who has private information about the return to the projects, and whose payoffs increase in his follower's effort. He suggests that the leader can induce a following by "leading by example", meaning that the leader, to convince his followers that the project is worthwhile, increases observable effort when the return is high. In Hermalin's model the leader's effort fully reveals his information, but the leader-follower equilibrium produces more efficient outcomes than does the equilibrium under full information, mainly because it improves the leader's incentives to work<sup>4</sup>.

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<sup>1</sup> Stackelberg (1934) is an early exception.

<sup>2</sup> Also KSH, Komai and Stegeman (2007, KS2007 hereafter), KS2004, and KGD.

<sup>3</sup> Some examples are Romano and Yildirim (2002), Moxnes and Van Der Heijden (2003), and Guth, Levati, Sutter, and Van Der Heijden (2003).

<sup>4</sup> Vesterlund (2003) applies Hermalin's idea to a model of charitable contributions, but in her model the leader chooses whether to acquire information before deciding whether to contribute. Vesterlund focuses on whether a third player, a fundraiser who moves first, chooses to announce that the leader's contribution will be public. Andreoni (2006) builds on Vesterlund's (2003) model by endogenizing the selection of the leader. Vesterlund's and Andreoni's leaders, like Hermalin's, fully reveal their information.

Komai, Stegeman, and Hermalin (2007, KSH hereafter) studies a team production problem in which the leader leads by example but his information is only partially revealed by his effort. By preventing full revelation of the state, the followers are induced to work harder than they would were the leader's action to reveal the state fully. The article sheds light on the reasons for a leader, and takes the contrarian view that concentrating information in the hands of a leader and lack of information transparency can improve efficiency versus a regime of information dispersal.

KSH make the assumption that utility is linear in actions, which implies that players' action set is binary, and that followers do not care whether others participate.<sup>5</sup> By studying non-linear utility functions Komai and Stegeman (2004, KS2004 hereafter) introduces strategic interaction among the followers and the problem of coordination failure. The paper shows that giving the leader private information and preventing full revelation can solve both problems of moral hazard and coordination.<sup>6</sup>

Komai, Grossman, and Deters (2007, KGD hereafter) experimentally test the model presented in KS2004 and provide strong evidence that giving the leader private information solves the free-riding problem only if full revelation is prevented not when the leader's information is fully transmitted to everyone.

Potters, Sefton, and Vesterlund (henceforth PSVa, 2005) provide experimental evidence which suggests that leaders improve cooperation by transmitting their private information to their ignorant followers, thus induce a following by improving information. Potters, Sefton, and Vesterlund (henceforth PSVb, 2007) show experimentally that leaders improve cooperation only

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<sup>5</sup> KS2007 extends the analysis to a continuous action set.

<sup>6</sup> Milgrom and Roberts (1992) survey general themes from both economists' formal models of organizations and the less formal management literature. They note the consensus view that the "key problem in achieving effective coordination and adaptation is that the information needed to determine the best use of resources... is not freely available to everyone."

in the presence of asymmetric information, not when information is equally available to their followers. In PSVa and PSVb, the subject's payoffs are linear in actions and the leader is followed only by one follower. PSVa and PSVb do not address the interaction among the followers and the coordination problems.

In most information based models of leadership leaders lead by example and followers follow them because they think leaders have more information about what is the right thing to do than they have. The leaders transmit their information to their followers either fully (to show them the intrinsic value of a project) or partially (to positively affect their beliefs about the intrinsic value of a project). In these models leaders improve efficiency either by themselves or by their followers or through both channels. But leadership is not all about information transmission. Leaders should also convince their followers that they are not being misled. A leader who can not do so will not be effective because after observing his signal, followers will not be persuaded to follow him.

A part of the leadership literature disregards the question of "what makes a leader effective or ineffective" (for example, KSH, KGD, PSVa, and PSVb). They do so by making assumptions or designing settings which ensure that followers find the leaders' signal convincing enough to follow him.

Others address this question (for example, Hermalin, 1998; and KS2004). In Hermalin, to convince his followers that a project is worthwhile, the leader fully reveals the project's return by increasing observable effort. This is not possible in KS2004, because in their setting the leader's signal cannot fully reveal the project's return. In models such as KSH and KS2004, where the leader is unable to fully reveal his information, the leader's ability to convince the followers relies on how closely his incentives represent those of an individual follower.

Otherwise, followers may expect the leader to often lead them into projects that they would individually prefer to avoid and they react by not following the leader. KS2004 address this issue formally in a heterogeneous population where players are differentiated by their cost of participation. KS2004 argue that high cost leaders are more convincing to their followers because in equilibrium, they are more selective than their followers when choosing projects. In some sense, the leader who leads least leads best.

In this paper we focus on models such as KSH and KS2004 in which the leader's signal can not fully reveal his private information<sup>7</sup> but address another factor that can affect the discrepancy between the incentives of the leader and those of his individual followers: the group's size.

We show that leadership is more likely to be effective in small groups than in large ones because the discrepancy between a leader's incentives and those of an individual follower increases with group size. This happens because as the group size increases a leader becomes more pivotal while an individual follower becomes more marginal relative to the rest of the group. This encourages a leader to be an influential initiator and an individual follower to be a marginal defector. Ineffective leadership thus can be an underappreciated diseconomy of scale.

This study is simple but interesting for the following reasons. First, because it empirically shows that effective leadership is not just about the leader but also about the followers and the circumstances in which they are all embedded. Second, because our study focuses on the

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<sup>7</sup> These models are realistic in many contexts. In some cases the leader's information is too complicated to be fully understood by an average player. In this case the leader is practically unable to fully transmit his information. In some cases the information is not complicated but difficult to verify. For example, much of the information revealed by a political figure is practically not verifiable by a potential voter. A political candidate is thus unable to credibly transmit all of his information to the voters. The same situation occurs when a person endorses a public project (a person's endorsement is a positive signal of the quality of a public project but does not reveal the project's exact rate of return).

incentives of the leaders and followers not their personal attributes<sup>8</sup>. Third, because it suggests that the incentives of the leaders and their followers can be corrected by changing their impact (via changing the group size) rather than their compensation (we are studying a contract free environment). We of course cannot ignore the fact that in reality, leadership is a complex phenomenon, and this paper describes at best one small piece of the puzzle. Nonetheless, it is a piece that seems interesting and consistent with some commonplace observations.

The remainder of the paper is organized as follows. Section II explains the benchmark model. Section III explains how our benchmark result changes as group size increases. Section IV explains our experimental design to test the group size effect. Section V provides empirical evidence that leaders of larger groups are indeed less successful in inducing cooperation than leaders of smaller groups. Section VI concludes.

## **II. The Benchmark Model**

In this section we create a setting that exhibits the familiar problems of moral hazard and coordination failure.<sup>9</sup> Consider a group with  $m$  players. Each player has an endowment of  $c$  dollars and decides whether or not to participate (i.e. invest his whole endowment) in a joint investment project. An investor contributes his  $c$  dollar endowment and earns a payoff of  $(x+c)q$ , where  $x$  is a random return and  $q$  is the fraction of players who invest in the project. A Non-investor, on the other hand, keeps his  $c$  dollar endowment plus earns a payoff of  $(ax+b)q^n/d$ , where  $q^n=q-1/m$ . Lets assume that  $m=3$ ,  $c=10$ ,  $a=4$ ,  $b=30$ , and  $d=6$ . Also assume that the random

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<sup>8</sup> The management literature includes myriad studies of leadership with a strong focus on personal attributes. Many of them of course omit the formal analysis familiar to economists. Dansereau and Yammarino (1998) survey some of these studies. Our study of course does not claim that personal attributes are not important.

<sup>9</sup> The model presented in this section is a numerical version of the model introduced in KS2004. The numerical version presented here satisfies all of the assumptions made in KS2004 and all the theoretical results apply in this paper. The model introduced in KS2004, along with the theoretical results are available at the request of the reader.

return  $x$  is uniformly distributed on the interval  $X=[-15,15]$ ; a project is good if  $x>0$  or bad if  $x<0$ . This payoff structure satisfies several main characteristics:

- a) Participation becomes more rewarding when  $x$  increases. There is also increasing returns to participation for good or neutral projects where  $x$  is non-negative.
- b) No player is willing to participate by himself even when  $x$  takes the highest possible value.
- c) A player who is uninformed about  $x$  is unwilling to participate even if he believes that everybody else will participate (because the expected value of  $x$  is 0).
- d) A player prefers to participate if he believes that  $x$  has taken its maximal value, and that everyone else will participate.
- e) If one player defects from full participation, for a good (or neutral  $x=0$ ) project, then he earns a positive payoff. In other words, the defector can take a free ride, gaining something from others participation while sacrificing nothing himself. For bad projects, participation may hurt non-participants.
- f) Efficiency requires either zero or full participation.

Given the payoff structure of the game, wellbeing is maximized if all of the group members participate whenever  $x>0$ . In what follows we show that, when  $x$  is common knowledge, our setting exhibits the problems of moral hazard and coordination combined.

Consider a simultaneous move game in which all players know  $x$  and simultaneously decide whether or not to invest in the project. We can characterize many symmetric Nash equilibria. The threshold  $\tau=6$  is the lowest return at which each player is willing to participate if all others participate. If  $6<x\leq 15$ , then the resulting sub-game is a coordination game for which

$q=0$  and  $q=1$  are both Nash equilibria. If  $0 < x < 6$ , then participation is strictly dominated in the sub-game. At  $x=6$  participation is weakly dominated.

The equilibria described above have two unattractive features. First, coordination failure implies missed opportunities for mutually beneficial and individually rational cooperation when  $6 < x \leq 15$ . Second, if players somewhat coordinate on the most efficient equilibrium, meaning that if they all participate for  $x > 6$ , they inefficiently fail to participate if  $0 < x \leq 6$ . This inefficiency is the typical consequence of free riding.

Projects which combine problems of moral hazard and coordination are common in reality. They may include developing a product, meeting a sales target, adopting a new procedure or technology, implementing a restructuring plan, or establishing a working relationship with another unit. In political contexts, many "projects" are conspicuously voluntary, which tends to make the shirking problem severe. Legislators in the U.S. are relatively free agents, who are not bound to vote with their party's leadership. Citizens, who join advocacy groups, endorse legislation or candidates, or work to support political causes are often volunteers. Such activities can be projects in the sense of our model.

Now consider a leader-follower setting where only one player (the leader) has unique access to  $x$  and other group members are aware only about how  $x$  is distributed. The leader moves first and his investment decision is observed by his followers who simultaneously make their decisions afterwards. Clearly, in the leader-follower setting there always exists a trivial equilibrium in which no one ever participates. Alternatively, there exists a productive equilibrium in which the leader participates when it is efficient to do so (whenever  $x > 0$ ) and followers mimic the leader because  $E_x[(x+c)q - (ax+b)q^n/d-c \mid x > 0] > 0$ <sup>10</sup> (this inequality means that

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<sup>10</sup> This is proved in detail in KS2004. The full proof is available upon request. Since this paper is empirical, we only sketch the argument to provide intuition. If the leader never participates then followers get no information about  $x$

an individual follower expects to gain from participation after observing the leader's participation signal; we call this condition the "Trust Inequality" because if this condition holds, followers find it optimal to mimic the leader which in a sense means that they trust his signal.

Note that one key characteristic of the model is that the leader is not able to fully reveal his information to his followers (his endorsement means  $x > 0$  but does not exactly reveal what  $x$  is) and this allows the leader to lead the followers into participating for values of  $x$  that they would be unwilling to participate if they were fully informed. This is, however, not the point in the current paper: in this paper we do not focus on how a leader leads or why a leader should exist but on "when a leader is followed".

What motivates our study is that in our benchmark model the "Trust Inequality" holds and thus followers find it optimal to participate when receiving the leader's participation signal (because the "Trust Inequality" simply says that followers expect to gain from participation after receiving the leader's signal). The problem arises when the Trust Inequality is no longer satisfied. In this case, the leader's signal is not strong enough to convince his followers that it is worthwhile for an individual to follow the leader; thus they will respond by ignoring him. This can occur if the discrepancy between the leader's incentives and those of an individual follower becomes too large. The next section shows how this discrepancy increases with group size.

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and thus never participate (because  $E(x) = 0$ ), and the equilibrium is the trivial one. It can not be an equilibrium for the leader to always participate. The reason is that his signal practically provides no information and thus no follower would follow him (since  $E(x) = 0$ ); given this the leader should not act alone. Now suppose that the leader participates with positive probability. Then all followers should adopt the same strategy, because the equilibrium participation of one follower implies, by increasing returns to participation, that other followers should also participate. That leaves four possibilities: (a) followers should not always participate, because the ex-ante returns are too low ( $E(x) = 0$ ); (b) if followers choose to never participate, then the leader also should never participate (a contradiction); (c) if the followers choose to do the opposite, then the only reason for the leader to participate is to prevent followers from participating in very bad projects, but our set up ensures that the followers cannot hurt the leader enough to cause him to participate in such unintuitive circumstances; and (d) the only remaining possibility is for all followers to mimic the leader. Given this the leader participates in the project when the project is good (whenever  $x > 0$ ), and the followers' optimal strategy is to follow the leader because  $E_x[(x+c)q - (ax+b)q^n/d - c | x > 0] > 0$ . The equilibrium concept employed here is a Bayesian Nash equilibrium in the sense of Crawford and Sobel (1982).

### III. The Group Size Effect

In this section, we show theoretically that the leaders of large groups are less likely to effectively induce a following. To do so we increase the group size from 3 in our benchmark model to 9. The theoretical prediction changes as follows.

In a simultaneous move game where  $x$  is common knowledge, we can characterize many symmetric Nash equilibria. The threshold  $\tau^C=10.9$  is the lowest return at which each player is willing to participate if all others participate. If  $10.9 < x \leq 15$ , then the resulting sub-game is a coordination game for which  $q=0$  and  $q=1$  are both Nash equilibria; if  $x < 10.9$  then not participating is strictly dominant in the sub-game. At  $x=10.9$ , participation is weakly dominated.

Again, the equilibrium described above has two unattractive features. First, coordination failure implies missed opportunities for mutually beneficial and individually rational cooperation when  $10.9 < x \leq 15$ . Second, if players somewhat coordinate on the most efficient equilibrium, meaning that if they all participate for  $x > 10.9$ , they inefficiently fail to participate if  $0 < x \leq 10.9$ .

Summarizing, as in our benchmark model the complete information game exhibits failures of both coordination and cooperation for  $m=9$ . The above analysis, however, shows that free riding is more severe in a nine member group ( $m=9$ ) than in a 3 member group ( $m=3$ ). Intuitively this happens because when group size increases from 3 to 9, an individual player becomes more marginalized; this encourages him to be a free rider rather than a small contributor.<sup>11</sup>

In the leader-follower scenario, the outcome is no more appealing either. When  $m=3$ , the leader could induce a productive equilibrium by participating whenever  $x > 0$  because the “Trust

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<sup>11</sup> The relationship between cooperation and group size has been addressed by several researchers. Some examples are: Chamberlin (1974), Hamburger, Guyer, and Fox (1975), Bonacich, Shure, Kahan, and Meeker (1976), Isacc and Walker (1988), and Walker and Williams (1992).

Inequality” held for  $m=3$ , meaning that an individual follower **expected** to gain from participation after receiving the leader’s signal. The “Trust Inequality”, however, does not hold for  $m=9$ , meaning that an individual follower **does not expect** to gain from participation (or can not be convinced that he will gain from participation) after receiving the leader’s signal. The problem is that the gap between the leader’s incentives and those of an individual follower increases with group size. As group size increases, an individual follower becomes more eager to free ride and less eager to participate. The leader, however, still has an incentive to participate whenever  $x>0$  (given that followers follow him). This makes the leader too eager to invest compare to an individual follower and thus weakens his signal to the level that the “Trust Inequality” is no longer satisfied. In some sense, the leader’s signal becomes too weak to overcome the strong free riding problem. Under these circumstances, the productive equilibrium disappears: followers do not trust the leader enough to follow his lead and knowing this the leader will not participate.

#### **IV. Experiment**

We use the models in sections II and III to design our experiment. The experiment consists of four treatments.

*Complete Information Treatment/Small Group ( $m = 3$ )-CIT<sub>S</sub>*: subjects engage in a 3-person investment game in which all three group members know the payoff of the game.

Subjects decide simultaneously, but separately, whether or not to invest.

*Complete Information Treatment /Large Group ( $m = 9$ )-CIT<sub>L</sub>*: which is a 9-person variation of the CIT<sub>S</sub>.

*Incomplete Information Treatment/Small Group (m = 3)-IIT<sub>S</sub>*: subjects engage in a 3-person investment game in which only one member of the group, the leader, knows the payoff of the game. The leader decides first whether or not to invest. The followers do not know the payoff of the game, but they do know the possible payoffs and their likelihoods. They also know whether or not the leader invested. After observing the leader's decision followers decide simultaneously, but separately, whether or not to invest.

*Incomplete Information Treatment /Large Group (m = 9)-IIT<sub>L</sub>*: which is a 9-person variation of the IIT<sub>S</sub>.

In each treatment there are three possible payoff scenarios, each occurring with equal probability. All subjects know and observe the assigned scenario in the CIT sessions. In the IIT sessions only the leader knows the assigned scenario. The followers only know the possible scenarios and their likelihood. In Scenario 1,  $x=12$  to represent the coordination problem; in Scenario 2,  $x=3$  to represent the free riding region; and in Scenario 3,  $x=-10$  to represent a bad project (see Tables 1 and 2). Numbers are rounded but the payoff structure still preserves the structural characteristics. Suppose the assigned scenario is common knowledge. In Scenario 1, the potential for coordination failure implies missed opportunities for mutually beneficial and individually rational cooperation both in 3-person and 9-person groups. Even if players somehow coordinate on investing in Scenario 1, they inefficiently fail to cooperate in Scenario 2; because in Scenario 2 the dominant strategy is not to invest (again, in both 3-person and 9-person groups).

Note, however, that the incentive to free ride is greater when  $m = 9$ . To see this, observe that an individual player in the 9-person game is more marginalized than an individual player in the 3-person game. On one hand, in the 9-person game, each player is  $1/9$  of the population and

thus has a smaller marginal effect on his earnings compared to an individual player in the 3-person game, who represents 1/3 of the population. On the other hand, in the 9-person game, an individual player can free ride on 8/9 of the population compared to 2/3 of the population in the 3-person game. This makes the free riding more appealing in the 9-person game because free riding is more beneficial.

Since we expect more free riding in the IIT<sub>L</sub> and the CIT<sub>L</sub> compared to the IIT<sub>S</sub> and the CIT<sub>S</sub>, our strategy is to put the IIT<sub>L</sub> and the CIT<sub>L</sub> in one category (the large group category) and the IIT<sub>S</sub> and the CIT<sub>S</sub> in a second category (the small group category) and then compare the two categories. Within the small group category, we expect the leaders to be **effective**. In the large group category, we expect the leaders to be **ineffective**. Formally our hypotheses are:

H1: In the IIT<sub>S</sub> groups, the coordination and free-riding problems are significantly less than the CIT<sub>S</sub> groups (in small groups leaders are effective).

H2: In the IIT<sub>L</sub> groups, the coordination and free-riding problems are **not** significantly less than the CIT<sub>L</sub> groups (in large groups leaders are ineffective).

Four sessions of each treatment were conducted. The sessions were conducted with paper and pencil. We recruited (by email and posters) 15 subjects for the small group sessions and 18 subjects for the large group sessions.<sup>12</sup> There was no show up fee. Subjects were seated in a common room. In small group sessions subjects were seated separately in 3 rows of 5. In the large group sessions subjects were seated separately in 3 rows of 6. In the small group sessions we created 5 groups of 3, and in the large group sessions we created 2 groups of 9. Subjects were instructed not to communicate with one another.

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<sup>12</sup> The email list was comprised of persons who had expressed an interest in participating by emailing a sign-up email address after being informed of the opportunity in large lecture classes. Posters were placed around campus and in dormitories.

After signing the consent form, subjects receive instructions, which are read aloud by the experimenter. Subjects are tested to make sure they understand the game. The experimenters monitor all the answers, correct any mistakes, and answer each subject's questions individually (see Appendix for copies of the instructions, tests, and other forms). Each session consists of 10 periods. Subjects begin each period with an endowment of \$10. In small (large) group sessions, a subject is randomly grouped with two (eight) other subjects each period. Groups are reformed after each round and no subject is grouped with the same two (eight) people more than one round. Leader/follower roles in the IIT sessions vary from period to period. A group's investment scenario is randomly determined at the beginning of each period and varies from period to period. The scenario is the same for all group members but can be different across groups. Each subject is identified by a randomly assigned 5-digit code number. At the end of each period each subject's individual earning is calculated and announced, using the code number, on a table posted on the front wall. Subjects are informed that their final earnings would be those of only one period chosen at random (by the role of a die at the end of the game) and therefore they should make the best decision possible in each period. At the end of the experiment subjects complete survey forms. They were then called up by code numbers to receive their earnings in private. Sessions take between 75 and 90 minutes to conduct, with the IIT sessions tending to take the most time. Subjects earned, on average, \$12.26. Average earnings by treatment were: CIT<sub>S</sub> - \$13.36; IIT<sub>S</sub> - \$13.76; CIT<sub>L</sub> - \$11.34; IIT<sub>L</sub> - \$11.01.

The post-experiment survey includes an item to determine whether or not subjects believe the instructions were clear. Subjects' answers are on a five-point Likert scale with 1 indicating that the subject strongly disagreed, and 5 indicating strong agreement with the statement "The instructions for the experiment were clear and easy to follow". With few exceptions, subjects

responded with 4s or greater, with the average response ranging between 4.4 and 4.75, and there is no significant difference in responses across treatments (see Table 3).

## V. Empirical Results

A total of 264 subjects participated in a total of 16 sessions. Table 3 reports by treatment summary statistics for subjects' socioeconomic characteristics. The only significant difference in subjects' socioeconomic characteristics is the proportion of male to female subjects, and this difference is largely due to the IIT<sub>S</sub> treatment. In the three other treatments, the majority of participants were male; in the IIT<sub>S</sub> treatment, the majority of participants were female. This difference is not, however, a concern. To determine whether or not subjects' investment decisions were influenced by gender, other socio-economic characteristics, or the clarity of instructions we ran random effect, Probit regressions controlling for all of these factors. With rare exceptions, these variables had no explanatory power, and, specifically, gender and clarity of instructions were insignificant. And those rare exceptions do not affect our basic results.<sup>13</sup> The results we report in this paper are strongly replicable and consistent in all the sessions we conducted.

Table 4 reports the investment rates in all four treatments (period by period and in aggregate) for Scenarios 1 and 2.<sup>14</sup> As expected, free riding is more prevalent in the large groups than it is in the small groups: the investment rate is lower in the CIT<sub>L</sub> and IIT<sub>L</sub> than it is in the CIT<sub>S</sub> and IIT<sub>S</sub>, respectively, for both Scenario 1 and Scenario 2. This is, however, not our

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<sup>13</sup> Results are available upon request.

<sup>14</sup> For Scenario 3, investment is neither individually nor socially optimal. Looking at the data we noticed consistently **very few** investment decisions (only in the first two rounds) and no significant difference across treatments. Thus, we focus our discussion on only Scenarios 1 and 2.

primary interest. Our primary concern is how much of a difference the leaders made within each category.

Consider first Scenario 1. Table 4 (and Figure 1) shows that the aggregate investment rates for the CIT<sub>S</sub> and IIT<sub>S</sub> are not significantly different (92.7 percent and 88.5 percent, respectively). The leaders neither improve nor hinder coordination in small groups. In the large group category, Table 4 shows that the aggregate investment rate is significantly higher in the CIT<sub>L</sub> than the IIT<sub>L</sub> (59.1 percent and 48.3 percent, respectively). These results suggest that, unlike in the small groups, in the large groups the leaders' ineffectiveness hindered coordination.

To get a better understanding of what is happening in Scenario 1 it is helpful to investigate the leaders and followers separately. Table 5 shows that all leaders in Scenario 1 invested in the IIT<sub>S</sub> but only 80.0 percent invested in the IIT<sub>L</sub> (see, also, Figure 2). The observed reticence of large group leaders to invest suggests that they were less certain of their followers' cooperation. Looking at the investment rates of followers (given that their leader invested), this reticence was justified (see Table 6 and Figure 3). (Note: followers' investment decisions are pooled for Scenario 1 and Scenario 2, because after observing the leaders' investments they still cannot distinguish between the two scenarios.) In the IIT<sub>S</sub> sessions, 83.0 percent of the followers who received an investment signal from their leaders followed their lead; in the IIT<sub>L</sub> sessions, only 50.4 percent of the followers who received an investment signal from their leaders followed their lead. Furthermore, the investment rate of followers in the IIT<sub>S</sub> sessions was highly stable, while the investment rate of followers in the IIT<sub>L</sub> sessions declines steadily with repeated play.

Now consider Scenario 2. Table 4 (and Figure 4) shows that the aggregate investment rate in the IIT<sub>S</sub> is significantly higher than in the CIT<sub>S</sub> (73.4 percent and 16.3 percent, respectively). The leaders significantly improved cooperation in small groups. In the large

group category, Table 4 shows that the aggregate investment rate in the IIT<sub>L</sub> is 24.1 percent and 10.5 percent in the CIT<sub>L</sub>. This suggests that leaders of large groups, while increasing the investment rate in the IIT<sub>L</sub> sessions relative to the CIT<sub>L</sub> sessions, are significantly less successful than leaders of small groups.<sup>15</sup>

Consider the investment rates period by period. Table 4 and Figure 4 show that investment rates in the CIT<sub>S</sub>, CIT<sub>L</sub>, and the IIT<sub>L</sub> decline with repeated play. This pattern is not, however, observed in the IIT<sub>S</sub>.

To get a better understanding, we investigate leaders and followers separately for Scenario 2. Table 5 shows that in aggregate 81 percent of the leaders invested in the IIT<sub>S</sub> but only 38.9 percent of the leaders invested in the IIT<sub>L</sub>. This suggests that the leaders of large groups do not trust their effectiveness as much as the leaders of small groups and reasonably decide not to invest in Scenario 2 (see Figure 2).<sup>16</sup> This is especially observed towards the latter rounds. The results reported in Table 6 indicate that, in both cases, the leaders' instincts were correct. As noted above, in the IIT<sub>S</sub> sessions, 83.0 percent of the followers who received an investment signal from their leaders followed their lead; in the IIT<sub>L</sub> sessions, only 50.4 percent of the followers who received an investment signal from their leaders followed their lead. As also noted, the investment rate of followers decreases over time in the large groups.

To summarize: the discrepancy between the leader's incentives and those of an individual follower increases with group size. Followers become more marginalized and thus more eager to

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<sup>15</sup> In a companion paper, authors conduct four sessions of the leader-follower treatment, for  $m=3$ , in which both leaders and followers are informed about the scenario. The data shows, quite strongly, that leaders make no difference when information is available to everybody. This is interesting because it shows that the leaders' commitment has no effect on the followers' decision even in our small groups. Thus, leaders are followed *not* because they make a commitment to the project but because they have superior information that can not be *fully revealed* to their followers. The results are available upon request but are not presented in this paper because our aim here is not to explain how the leader leads or why the leader exists but when a leader is convincing to his followers.

<sup>16</sup> As noted above, this pattern was also observed in Scenario 1. But, the percentage of the leaders who decided to invest in Scenario 1 was higher than in Scenario 2, because followers refusal to cooperate does not hurt leaders in Scenario 1 as much as it does in Scenario 2.

free ride and less eager to invest, while the leader is still interested in investing in Scenarios 1 and 2 if followed. Thus, the leader of a large group may no longer represent the interest of an individual follower. As a result, the leader's persuasive signal may become too weak to overcome the strong free riding tendencies of an individual follower. This happens in our experiment.<sup>17</sup> Our overall findings suggest that in large groups followers do not follow the leader's lead as often as they do in small groups and this becomes more evident towards the ending rounds.<sup>18</sup> Leaders rationally understand this (especially towards the ending rounds) and thus often do not initiate investments, in particular in Scenario 2, because it is not reasonable to invest unless they are followed.

## **VI. Concluding Remarks**

In many economic models of leadership the leader's informal authority arises plausibly from superior information. In such models, leadership is not only about transmitting information, but also about convincing the followers that the leader is not misleading them, particularly in situations where the leader has an incentive to do so. Otherwise the leader will not be trusted and will not be able to induce a following. A leader can be mistrusted if his incentives diverge from those of an individual follower. In this case followers expect to be led into situations which they individually tend to avoid and they respond by not following the leader. This is more likely to happen in a large organization, where a leader has too much impact-- he becomes too pivotal-- relative to the others and an individual follower has too little impact-- he becomes too marginal-- compare to the rest.

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<sup>17</sup> When  $m=9$ , an individual follower's expected gain from following the leader becomes negative.

<sup>18</sup> Possibly because of repeated play and learning.

Encouraging participation may be difficult for a manager when he tends to initiate too many projects that are not worthwhile to the other team members. In some cases this may reflect inability to distinguish good projects from bad projects, a possibility which our model assumes away. In other cases, managers may fail because of excess enthusiasm for a project due in part to a failure to represent the interest of others. This excess enthusiasm arises for different reasons; for example in a heterogeneous population managers may gain more than other group members and thus may be more enthusiastic than the others. In our model, this excess enthusiasm arises when the group size increases and it fails the managers (or the leaders) when the group size becomes too large. This is the kind of leadership failure that has not formally appeared in the literature to our knowledge, but is captured in our model.

To restore trust in such cases we can correct the leaders' and followers' incentives by reducing the group size. By reducing the group size followers become less marginal and thus more enthusiastic to participate. The leaders on the other hand become less pivotal and thus not too enthusiastic to lose the trust of their followers. This encourages the followers to follow their leaders. Our empirical evidence supports our claim. The results we report in this paper are strongly replicable and consistent in all the sessions we conducted. Our study is interesting in creating effective leadership by focusing on a leader's (or a follower's) impact not on his special attributes or talents; an approach which rarely appears in formal studies of management. Our study is also interesting because it magnifies a leader's (or a follower's) impact not his compensation.

In reality, of course, there are many reasons to select exceptionally talented leaders or loyal followers which our simple model does not capture. Thus, our model describes only a part

of the reality, which is small but is important for introducing a different notion of what makes an effective leader.

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Table 1: Payoff Scenarios (m = 3)

Scenario 1	Invest (each)	Not invest (Each)	Scenario 2	Invest (each)	Not invest (Each)	Scenario 3	Invest (each)	Not invest (Each)
All invest	22	-	All invest	13	-	All invest	0	-
2 invest	15	19		9	15		0	8
1 invests	7	15		5	12		0	9
Nobody invests	-	10		-	10		-	10

Table 2: Payoff Scenarios (m = 9)

Scenario 1	Invest (each)	Not invest (Each)	Scenario 2	Invest (each)	Not invest (Each)	Scenario 3	Invest (each)	Not invest (Each)
All invest	22	–	All invest	13	–	All invest	0	–
8 invest	20	21	8 invest	12	16	8 invest	0	8.5
7 invest	17	20	7 invest	9	15	7 invest	0	8.7
6 invest	15	18	6 invest	7	14	6 invest	0	8.9
5 invest	12	17	5 invest	6	13.5	5 invest	0	9
4 invest	10	15	4 invest	5	13	4 invest	0	9.2
3 invest	7	14	3 invest	4	12	3 invest	0	9.4
2 invest	5	12	2 invest	3	11.5	2 invest	0	9.6
1 invests	3	11	1 invests	2	11	1 invests	0	9.8
Nobody invests	–	10	Nobody invests	–	10	Nobody invests	0	10

Table 3: Socio-Economic Characteristics

	CIT <sub>S</sub> N = 60	IIT <sub>S</sub> N = 60	CIT <sub>L</sub> N = 72	IIT <sub>L</sub> N = 72	chi-squared contingency table test p-value
Age (Std. Dev.)	19.98 <sup>+</sup> (1.91)	20.08 (2.13)	20.19 (1.94)	20.32 (2.01)	0.95
18	12	7	10	11	
19	21	25	28	21	
20	6	12	8	13	
21	6	5	9	9	
22	7	5	5	8	
23	3	3	6	4	
24	1	1	4	4	
25+	2	2	2	2	
Male	43	28	45	41	0.03
Female	17	32	27	31	
Employed					0.64
Full-time	2	2	3	2	
Part-time	29	30	45	42	
No Job	29	27	24	28	
Econ/Business Major	23	15	25	25	0.44
Other	37	45	47	47	
Economics Classes (Std. Dev.)	1.05 <sup>+</sup> (1.27)	0.98 (1.20)	1.00 (1.17)	1.22 (1.21)	0.22
0	27	30	34	24	
1	13	14	15	19	
2	8	11	16	23	
3	5	0	3	4	
4+	4	5	4	2	
GPA					0.66
<2.00	3	6	1	2	
2.00 – 2.49	8	5	13	9	
2.50-2.99	21	23	26	28	
3.00-3.49	18	15	19	20	
3.50-4.00	8	9	13	13	
Procedures preserve anonymity	4.29 <sup>+</sup> (0.96)	4.55 (0.65)	4.35 (0.97)	4.33 (0.90)	0.90
0	1	0	2	1	
2	1	0	1	1	
3	11	5	10	12	
4	12	17	16	17	
5	33	38	43	41	
Instructions were clear	4.50 <sup>+</sup> (0.56)	4.72 (0.67)	4.40 (0.87)	4.56 (0.58)	0.26
0	1	1	2	0	
2	2	0	1	0	
3	2	1	3	3	
4	15	11	26	26	
5	38	47	40	43	

Table 4: Investment Rates - IIT versus CIT Sessions

	Scenario 1										
Period	1	2	3	4	5	6	7	8	9	10	Aggregate.
IIT <sub>S</sub>	91.7%	79.2%	91.7%	83.3%	95.8%	95.8%	87.5%	83.3%	83.3%	100.0%	88.5%
CIT <sub>S</sub>	91.7%	95.8%	83.3%	100.0%	91.7%	95.8%	91.7%	95.8%	87.5%	91.7%	92.7%
Proportion Test P-value											0.161
IIT <sub>L</sub>	44.4%	...	61.1%	61.1%	55.6%	55.6%	...	38.9%	41.7%	...	48.3%
CIT <sub>L</sub>	80.6%	...	44.4%	66.7%	55.6%	66.7%	...	52.8%	41.7%	...	59.1%
Proportion Test P-value											0.036
	Scenario 2										
Period	1	2	3	4	5	6	7	8	9	10	
IIT <sub>S</sub>	58.3%	75.0%	83.3%	72.9%	66.7%	100.0%	62.5%	83.3%	79.2%	70.8%	73.4%
CIT <sub>S</sub>	25.0%	16.7%	12.5%	27.1%	16.7%	33.3%	4.2%	12.5%	0.0%	12.5%	16.3%
Proportion Test P-value											0.000
IIT <sub>L</sub>	41.7%	66.7%	33.3%	27.8%	33.3%	5.6%	13.9%	16.7%	11.1%	15.3%	24.1%
CIT <sub>L</sub>	19.4%	11.1%	27.8%	18.5%	0.0%	0.0%	8.3%	11.1%	5.6%	1.6%	10.5%
Proportion Test P-value											0.000

Table 5: Percentage of IIT Leaders Investing

	Scenario 1										
Period	1	2	3	4	5	6	7	8	9	10	Aggregate.
Group Size 3	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Group Size 9	50.0%	...	100.0%	100.0%	100.0%	100.0%	...	75.0%	75.0%	...	80.0%
Proportions Test p-value											0.000
	Scenario 2										
Period	1	2	3	4	5	6	7	8	9	10	
Group Size 3	62.5%	75.0%	87.5%	87.5%	75.0%	100.0%	62.5%	87.5%	87.5%	87.5%	81.0%
Group Size 9	50.0%	100.0%	50.0%	50.0%	50.0%	0.0%	25.0%	0.0%	25.0%	37.5%	38.9%
Proportions Test p-value											0.000

Table 6: Percentage of IIT Followers Investing (Given Leader Invested)

	Scenarios 1 and 2										
Period	1	2	3	4	5	6	7	8	9	10	Aggregate.
Group Size 3	88.9%	77.3%	90.9%	72.2%	88.2%	95.8%	84.6%	83.3%	76.7%	77.3%	83.0%
Group Size 9	81.3%	62.5%	58.3%	52.5%	50.0%	50.0%	37.5%	41.7%	31.3%	29.2%	50.4%
Proportions Test p-value											0.000

Figure 1: IIT and CIT Investment Rates - Scenario 1

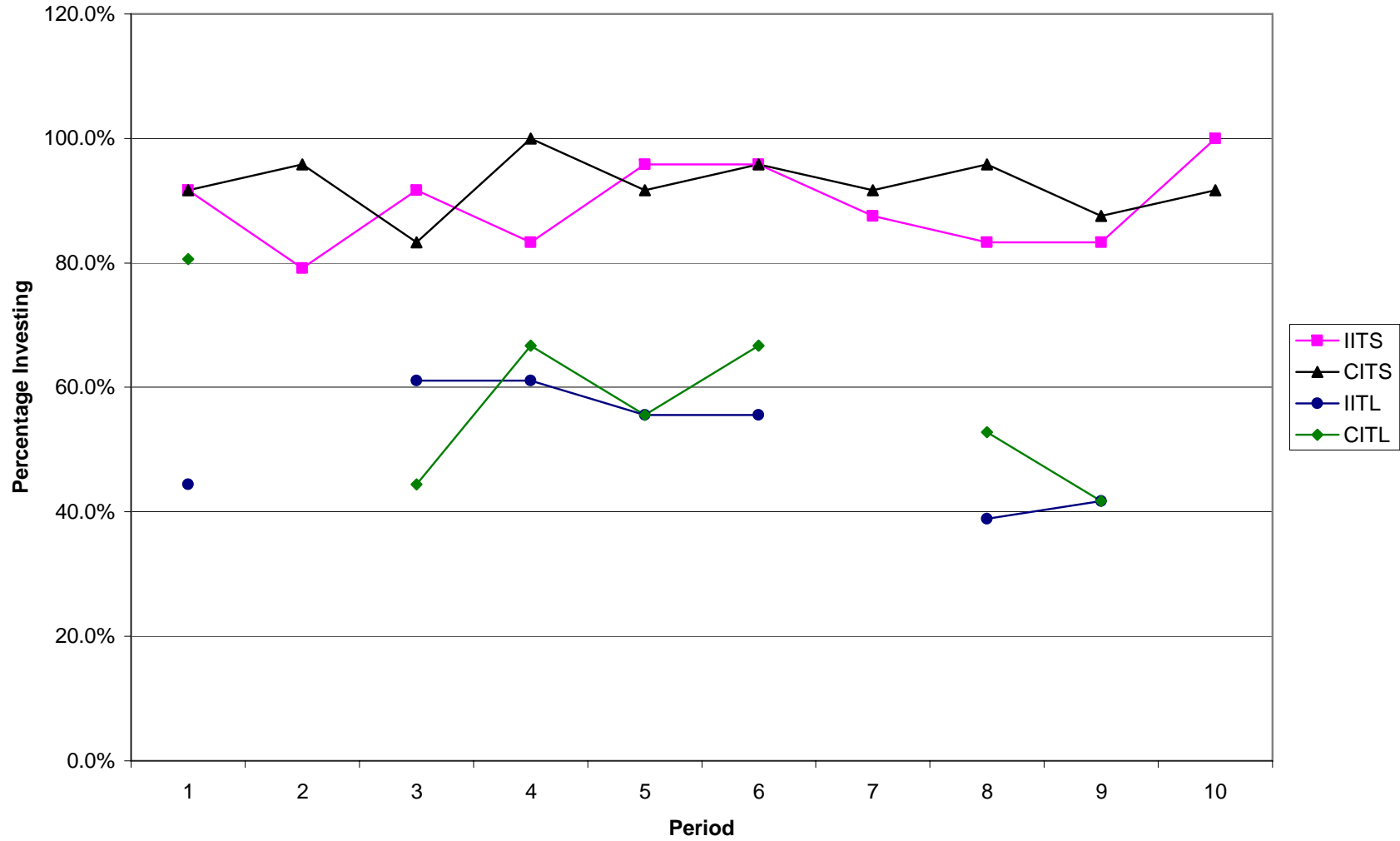
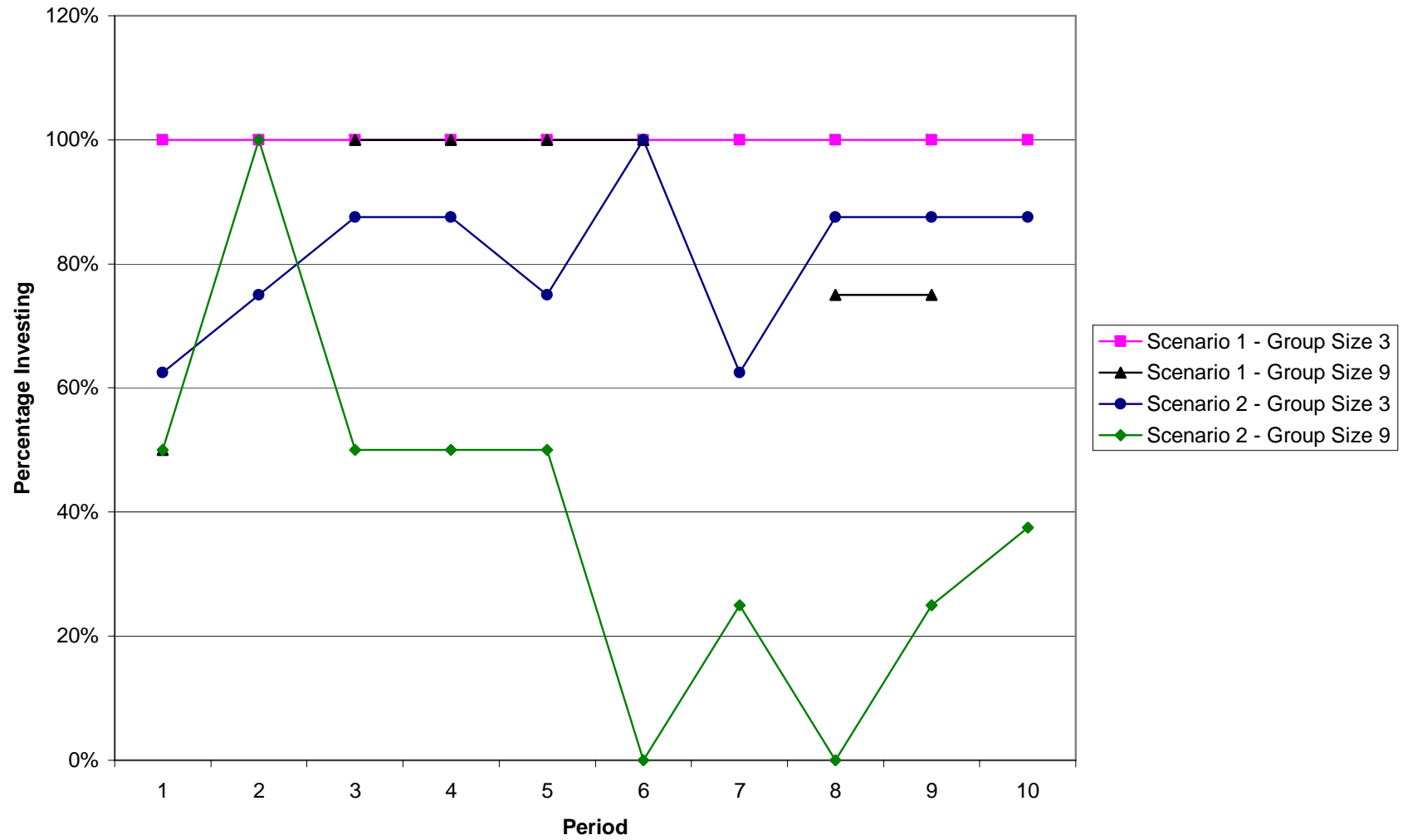


Figure 2: Percentage of IIT Leaders Investing By Period



**Figure 3: Percentage of IIT Followers Investing (Given Leader Invested) By Period**

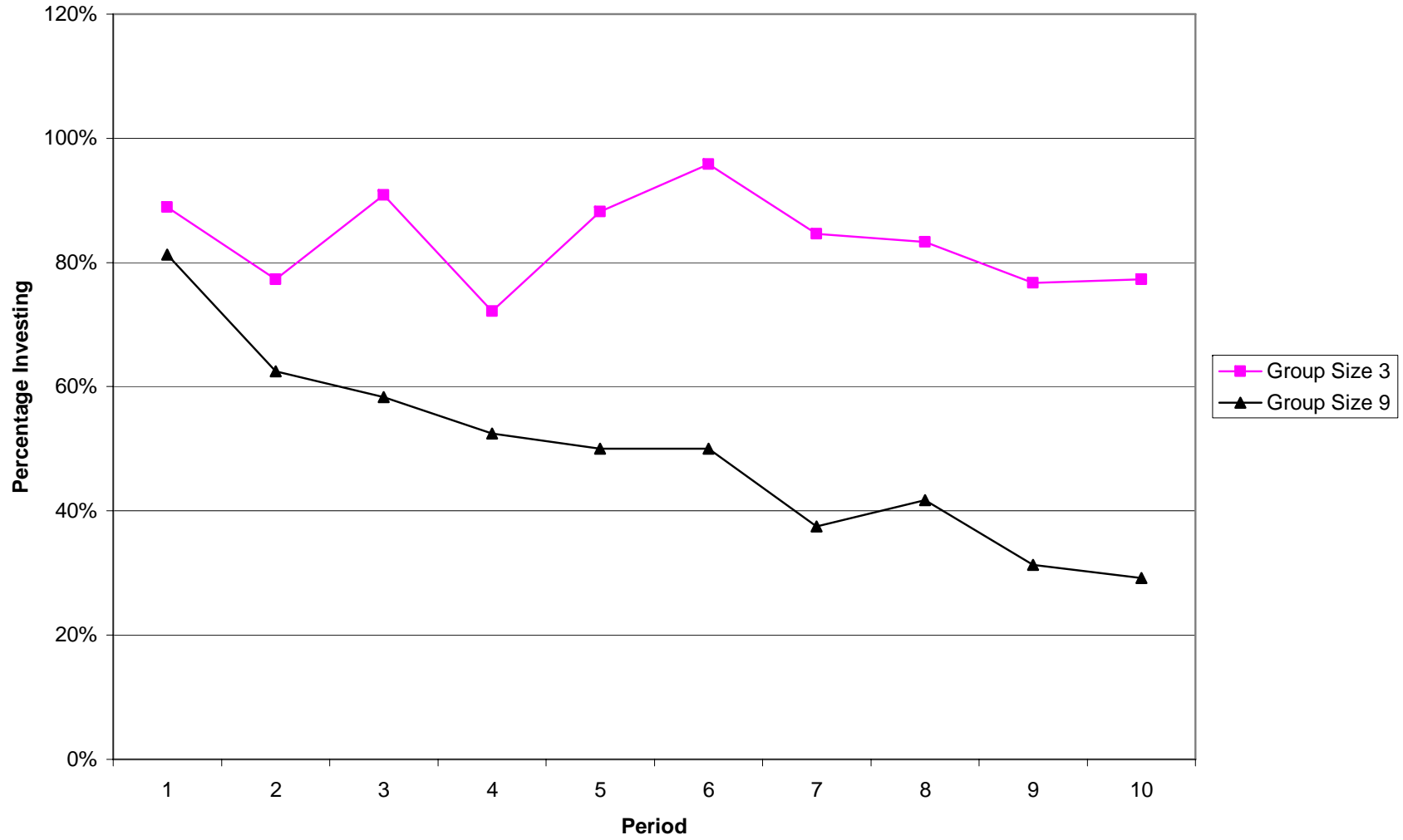
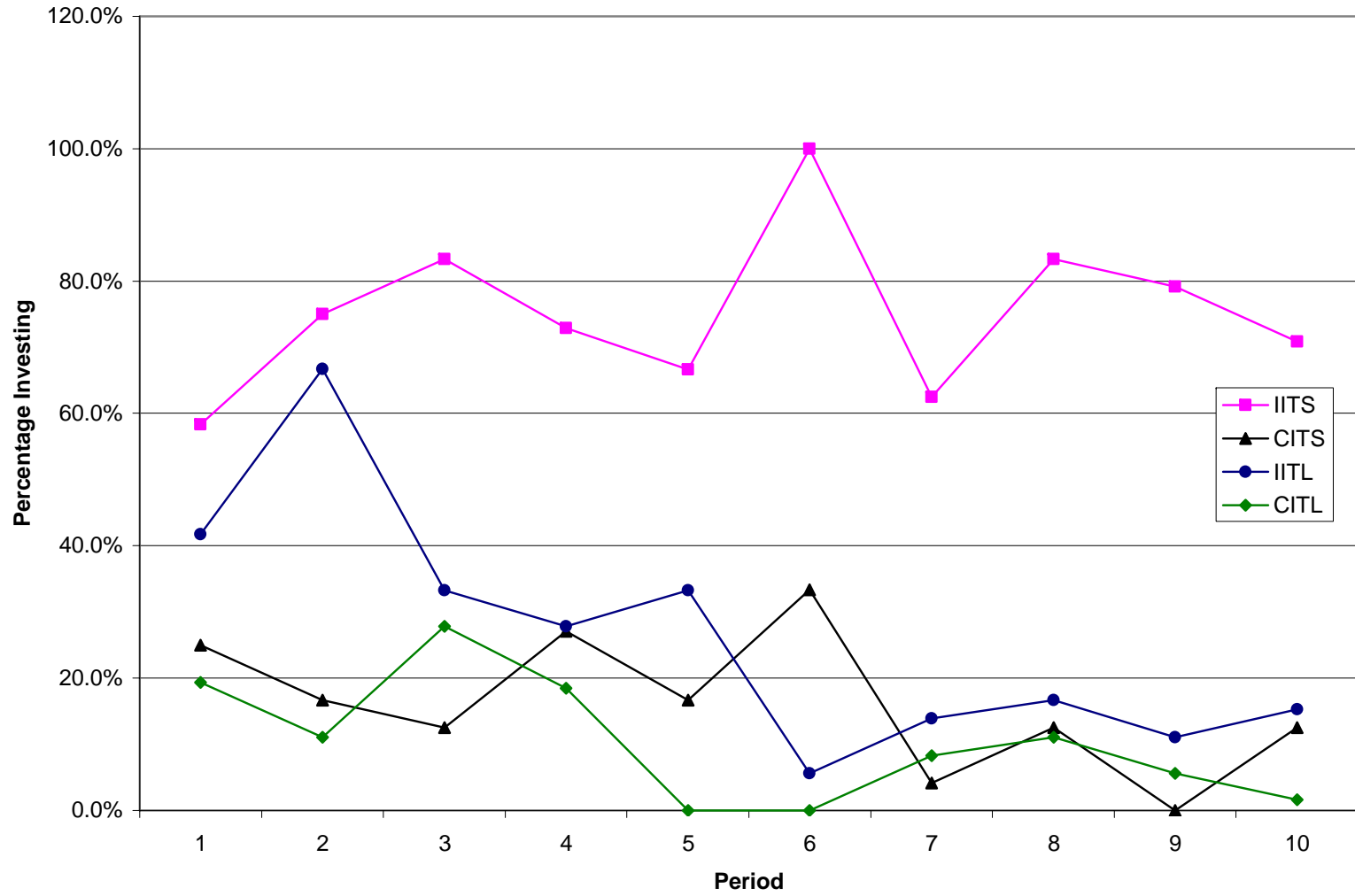


Figure 4: IIT and CIT Investment Rates - Scenario 2



## Appendix – Examples of Instructions and Forms

(IIT changes or additions to the CIT instructions are indicated in *bold italics*. Large group changes or additions to the small group instructions are in **bold**).

### Instructions

This is an experiment about decision-making involving 15 **(18)** participants. You must not talk to the other participants or communicate with them in any way during the experiment. If at any time you have questions, raise your hand and we come to you to answer them.

You have received a folder with a unique five digit code number. You will use this number to collect your earnings at the end of this session.

The experiment consists of 10 rounds. In each round you play an investment game. At the end of each round your earnings will be calculated and announced. You are given a record sheet on which you should record your decision and earnings at the end of each round. Your final earnings will be those of only one round, chosen at random (by the role of a die) at the end of the experiment. Since you don't know which round will determine your earnings, it is important that you make the best decision possible in each round. Your earnings will be paid to you in private at the end of the experiment.

At the end of the experiment you will receive a survey form. Please complete the questions. When you have completed the survey deposit it in the box at the front of the room. You will then be called up to receive your earnings and then you are free to go.

### The game

In each round you will be randomly grouped with two **(eight)** other participants. Groups will be reformed each round. You will not be with the same two **(eight)** people more than one round.

At the beginning of each round you will each be given an endowment of \$10. You must decide whether to invest or not invest your endowment in a joint investment project. The project's potential return is randomly determined at the beginning of each round and will vary from round to round. In each round three scenarios are **equally likely** to happen: Scenario 1 in which potential returns are high, Scenario 2 in which potential returns are average, and Scenario 3 in which potential returns are low. The potential return is the same for you and the other members of your group for that round. Potential returns, however, may vary among groups. The three scenarios are shown on the next page.

Your earnings depend on your decision, the decisions of the others in your group, and the return to the project.

**Table 1: Payoff Scenarios – Small Group**

Scenario 1	Invest (each)	Not invest (Each)	Scenario 2	Invest (each)	Not invest (Each)	Scenario 3	Invest (each)	Not invest (Each)
All invest	22	–	All invest	13	–	All invest	0	–
2 invest	15	19		9	15		0	8
1 invests	7	15		5	12		0	9
Nobody invests	-	10		-	10		-	10

**Table 1: Payoff Scenarios – Large Group**

Scenario 1	Invest (each)	Not invest (Each)	Scenario 2	Invest (each)	Not invest (Each)	Scenario 3	Invest (each)	Not invest (Each)
All invest	22	–	All invest	13	–	All invest	0	–
8 invest	20	21	8 invest	12	16	8 invest	0	8.5
7 invest	17	20	7 invest	9	15	7 invest	0	8.7
6 invest	15	18	6 invest	7	14	6 invest	0	8.9
5 invest	12	17	5 invest	6	13.5	5 invest	0	9
4 invest	10	15	4 invest	5	13	4 invest	0	9.2
3 invest	7	14	3 invest	4	12	3 invest	0	9.4
2 invest	5	12	2 invest	3	11.5	2 invest	0	9.6
1 invests	3	11	1 invests	2	11	1 invests	0	9.8
Nobody invests	–	10	Nobody invests	–	10	Nobody invests	0	10

*In each group one member is selected randomly and will be informed which scenario has been assigned to his/her group. The other two (eight) members will not know the scenario. At the beginning of the game you get a sheet of paper that tells you whether or not you are the informed member. The game is then played in two stages:*

*Stage 1: At this stage the informed member observes the scenario and decides whether or not to invest in the project. The uninformed members do not make a decision in this stage. They, however, should pretend that they are making a decision by drawing a circle. It is important not to show your identity to the others.*

*Stage 2: At this stage the uninformed members will be informed about the decision made by the first person and then will simultaneously decide whether or not to invest in the project. The first mover does nothing at this stage but should pretend that he/she is making a decision by drawing a circle on the paper.*

Before we start the game we will practice to make sure you understand the game and your potential earnings.

**Test (Small Group)**

**Suppose that you are in Scenario 1.**

What will you earn if all of you invest in the project?

What will you earn if nobody invests in the project?

What will you earn if you invest only by yourself?

What will you earn if you and one other member invest?

**Suppose that you are in Scenario 2.**

What will you earn if all of you invest in the project?

What will you earn if nobody invests in the project?

What will you earn if you invest only by yourself?

What will you earn if you and one other member invest?

**Test (Large Group)**

**Suppose that you are in Scenario 1.**

What will you earn if all of you invest in the project?

What will you earn if nobody invests in the project?

What will you earn if you invest only by yourself?

What will you earn if you and one other member invest?

What will you earn if you and two other members invest?

What will you earn if you and three other members invest?

What will you earn if you and four other members invest?

What will you earn if you and five other members invest?

What will you earn if you and six other members invest?

What will you earn if you and seven other members invest?

**Suppose that you are in Scenario 2.**

What will you earn if all of you invest in the project?

What will you earn if nobody invests in the project?

What will you earn if you invest only by yourself?

What will you earn if you and one other member invest?

What will you earn if you and two other members invest?

What will you earn if you and three other members invest?

What will you earn if you and four other members invest?

What will you earn if you and five other members invest?

What will you earn if you and six other members invest?

What will you earn if you and seven other members invest?

## CIT Decision Forms

**Round**

**Group**

**ID#**

You are in **scenario 1**. You are randomly grouped with two (**eight**) other participants. You and the other two group members have the chance to invest your 10 dollars in a joint project. The following table shows your potential earnings.

Circle your decision:

(A) I invest

(B) I do not invest

Small Group

	Investors (each)	Non-investors (each)
All invest	22	–
Two invest	15	19
One invests	7	15
Nobody invests	–	10

Large Group

	<b>Investors (each)</b>	<b>Non-investors (Each)</b>
<b>All invest</b>	<b>22</b>	<b>–</b>
<b>8 invest</b>	<b>20</b>	<b>21</b>
<b>7 invest</b>	<b>17</b>	<b>20</b>
<b>6 invest</b>	<b>15</b>	<b>18</b>
<b>5 invest</b>	<b>12</b>	<b>17</b>
<b>4 invest</b>	<b>10</b>	<b>15</b>
<b>3 invest</b>	<b>7</b>	<b>14</b>
<b>2 invest</b>	<b>5</b>	<b>12</b>
<b>1 invests</b>	<b>3</b>	<b>11</b>
<b>Nobody invests</b>	<b>–</b>	<b>10</b>

IIT Decision Forms - Leader

Round

Group

ID #

You are the informed player this time.

*Stage 1:*

You are in scenario 1. You are randomly grouped with two (**eight**) other participants. You and the other two (**eight**) group members have the chance to invest your 10 dollars in a joint project. The following table shows your potential returns. You are *the only one* who knows the potential returns (the other two (**eight**) group members do not know the potential returns). You will make your decision first. Your other group members will be informed about your decision before they make theirs.

Please circle your decision.

(A) I invest

(B) I do not invest

Small Group

	Investors (each)	Non-investors (each)
All invest	22	–
Two invest	15	19
One invests	7	15
Nobody invests	–	10

Large Group

	<b>Investors (each)</b>	<b>Non-investors (Each)</b>
<b>All invest</b>	<b>22</b>	<b>–</b>
<b>8 invest</b>	<b>20</b>	<b>21</b>
<b>7 invest</b>	<b>17</b>	<b>20</b>
<b>6 invest</b>	<b>15</b>	<b>18</b>
<b>5 invest</b>	<b>12</b>	<b>17</b>
<b>4 invest</b>	<b>10</b>	<b>15</b>
<b>3 invest</b>	<b>7</b>	<b>14</b>
<b>2 invest</b>	<b>5</b>	<b>12</b>
<b>1 invests</b>	<b>3</b>	<b>11</b>
<b>Nobody invests</b>	<b>–</b>	<b>10</b>

**Round**  
**Group**  
**ID #**

Stage 2:

You have already made your decision and are waiting to see what the other two will do. The only thing that you have to do in this round is to pretend that you are making a decision by drawing a circle.

## IIT Decision Forms - Follower

**Round**

**Group**

**ID #**

**You are NOT the informed player in this round. Please follow the instructions below.**

*Stage 1:*

Do not make any decision at this stage. But pretend that you are making a decision by drawing a circle. When you are done wait for 1 minute and give this sheet back to me.

**Round**

**Group**

**ID #**

Stage 2:

The first mover decided -----.

What is your decision? Please circle one.

A) Invest

B) Do not invest

**SURVEY  
ID#**

1. AGE \_\_\_\_\_

2. What is your sex? (Circle one number.)            00 Female                            01 Male

3. Married? (Circle one number.)                    00 NO                                    01 YES

4. Children? (Circle one number.)                    00 NO                                    01 YES

5. Are you employed?                            00 No                            01 Yes, Part time                    02 Yes, Full time

6. Which of the following categories best describes you? (Circle one number.)

01 Asian-American/Oriental                            02 Black/African-American                    03 White/Caucasian

04 Hispanic-Black/Spanish-speaking Black                    05 Hispanic-White/Spanish-speaking White

06 Native American/American Indian

07 Other (Please specify) \_\_\_\_\_

7. Class (Circle one number)

00 Freshman            01 Sophomore            02 Junior            03 Senior            04 Graduate Student

8. Major (Circle one number)

00 Economics            01 Other Business            02 Psychology            03 Sciences            04 Liberal Arts            05 Other

10. How many Economics classes have you taken at the university level? (Circle one)

00 None    01 One    02 Two    03 Three    04 Four    05 Five    06 Six    07 More than Six

11. What is your GPA?

00 below 2.00    01 2 to 2.49    02 2.5 to 2.99    03 3 to 3.49    04 above 3.5

						Strongly Disagree				Strongly Agree
12.	The procedures followed in this experiment preserved your anonymity.	1	2	3	4	5				
13.	The instructions for the experiment were clear and easy to follow.	1	2	3	4	5				