Optional Budget Mechanisms with Verifiable Cost Signals: An Experiment

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I. Introduction

The purpose of this study is to investigate the effect of an agent's ability to provide discretionary information regarding profitability in a budgeting context. The setting I employ captures important elements of many organization's budgeting systems, such as information asymmetry, limited liability of employees and limitations on commitment by superiors. Through the use of an experiment I investigate whether providing an agent with a cost signaling capability decreases agency costs and increases efficiency, despite the fact that the signal's use is optional and the principal cannot commit to how the signal will be used.

The remainder of this paper is organized into six sections. In the next section, I provide a brief review of literature to identify the specific research questions which I address. In section three, I outline my laboratory experiment and, in section four, I provide an overview of my hypotheses. The fifth and sixth sections contain the results and conclusions, respectively.

II. Literature Review

A common purpose of budgeting studies is to explore the importance of non-pecuniary motivations within an agency setting. Accounting and economic researchers often, but not always, assume that an agent's utility function is directly and solely related to monetary incentives. Through the use of experimental economics, researchers have found that non-pecuniary incentives may also have an affect on an agent's decisions. In order to better understand the effects of these non-pecuniary motivators, studies have focused on two interrelated questions. First, studies were conducted to ask whether non-pecuniary motivations played any role in the agent's decision making process. Examples include Baiman and Lewis [1989], Evans, Hannan, Krishnan, and

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Moser [2001], Hannan, Rankin, and Towry [2006], Young [1985], Hennig-Schmidt, Rockenbach, and Sadrieh [2003]. These studies found that non-pecuniary motivations such as honesty, fairness, etc. were significant to the agent's decision making process. A second series of studies asks the question of how a superior can best utilize non-pecuniary motivations in her design of budgeting systems. One possibility is to put the agent in situations where he is asked to submit reports on costs and analyze the mechanisms that encourage honest or fair reporting by the agent. This topic of research has shown that, by utilizing a reporting mechanism, it is possible to reduce agency costs and improve efficiency in transactions. Studies that have examined the design of budgeting report systems include Schwartz, Wallin, and Young [2008], Hannan, Rankin, and Towry [2006], Nikias, Schwartz, Spires, Wollscheid, and Young [2008], Rankin, Schwartz, Young [2007], Rankin, Schwartz, and Young [2003], and Evans, Hannan, Krishnan, and Moser [2001].

Budgeting researchers have actively explored the level of honesty and misrepresentation that are chosen by the agent. Research has identified conditions under which an agent is willing to forgo additional monetary incentives in order to be honest or appear fair. In Baiman and Lewis [1989], the authors explore where the threshold lies for misrepresentation over monetary value is for an informed agent. For this agent, the 'best' contract is only available if the agent chooses to misrepresent his qualifications by a non-trivial amount. Within this setting, BL find that agents are willing to engage in misrepresentation for even a small amount of money. BL's results may have been influenced by the experimental training sessions, where subjects practiced expected value calculations. While the purpose of these exercises was to increase subject understanding of complex contracts, the practice in calculating expected value may have unintentionally caused the subjects to focus their analysis on a monetary motivation more than they otherwise would have.

Evans, Hannan, Krishnan, and Moser [2001] (EHKM) also explored how an agent's preferences for wealth and honesty affect managerial reporting in an

experiment that was based on Antle and Eppen (1985). Using a simpler experiment compared to BL, EHKM found that agents offer a non-trivial amount of wealth to the principal even though the economic opportunity cost of honesty was quite high. So long as the agent was able to extract a fair share of profit from the opportunity, the agent was willing to return a non-trivial portion of slack back to the principal.

Schwartz, Spires, Wallin, and Young [2008] (SSWY) explore the effects of the budget proposal format on budget acceptance rates in a management control setting. SSWY focus on capturing the benefits of aggregation and delay in budgetary reporting where there is an option to take three individual projects. SSWY finds that an aggregation of projects greatly increases the project acceptance rate relative to disaggregated reporting, and that delaying project proposals is less effective at increasing project acceptance than aggregate reporting, but is still more efficient than disaggregate reporting. The authors conclude that these findings are due to the smoothing of costs that are made possible due to the aggregation of costs. Since costs may vary considerably over the three projects, the agent is able to present aggregate costs so as to suggest a 'fair' distribution of costs. One high cost project can be offset by another low cost project in the agent's aggregated report because the principal is not making individual decisions. Furthermore, they conclude that when the principal has the option of using a smoothed cost, as they do in the delayed setting, the principal chooses not to utilize the aggregate costs of the three projects together and the effectiveness of smoothing is decreased. This observation suggests that the principal prefers to look at costs of individual projects even though looking at them in aggregate is optimal for both parties. This can be seen as the principal's desire to use the signals that contain the most information. These findings are important to my experiment because they indicate that the design of reporting procedures can lead to non-trivial reduction in agency costs.

Nikias, Schwartz, Spires, Wollscheid, and Young [2008] explore additional theories as to why aggregation is a part of management control. In addition to

image management and a perceived benefit of honesty, NSSWY highlight the effects of guilt alleviation (especially in driving kindness in subsequent acts) and the agent's need to cope with uncertainty. All of these behavioral predictions may help explain why the use of cost signals can be useful in reducing agency costs in our experiment. Most important to my study is NSSWY's discovery of the agent's need to cope with uncertainty. The use of a verifiable signal should alleviate some uncertainty on the agent, especially the agent's uncertainty for the principal's actions.

Hannan, Rankin, and Towry [2006] offer an expanded study into the trade-offs between the benefits of appearing honest and the benefits of misrepresentation for the agent. This study also introduces the use of information signals, although they have limited strategic effectiveness because every budget proposal from the agent is automatically accepted. The authors find that, if an information signal is used, the agent prefers a signal with a coarse indication of actual cost because it allows the agent to balance the benefits of appearing honest with some amount of wealth from misrepresentation. When the information system becomes more precise, the agent shifts the balance from appearing honest to utilizing his ability to capture wealth through misrepresentation. Therefore, it can be better for the principal to create an information system that is coarse enough to allow the agent some non-trivial slack and still have him report honestly. For my experiment, the balancing act that the agent undertakes is quite different in that we allow the principal to reject offers. Because the rejection of offers introduces strategic interaction back into the budgeting scenario, I expect that the principal will use her power of rejection to refuse projects that fall outside of her threshold for fairness. While a certain amount of slack is still desirable to the agent, the threat of rejection by the principal may cause the agent to report more truthfully than in HRT's experiment.

The first effect of a cost signal is that it offers the agent a verified indication of his honesty in reporting to the principal. In the absence of a cost signal, a high monetary value report by the agent can mean two things for the principal: (1),

that the agent is faced with a high cost when he observed the project or, (2), that the agent is misrepresenting costs to extract non-trivial wealth from the principal. The information asymmetry leads to a moral hazard problem and, coupled with non-pecuniary motivations for fairness or/and honesty, may cause the principal to reject a large portion of high-request projects. These rejections cause a significant loss in social efficiency and make high-cost (although profitable) projects much harder to get approved. The cost signal provides the principal with additional information on whether the agent is reporting honestly. The second effect is that a cost signal allows the agent to deal with his uncertainty over how the principal will respond to different budget requests. After viewing project costs, the agent faces considerable uncertainty about where to report cost so as to get the project approved and extract some wealth from the project. A cost signal alleviates some of this uncertainty by giving the agent the ability to indicate actual costs along with his budget report. Such a report should give the principal enough information to approve a high-budget request even though she is receiving a relatively low amount of slack.

III. Experimental Setting

In the experiment there is a principal and an agent, who interact only once. The principal employs an agent for the purpose of managing a potential investment. The agent is able to privately view the actual cost (**c**) of an investment drawn from a discrete uniform distribution on {0,1,2,...,199,200}. In all cases, the parameters are common knowledge; the only private information is the actual cost. The agent keeps as slack any difference between the funding and the actual cost. The cost of the investment (**c**) can only be observed by the agent. The revenues (**R**) are non-stochastic and common knowledge. In all cases the investment will provide revenues of **R** = 200, which will be received by the principal if the project is approved.

The principal requests that the agent submit a budget request (**B**) for the investment that has to cover the investment's costs and include the agent's desired slack for managing the investment. The only constraints on the request is

it cannot exceed the highest feasible cost and it cannot fall below the actual cost, implying that slack must be non-negative. The principal then observes **B** and decides whether to approve or reject the request, but she cannot make an ex ante commitment as to how she will act.[2] If approved, the principal pays **B** to the agent and collects all revenues from the investment, so his earnings are **R - B**, and the agent consumes as slack any difference between the budget proposal and the actual cost (**B – c**). If the request is rejected, both parties receive zero earnings from the investment. For the agent, it is necessary to submit a budget request that is greater than his observed actual cost if he wishes to make any profits from the investment.[3]

III (A). Benchmark Setting

The Rankin et al. (2003) *no signal* [NS] case is the benchmark for this experiment. In the [NS] case, the agent is only able to submit his budget request (**B**) without additional signals on cost. The parameters of the equilibrium analysis experiment imply that the agent should always request 199. Given that the principal is motivated by monetary wealth, she will approve a request of 199 because rejecting the request means the principal receives no slack. With this assumption of principal behavior, the agent has no incentive to request anything but 199. This outcome is what utility maximizing agents will exhibit under traditional economic assumptions about preferences. However, the allocation of wealth may appear unfair to the principal, and potentially to society as well, depending on how it views property rights. Because individuals commonly avoid "unfair" distributions of wealth in spite of countervailing pecuniary incentives, past experiments have seen the principal as facing non-pecuniary costs when accepting an unfair offer as well as pecuniary costs when rejecting an unfair, yet profitable offer.

2 This lack of commitment makes this experiment fundamentally different than the experiment used in Antle and Eppen (1985).

3 This misrepresentation should not be confused with dishonesty. The issue is a commingling of concerns for fairness and honesty with the first order concern for one's own wealth. It is common knowledge to both parties that the agent's slack from the investment is directly related to his requested distribution of available slack, in that the agent must lie to extract any slack from the project.

Anticipating that the principal may reject a proposal that she views as unfair, the agent tends to submit budget requests that provide the principal with a perceived-to-be fair level of profit [RSY 2003]. However my budget setting feature significant information asymmetry between principal and agent. The agent can exploit this feature by extracting large rents from the principal without the principal knowing the fairness of the agent's actions. This would occur in my setting when the actual cost is low but the agent submits a relatively high budget request. Conversely, the principal may perceive a proposal to be unfair when in fact actual costs are high and the agent had no choice but to submit a high budget proposal. In this case the principal may reject a proposal that she would otherwise accept, if she were better informed.

One potential way to facilitate a reduction in agency costs is to provide the agent with a mechanism that can produce verifiable signals regarding the investment's cost. Such a signal is useful because it can provide the principal with a true basis for judging the fairness of a proposal. In this experiment, the use of this mechanism is at the option of the agent. However if sent, the signal is constrained to be truthful. Under the optional signal treatment, it is left to the agent to decide on the precision of the signal. A comparable situation might be the following. A hotel can disclose online how close it is to some facility of interest, e.g. an airport or an amusement park. A hotel three blocks away might disclose "within half a mile", "within five miles" or make no disclosure at all. A hotel five miles away would be limited to not claiming to be less than five miles away. Potential guests may make inference about the exact location of the hotel given the disclosure made.[4] Also, companies base their per diem payments on the signal of the city that the employee traveled to for business. For example, the per diem for Chicago would be greater than the per diem for Columbus, Ohio because the employer has a rough idea of the higher costs incurred by the employee in each city.

4 Of course potential guests can simply call the hotel and get a more precise disclosure, many do not avail themselves of this option. To the extent that many people do not call, this setting is very similar to the one I explore.

It is important to understand the motivation for the limited liability by the agent. In this setting, the agent is not asked to pay for the cost of investment before being paid by the principal. This forces the principal to make all cash outlays and provides the agent with slack for investment management and not financial risk. This is analogous to the business world because employees are rarely expected to pay, out of pocket, for million dollar projects but are still paid based on the success of the project. In keeping with that model, this setting does not ask the agent to assume all the liability of investment and, instead, puts that responsibility on the principal.

Using game theory to evaluate this setting, the signal would have no economic value to either the agent or the principal. The agent's optional decision is still to submit budget requests equal to 199, because the wealth-maximizing principal would prefer profit of one over no profit. The introduction of this signal does not change this setting because the use of the signal has no direct effect on his payoffs, the wealth-maximizing agent will send no signal (because the signal is noise) and request 199. The principal will see that a budget request offers him revenue of 1 and will accept the project regardless of the lacking signal. In equilibrium, the signal will have no value to either the principal or the agent.

III (B) Treatments

There are three treatments in this experiment: Always Signal Fine [ASF], Always Signal Coarse [ASC] and Optional Signal [OS]. In [ASF] the agent submits a budget request and in addition must send a truthful but imperfect signal about cost — no option of withholding information is available to the agent. The signal truthfully reveals in which $1/8^{th}$ of the cost distribution the actual cost lies, i.e., [0,25], [26,50], [51,75], [76,100] etc… Observing both the budget request and the signal, the principal will either accept or reject the budget request. If accepted, the principal will provide the agent with his full budget request, regardless of the cost signal observed by the principal. This treatment is important for comparison with the [OS] treatment and a no signal benchmark because the agent is forced to send a cost signal.

In [ASC] the agent submits a budget request and in addition must send a truthful but imperfect signal about cost — no option of withholding information is available to the agent. The signal truthfully reveals in which 1/4 of the cost distribution's support the actual cost lies, i.e., [0,50], [51,100], [101,150] etc.… Observing both the budget request and the signal, the principal will either accept or reject the budget request. If accepted, the principal will provide the agent with his full budget request, regardless of the cost signal observed by the principal. The purpose of this treatment is to provide the incremental effect of the coarse precision cost signal over the fine signal, above, compared to the benchmark case in RSY [2003] no signal. Additionally, the incremental effect is important for comparison with the [OS] signal because here the option of choosing a signal is removed from the agent. Seeing the effect on agent report when he is forced to send the signal provides this experiment with increased information to gauge the effectiveness of giving the agent a choice of sending a cost signal.

In the third treatment, *option signal* [OS], the agent submits his budget request and is given the option of sending a signal, **s**. The signal, if sent, must be truthful. The agent has the option to reveal within which quarter, which eighth of the distribution's support the actual cost lies, or to send no signal at all.[5] Thus, the principal will observe both **B** and **s** or just **B.** The principal is made aware that the agent had the option of submitting the additional truthful signal. The principal will either reject or accept the project, paying **B** to the agent and collecting **R** if he accepts the project.

Running these three treatments allows me to explore the following issues relating to budget mechanisms. The first issue is how a firm should organize its budgeting mechanisms efficiently. In comparing the two always signal treatments ([ASF] and [ASC]) with the [OS] treatment, I am able to assess, by comparing acceptance rates, whether it is more efficient to force an agent to report a cost

5 Since the signal accuracy is based on increments that all break at 100, there is the potential that actual costs very close to 100 will cause the agent to choose to disclose no signal at all. Submitting a signal of any precision could severely limit the amount of slack that the agent is able to consume.

signal or give him the option of the signal. Also, the two “always signal” treatments allow an assessment of the effect of the precision of the cost signal. Further, these treatments provide insights into the most efficient reporting system for both parties pecuniary wealth by comparing the wealth collected in the signaling cases with the no signal benchmark.

The second issue examines the agent's use of the cost signal as a means indicating to the principal that a high budget request was necessary because a high cost was observed. The principal could use the cost signal as a gauge for determining how fair the agent is being with his proposed slack sharing or as a method of trusting that the agent's high budget request is due to high cost. The comparison between the [OS] and [ASF], [ASC] offers insight into whether the agent use his signal only to get a project approved (a strategic motive) or whether he is concerned with both project approval and creating the appearance of fair reporting, which puts importance on both strategic and non-strategic motivations.

To examine these two possibilities I analyze the cost observed by the agent in each treatment and compare his budget requests across the three signaling treatments. Also, given a particular cost, the agent's choice to use a cost signal (in the optional signal case) could provide additional insight. In the [ASC] treatment, an agent may forgo the appearance of honesty in order to capture monetary slack. Since the appearance of honesty likely must be accompanied by some pecuniary reward for the agent, his reports in the [ASC] treatment will begin request without regard for the cost signal, especially as actual costs decrease. For example, if an agent observes an actual cost of 13 and is forced to report a cost signal of [0-50], there is little monetary motivation to also submit a budget request that is between 13 and 50 because that only provides the agent with meager earning in a low cost situation (where both parties could capture high earnings from the project). The agent will likely forgo his desire to report fairly and submit a budget request that exceeds the upper

limit of the cost signal.[6]

For each signal precision and budget request amount in the optional signal, I compare the requests under the optional treatment to the results offered in the corresponding always signal system. For example, an agent who chooses a coarse cost signal in the optional signal case can be compared, by acceptance rates, to an agent in the always signal coarse treatment. How these actions compare can explain the agent's preferences towards strategic and non-strategic motivations and show how they change when the agent is given an option of choosing his cost signal.

The third issue concerns how the principal decides whether to approve projects, knowing the agent has the option of signaling. By comparing the number of approvals and rejections made by the principal across the three treatments, I am able to gauge the affect an optional signal has on the principal's project approval decision. For example, suppose an agent observes a cost of 45 and chooses to request 185 with a coarse signal of [0,50]. The principal may treat this optional signal of [0,50] differently than the forced signal provided in the always signal coarse treatment although the information within the signal is exactly the same. This difference is due to the nature of the agent's choice to send a signal and provide the principal with additional information.

Information sharing between the principal and agent could increase trust between the two parties and convince the principal to accept this project when she may have otherwise rejected it. As another example, the agent observes a cost of 125 and wants to request 150. In the absence of a cost signal, the principal may not be able to trust that the agent had a cost close to 150 as opposed to a cost that was near 0. The inclusion of a coarse cost signal of [101-150] shows the principal that the agent had observed a cost that would justify requesting 150. Therefore, the cost signal increases the principal's trust in the agent. The comparison explores how the principal utilizes a signal that the agent

6 I assume that both the principal and agent will view a budget report that is within the cost signal as honest.

has no choice but to send versus one that he sent by choice. Because the choice of signaling indicates additional information about the non-pecuniary motivations of the agent, utilizing an optional signal scheme may result in a higher number of project approvals.

The fourth issue comes from comparing the principal's decision under the RSY no announcement case to the [OS] treatment where the agent chooses to send no signal. In the RSY no announcement case, the agent has no option of sending any additional cost signal. By comparing the requests in the [OS] treatment that lack a signal to the RSY benchmark case, I can discover the value that the principal puts on optional information (even though no additional information was received) and if that withholding leads the principal to reject projects that would have been accepted if the choice to signal was not present. For example, suppose the agent observes an actual cost of 45 and, in the optional signal treatment, sends a budget request of 165 without any cost signal. Prior research has suggested that requests of 165 are usually accepted but the principal may be hesitant to accept this request because it lacks any cost signal and implies that the agent is withholding information to get more slack from the principal.[7] In other words, the principal is hesitant at the lack of a signal being provided by the agent and may suspect the agent of being unfair because they chose to send no signal (in the example above, the agent could be considered unfair). In comparing these three treatments and the RSY no signal case, this study can isolate the effects that a budget mechanism and an optional choice can have on agency efficiency.

IV. Hypotheses

With the previous issues in mind, I present seven hypotheses. The first is derived from previous budgeting experiments that have shown that non-trivial portions of economically profitable projects will be rejected. Although it is always in the best interest of the principal to approve all projects, she still rejects some projects on the basis that they are unfair distributions of wealth. While irrational

7 See SSWY for verification.

under an assumption of wealth maximization, the rejection of perceived-to-be-unfair offers aids in framing an understanding of the non-pecuniary motives at play in this scenario. Therefore, my first hypothesis is:

> *Hypothesis 1 [H1]:* Under all the [ASF], [ASC] and [OS] treatments a non-trivial portion of budget requests will be rejected.

The second is that a greater proportion of high-cost projects will be funded with the introduction and use of the cost signal. When the agent is faced with a high cost, he will be able to send a verifiable cost signal along with his budget request. While the principal would generally reject a high request, she will be better informed by the signaling mechanism and, in utilizing all available information, will be able to see that the offer, although high, is a fair request from the agent. For example, suppose that actual cost is very high, say 188 and that no cost signal was available to the agent. In this case the agent is likely to be afraid that any budget proposal, even one that provides very little personal slack, will get rejected by the principal on grounds that it is unfair and that the agent is being very selfish and unfair.

By incorporating a cost signal in with his report, the agent can provide the principal with enough information to distinguish a high request that resulted from a high-cost state from a high request where the agent is being selfish and unfair. To the principal, a cost signal indicates an additional bit of information that can be used to gauge the agent's request. With the cost signal, the principal is better able to judge fair and unfair cost requests. This situation leads to less information asymmetry about the agent's intentions for the principal and should cause a higher number of request approvals.

> *Hypothesis 2 [H2]:* The existence of the cost signal will lead to a greater frequency of approvals for high cost requests compared to the RSY benchmark. This effect should be equally strong in the [ASF], [ASC] and [OS] treatments because the agents should be inclined to send cost signal information in the high-cost case (actual costs between 160 and 200).

The third and fourth hypotheses compare rejection rates among [OS], [ASF], [ASC], and [NS] RSY benchmark. Under the [ASF] treatment, the agent is more likely to report inside of the cost signals range. Much like the HRT results, even in cases where the agent has strong incentive to make high budget requests and capture larger amounts of slack, the agent may not do so, because reporting outside the cost signal may imply unfairness to the principal. For example, when actual costs are 89, the agent is aware that the signal that will accompany his request will indicate that actual costs were between 76 and 100. Although the agent in the absence of a signal would like to request approximately 150, he may feel he is better off submitting a request that is close 100 for fear of being perceived as unfair due to the signal sent to the principal.

From the principal's perspective, any budget request outside the signal's range could indicate unfairness by the agent and, depending on her threshold for fairness, could be rejected by the principal. Knowing that this is a possibility, the agent is likely to submit budget requests that are closer to his cost signals and more of his requests should therefore be approved. When the agent is forced to submit a coarse signal in the [ASC] treatment, the agent is better able to make requests within the cost signals range without facing as much pressure of rejection due to the principal's preferences towards fairness. Given the easing of the pecuniary motivation to misrepresent, the [ASC] treatment may see fewer reports outside of the signal range and the principal will have more reason to approve projects.

Under the [OS] treatment, the agent will send precise signals in the high-cost range (in order to get his projects approved) and the signal he sends will become coarser as costs decrease because the agent will not feel as inclined to indicate a high-cost state to get his project approved. Due to this gradual decrease in precision will limit the accuracy of information available to the principal, the agent will be better able to send requests without cost signals that appeal to the principal's first-order preferences for monetary wealth without having as much pressure of rejection from the principal's second-order

preferences towards fairness. In either case, each treatment will have a lower rejection rate than the [NS] benchmark. Therefore our third and fourth hypotheses are:

> *Hypothesis 3 [H3]:* The [OS], [ASF] and [ASC] treatments will have a lower frequency of rejection than the [NS] benchmark.
>
> *Hypothesis 4 [H4]:* The [ASC] and [ASF] treatments will have a higher frequency of rejection than the [OS] treatment.

Closely related to hypothesis 2, above, is the case where costs are low, a cost signal is being used, and the agent still requests a high amount. For example, the agent views a cost of 35 and is in the always signal fine treatment. In this case, the agent has to send a cost signal of [26-50] but, the agent requests 175 from the principal. The principal observes both the cost signal and the agent's request, which are contradictory. For the principal, this contradiction implies that the agent is being unfair with his budget request and she may be more likely to reject this investment.

This situation should also arise in the ASC treatment but not in the OS treatment. This assumption is based on the idea that the agent could choose to send no signal if they wanted to request significantly outside the cost signal. I hypothesize that the principal will reject such requests more often than when no signal was sent. Whereas information asymmetry exists in a no signal treatment, an agent being forced to send a signal has more information symmetry with the principal and will find that high budget requests that are not accompanied with high cost signals will be rejected more often.

> *Hypothesis 5 [H5]:* When the agent sends budget requests that are significantly higher than the cost signals (more than one quarter of the cost distribution different), there will be a greater frequency of rejections than when requests are less than 50 different from the cost signal. This effect will be strongest in the [ASC] treatments because the agent is forced to send a cost signal that already has a wide range for misrepresentation.

The sixth hypothesis pertains to the [OS] treatment. As actual costs decrease, the agent will send signals that are less precise. This situation will continue until the most extreme case is reached in the lowest section of possible costs (between 0 and 20 actual cost). In the highest cost situations (between 180 and 200 actual cost), the agent is likely to send the most precise cost signal along with his budget request, because without the additional signal the principal is likely to reject the budget request.

As the actual costs decrease, the agent is less inclined to use a precise cost signal because, from the agent's perspective, it is unnecessary to send a cost signal if his budget request is relatively low and still provides him with a fair amount of slack. It is thus very unlikely that the agent would send a precise cost signal and admit that his slack consuming budget request is a misrepresentation of actual cost and could be viewed as unfair by the principal. In other words, the agent will allow the information asymmetry to increase as costs decrease because his budget requests will be low enough that they offer the agent a fair amount of profit and the agent does not want to over inform that principal as to convince her that he is being unfair.

However, there is a drawback to the agent of having optional signals for the agent available. Suppose the agent makes a somewhat high budget proposal (145), a proposal that normally would be accepted without the availability of signals. The principal might be expecting a signal that indicated that the actual cost was at least moderately high, either a coarse signal of [101-150] or a fine signal of [101-125] or [126-150]. Otherwise she might suspect that the agent is attempting to exploit his informational advantage by asking for a lot of funding when the actual cost is quite low. Knowing that the principal is expecting some indication of actual cost, the agent is inclined to send a coarse cost signal in an effort to appease the principal's desire for information in making his approval decision. This change in signaling behavior by the agent brought on by the option to send the verifiable signal may cause the agent to submit the coarse cost signal until the actual costs are low enough that any reasonable budget request will be

accepted.

> *Hypothesis 6 [H6]:* In the [OS] treatment the agent will accompany their request with the most precise signal possible in the highest cost range (actual costs between 175 and 200). As costs decrease, the agent will send coarser and coarser signals, until actual cost is in the lowest tenth of the distribution, and then he will send no cost signal with his request.

The seventh hypothesis is that the principal will reject more proposals that lack a cost signal in the [OS] treatment than in the RSY benchmark case. Knowing that the agent had the option of sending a cost signal and decided not to will be an important indication for rejection by the principal. Because the agent neglected to provide the principal with a metric to judge the fairness of his request, the principal is more likely to assume that the agent is being unfair and reject his request. I believe that this outcome will happen more often then when no signal requests are made in the RSY benchmark case. Essentially, the choice not to send a signal will be interpreted by the principal as an indication of misrepresentation by the agent. This will lead to a requested amount that is approved in the RSY [NS] case being rejected when submitted in the [OS] case without a signal.

> *Hypothesis 7 [H7]:* The lack of a signal in the [OS] treatment will lead to a higher frequency of rejections than similar requests in the RSY [NS] case.

V. Results and Discussion:

One session was run for each of the three treatment using undergraduate students from The Ohio State University. The total number of participants (agents and principals) were 18, 20, and 22 for *Always Signal Coarse, Always Signal Fine,* and *Optional Signal*, respectively. In each session, 15 rounds of play were administered, with each round consisting of a single investment. After each round, participants were re-paired randomly. Sessions lasted ninety minutes and average monetary payment for participating was $16.44, which included a $10

show-up fee.[8] Participants were paid in private at the end of the experiment.

Table 1: Summary Statistics

	n	Cost	Budget Request	Acceptance Rate**	Agent Share of Slack	Principal Share of Slack
ASF	150	96.82 (56.89)	157.86 (28.43)	0.813** (0.39)	0.56 (0.09)	0.44 (0.09)
ASC	135	98.12 (55.989)	150.53 (37.89)	0.711** (0.45)	0.5 (0.18)	0.5 (0.18)
OS	165	97.55 (57.22)	146.98 (37.22)	0.769** (0.42)	0.45 (0.18)	0.55 (0.18)
*NS**	510	98.52 (59)	162.06 (24.03)	0.661** (0.47)	0.59 (0.17)	0.41 (0.17)

Cells contain means and standard deviations in parentheses

* Data is from RSY [2003]

** Acceptance Rates all significantly less than 1

Table 1, above, provides summary statistics of all rounds for all costs. The total number of projects was 9(15) = 135 for [*ASC*], 10(15) = 150 for [*ASF*], and 11(15) = 165 for [*OS*]. Although not statistically significant, acceptance rates are greatest for the [*ASF*] treatment as opposed to my hypotheses that the [*OS*] treatment would lead to the highest rate of acceptance. Consistent with my expectations, the [*OS*] treatment has fewer rejections than in the [*ASC*] treatment and by a greater margin than between the [*OS*] and [ASF] treatments. I believe that the agent had to spend time learning how to use the cost signal that led to lower rates of acceptance. I explore this issue more throughly later in this analysis.

Directly related to *[H1]*, I find that all three treatments had mean acceptance rates that were significantly less than 1 (perfect approval). For each treatment, we reject the null hypotheses of acceptance rates equal to 1 (all one-tailed p-values where less than 0.001). Therefore, this data suggests that principals still reject otherwise profitable offers and are including non-pecuniary motivations in their investment decisions.

Tables 2a to 2b, below, display the analysis on acceptance rates by cost

8 The subjects were told about a $5 show-up fee as per the instructions included herein. Due to a computer error during the first session, subjects received additional payments of $5 in an attempt to keep monetary payments equal across sessions. Subjects from the first session were paid for the experimental rounds up to the crash, which averaged about $5.

ranges between each treatment. Hypothesis 2 predicted that the existence of a cost signal would lead to more approvals in the highest cost region compared to the RSY benchmark. As Table 2a indicates, mean acceptance rates for all three treatments were significantly greater than the no-signal benchmark when costs were greater than 160 (0.6207, 0.4615, 0.4545, and 0.2353 for ASF, ASC, OS, and NS respectively).

Table 2a: Acceptance Rates by Cost Summary

		Region I			Region II			Region III		
		Costs >=160			Costs 120>=x<160			Costs <120		
		N	Accept Rate	Request Mean	N	Accept Rate	Request Mean	N	Accept Rate	Request Mean
Treatment	*ASF*	29	.6207	191	30	.8333	177	91	.8681	141
	ASC	26	.4615	192	28	.5714	171	81	.8395	130
	OS	33	.4545	188	33	.7576	166	99	.8788	127
	*NS**	102	.2353	188	101	.5446	171	307	.8404	151

* Data is provided by the RSY no-communication treatment

Table 2b: t-test to determine equal means between treatments by cost regions

Null Hypothesis: Mean AR between treatments are equal		ASF			ASC			OS		
		t-statistic	p-value	df	t-statistic	p-value	df	t-statistic	p-value	df
ASC	Costs >=160	1.18	0.12	51.98						
	Costs 120-160	2.24***	0.014***	56						
	Costs <120	0.53	0.3	163.6						
OS	Costs >=160	1.31	0.098	59.3	0.05	0.48	53.7			
	Costs 120-160	0.7	0.23	60.9	-1.55	0.063**	59			
	Costs <120	-0.22	0.41	185.3	-0.75	0.23	161.6			
NS*	Costs >=160	4.15***	<.001***	129	2.32***	0.01***	126	2.45***	0.008***	133
	Costs 120-160	2.92***	0.002***	129	0.25	0.4	42.9	2.19***	0.015***	132
	Costs <120	0.62	0.25	157.2	-0.02	0.49	124.9	0.93	0.18	404

* Data is provided by the RSY no-communication treatment

** Denotes Significance at 85% confidence (p-value <0.075)

*** Denotes Significance at 95% confidence (p-value <0.025)

To analyze *[H2]* further, I performed a series of one-tailed t-test comparing the mean acceptance rates of each treatment for three cost regions (costs greater than 160, costs between 160 and 120, and costs less than 120). Although not significant in all cases, the existence of a signal did lead to higher approvals of high-cost projects. For the highest cost region (160 and above), all three treatments had significantly greater mean acceptance rate than the NS benchmark case (t-statistics of 4.145, 2.321, and 2.451 for [ASF], [ASC], and

[OS] respectively). Based on these findings, I support *[H2]*s claim that the existence of a cost signal leads to more approvals in the high cost cases.

Using a post-hoc questionnaire given after all the decision rounds, I asked participants to indicate their preference for various statements (a copy is contained in appendix B). Participants were given a set of statements and asked to choose, on a seven point scale, whether they agreed or disagreed with the statement (1 was completely disagreed, 4 was neutral, and 7 was completely agree). Table 3a, below, and Table 3b, below, contains the mean responses for each player type by treatment.

Table 3a: Questionnaire Mean Responses by Treatment

Principal Questions		Q1	Q2	Q3	Q4	Q5
		Mean	Mean	Mean	Mean	Mean
TREATMENT	ASF	5.3000	4.0000	6.0000	3.5000	5.1000
	ASC	3.3333	4.0000	5.3333	3.7778	4.0000
	OS	5.2727	3.7273	5.1818	4.0909	4.7273
TOTAL:		4.6354	3.9091	5.5051	3.7896	4.6091

Q1: The other player's request had to provide a fair allocation of profit for me to approve the project

Q2: If the other player did not include a cost signal, I was more likely to reject the project

Q3: If a high budget request from the other player was coupled with a cost signal indicated a high actual cost, I was still willing to approve the project even though it offered me very little profit.

Q4: If the other player's budget request was outside of the cost signal, I was more likely to reject.

Q5: I used my power of rejection to punish the other player for unfair budget requests.

Table 3b: Questionnaire Mean Responses by Treatment

Agent Questions		QA	QB	QC	QD	QE	QF
		Mean	Mean	Mean	Mean	Mean	Mean
TREATMENT	ASF	4.9000	3.3000	3.7000	2.1000	4.5000	2.4000
	ASC	5.1111	3.8889	4.8889	2.6667	4.6667	2.7778
	OS	4.4545	4.0909	4.2727	2.9091	4.8182	2.2727
TOTAL:		4.8219	3.7599	4.2872	2.5586	4.6616	2.4835

QA: I wanted to leave the other player with a fair amount of profit.

QB: I wanted to report honestly to the other player.

QC: I used the cost signal as a means of indicating my honest reporting.

QD: I cared about sending a budget report that was within the cost signal's range.

QE: The possibility that the other player could reject a project kept my budget request conservative

QF: I did not consider the other player's profit when making my budget request.

One motivation I suggested for *[H2]* was that the agent could use the cost signal to help ease the information asymmetry and moral hazard problem when faced with a high cost. Question three asks the principal whether a high budget

request that was coupled with a cost signal indicating high cost would be approved even though the request offered very little monetary incentive. I performed a one-sample t-test on the mean response for all treatments (5.501) using the null hypothesis that the mean was equal to 4 (neutral) and rejected the null hypothesis at the 95% level (t-statistic of 4.901). Additionally, I performed three one-sample t-tests on each of the treatments for this question and discovered that all three treatments achieved at least 90% confidence (t-statistics of 4.243, 2.066, and 2.358 for ASF, ASC, and OS respectively). This finding further suggests that the existence of the cost signal led to higher approval rates for high cost projects. Based on these findings, I further support *[H2]*.

[H3] compares the acceptance rates between the treatments and the RSY benchmark case. The overall acceptance rates for the three treatments and the RSY benchmark are contained in Table 1, above. Using a one-way t-test, treatments ASF and OS have acceptance rates that are significant at the 95% level (t-statics of 3.598 and 2.633 for ASF and OS respectively) and are not significant for the ASC treatment (t-statistic of 1.106). The results for the ASF and OS treatments were as predicted but, not for the ASC treatment. I believe that this is driven by the lack information precision included in the coarse cost signal.

Notice that mean acceptances in ASC dramatically dropped between regions II and III (0.84 to 0.57). This drop implies that the principal is not satisfied with the information content of the agent's cost signal as costs increase and are less willing to approve projects. Additionally, the region III mean acceptance rate for ASC is slightly less than the NS benchmark (0.8395 compared to 0.8404 for ASC and NS). This result also supports my explanation for the contradiction in the ASC results. Despite these limitations, this test still provides overall support for *[H3]* and indicates that the existence of a cost signal leads to more approvals than in a no-signal setting conditional on the information content of the signal.

In *[H4]*, I predicted that the OS treatment would lead to the highest acceptance rate among the three treatments. Instead of the predicted outcome, the ASF treatment had the highest acceptance rate (81%). To better understand

how the agent's report depended on the actual cost, I split the treatments into three cost groups that are disclosed in Tables 2a to 2b, above. It is important to note that the OS treatment did have the lowest mean budget request in every cost region. This result implies that the agent sends lower budget requests when given the option of a signal. This finding is especially important to productive and social efficiency because lower requests are both more likely to get approved and provide both parties with a more equal share of total slack.

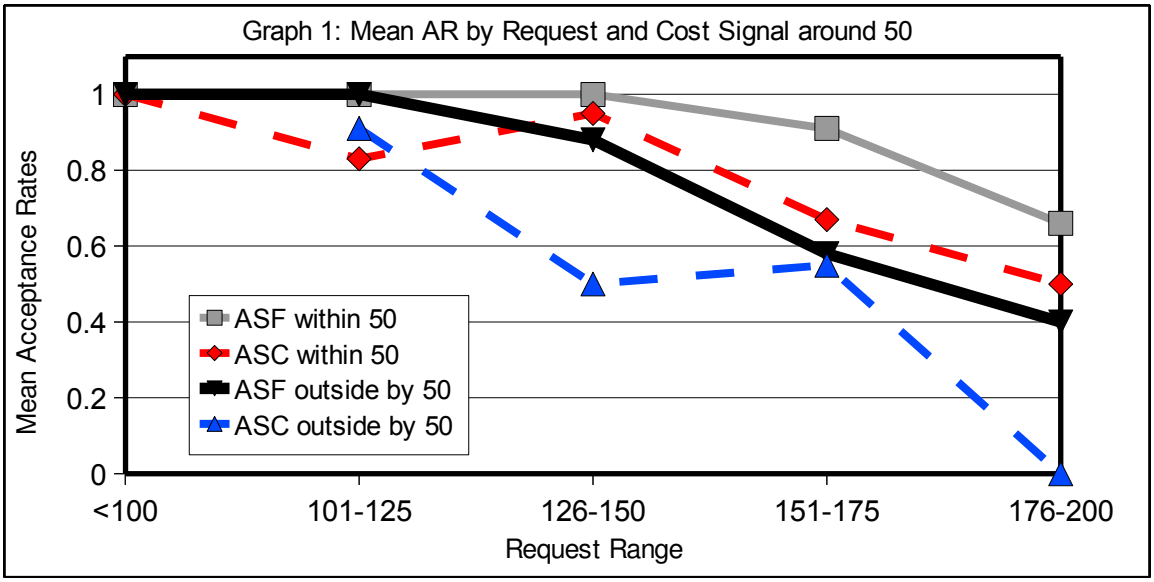
The acceptance rate for the OS treatment dramatically increased from region I to region II and caused the acceptance rate for OS to be significantly greater than the ASC treatment (t-statistic 1.55). As discussed later in this analysis, this increase is due to the agent's effective use of the optional cost signals in the high cost regions. This efficiency allowed the agent to reduce the information asymmetry between him and the principal and led to a higher number of approvals. Despite this increase, the ASF treatment still has the highest acceptance rates in each cost region. Based on this data, I reject hypothesis four *[H4]* because the ASF treatment and not the OS treatment had the highest acceptance rate.

[H5] predicts that budget requests that are significantly outside the cost signal will face a higher frequency of rejection. To better analyze this hypothesis, I controlled for the agent's request and then determined if that request was within 50 of the cost signal. That data is disclosed in Table 4, below. The OS treatment was excluded because there were very few instances of the budget request being more than 50 different from the cost signal sent. To appropriately analyze this hypothesis, I first examine whether requesting significantly outside the cost signal leads to more rejections and then compare between the treatments to determine if the effect is stronger in the ASC treatment.

Table 4: Mean Acceptance Rates by Request closeness to Cost Signal

	Request <100		Requests 101 - 125		Requests 126 - 150		Requests 151 - 175		Requests >175		Total	
	N	Mean AR	N	Mean AR	N	Mean AR	N	Mean AR	N	Mean AR	N	Mean AR
Treat	**Request within 50 of the Upper Bound of Cost Signal Range**											
ASF	2	1.00	2	1.00	15	1.00	23	0.91	44	0.66	86	0.80
ASC	16	1.00	6	0.83	19	0.95	33	0.67	30	0.50	104	0.73
Treat	**Request greater than 50 different than the Upper Bound of Cost Signal Range**											
ASF	3	1.00	20	1.00	24	0.88	12	0.58	5	0.40	64	0.83
ASC	-	-	11	0.91	8	0.50	11	0.55	1	0.00	31	0.65

For the both treatments, the results are generally predicted by my hypothesis. When sending a budget request that was more 50 different from the cost signal, the investment was rejected more often than when the request was within 50 of the cost signal. Graph 1, below, offers a visual representation of the effect of requesting within 50 of the cost signal compared to when the agent's request was more than 50 different than the cost signal. From this analysis, requesting significantly outside the cost signal led to greater rejections by the principal.



When considering whether the effect of sending a request that is more than 50 greater than the cost signal is stronger in ASC than ASF, I compare the means within each request region for each treatment. The differences between mean acceptance rates within each ASF request region are 0 (1.00 – 1.00 for the <100 region), 0 (1.00 – 1.00 for the 101-125 region), 0.22 (1.00 – 0.88 for the

126-150 region), 0.33 (0.91 – 0.58 for the 151-175 region), and .26 (0.66 – 0.40 for the 176-200 region), which is a mean difference of 0.162. Whereas the differences between mean acceptance rates for each ASC request region are -0.08, 0.45, 0.12, and 0.50 (I excluded the <100 region because no data exists for the agent requesting outside the cost signal by 50 for the ASC treatment), which is a mean difference of 0.248. These differences suggest that the effect of getting more rejections for requesting significantly outside the cost signal is greater in the ASC treatment. From the principal's perspective, a request that is at great odds with the cost signal would indicate that the agent is over-requesting in an attempt to gain excess slack from the investment. Considering the wide distribution of the coarse signal, it makes sense that the principal would be more willing to reject requests over 50 different from the coarse cost signal.

Table 5: Mean Acceptance Rates by Request closeness to Cost Signal

	Request <100		Requests 101 - 125		Requests 126 - 150		Requests 151 - 175		Requests >175		Total	
	N	Mean AR	N	Mean AR	N	Mean AR	N	Mean AR	N	Mean AR	N	Mean AR
Treat	**Request within 25 of the Upper Bound of Cost Signal Range**											
ASF	-	-	-	-	2	1.00	12	0.92	33	0.67	47	0.75
ASC	11	1.00	6	0.83	4	0.75	33	0.67	28	0.50	82	0.67
Treat	**Request greater than 25 different than the Upper Bound of Cost Signal Range**											
ASF	5	1.00	22	1.00	37	0.92	23	0.74	16	0.56	103	0.84
ASC	5	1.00	11	0.91	23	0.83	11	0.55	3	0.33	53	0.77

To further understand the threshold effect of requesting outside the cost signal, I ran the same analysis as above except that I changed the cutoff from 50 to 25. The results form this analysis are contained in Table 5, above. Using the 25 cutoff, the effect in the ASF treatment appears to be the same, although there is limited data for the lower request regions. For the ASC treatment, the effect is far less pronounced and, in the middle request regions, requests that differ by more than 25 have higher acceptance rates than those within 25 of the signal. This effect is graphically represented in Graph 2, below. These contradicting results could be driven by a tendency for agents in the ASC treatment to send requests that are greater than 25 from the cost signal but less than 50. Within this requesting area, principal's are still very likely to accept a reasonable request, which the middle request regions represent (the principal is getting

between 99 and 50, if the projected is accepted). This conclusion is supported by the severe decrease in acceptances for the requests differing by more than 25 in the higher request regions of the ASC treatment.

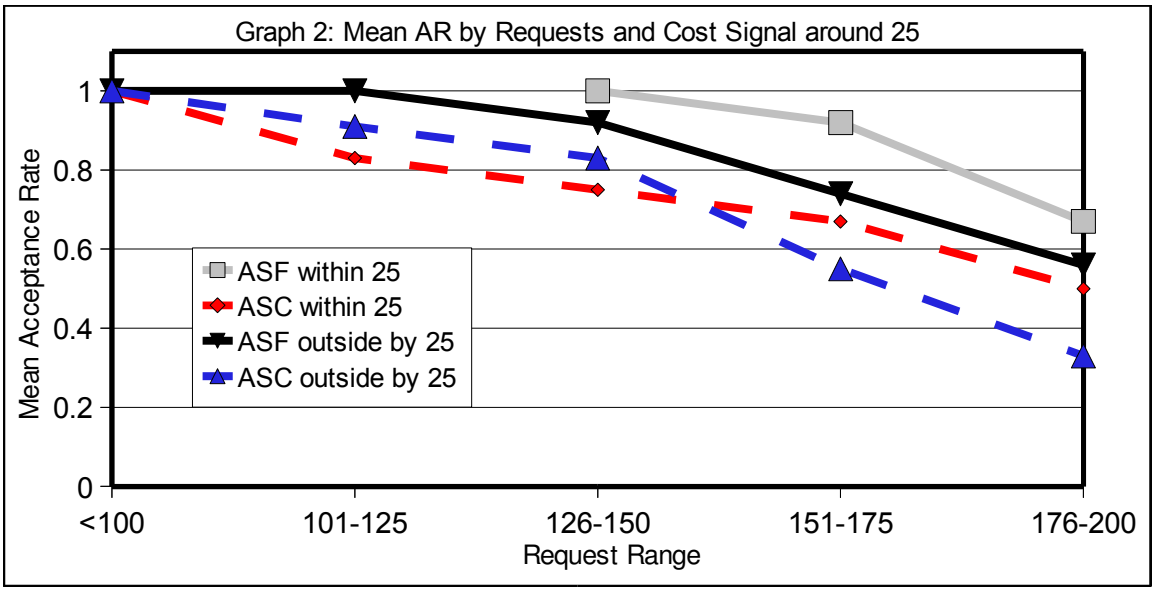
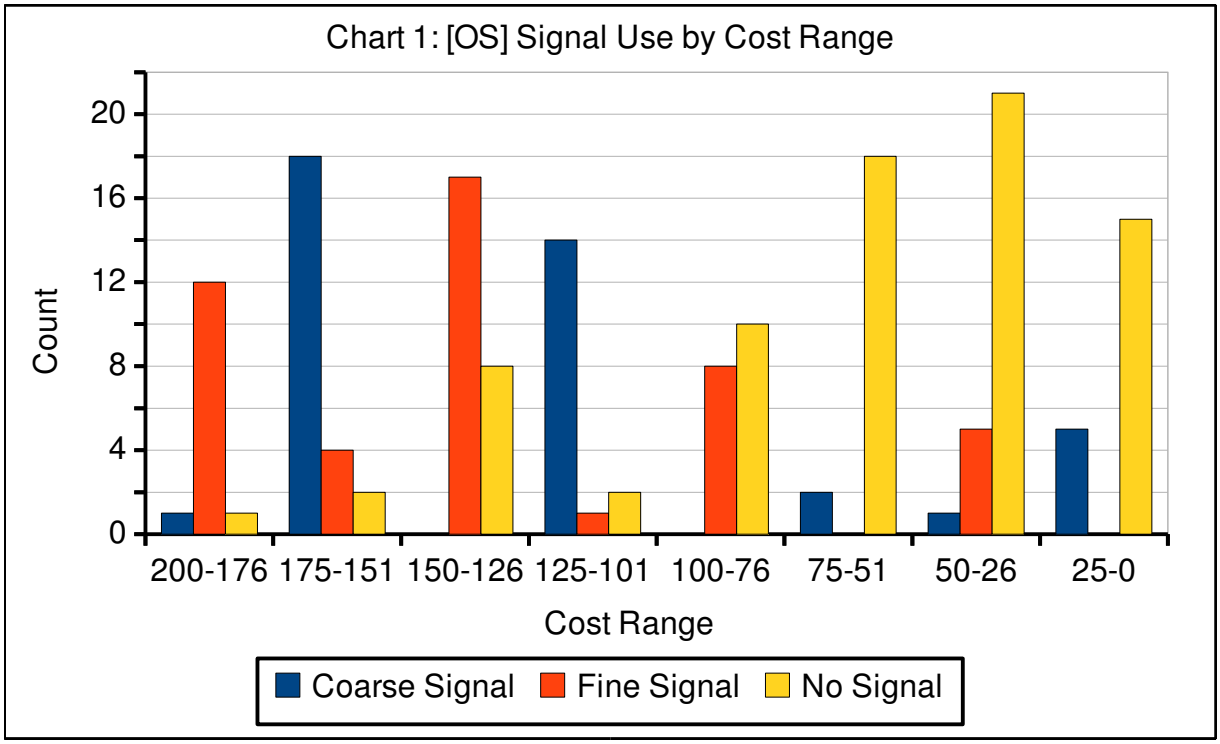


Chart 1, below, shows the signal use from the [OS] treatment for each eighth of the cost distribution. This data provides support for *[H6]* because, the agent sends the fine signal more often in the high cost cases. As costs decrease, the agent sends more coarse signals and then, with costs less than 100, they send no signal with an overwhelming majority. Furthermore, the agent utilizes the limited information contained in the coarse in a way that is more efficient than this hypothesis predicts. The use of the coarse signal is favored in the 175-151 cost range, which could suggest that the agents are sending coarse information at an inappropriate cost level. Instead, sending a coarse signal in this range ensures that the agent's request will be within the signal that he sends. For example, sending a coarse signal for an actual cost of 167 means that the principal observes [151-200], which would encompass any possible budget request. Using the coarse signal in this way provides the principal with just enough information for her to see that the agent observed a high cost. In a setting where the fineness of the signal indicates more work for a firm's internal auditor, this use of a coarse signal in a relatively high cost setting would be an efficient allocation of the firm's

resources. Based on this analysis, I find that the data supports hypothesis six *[H6]*.



Additionally, the agent reverted to mostly using the fine signal in the 150-126 cost range. At first glance, this appears to be a contradiction to hypothesis six. Instead, I propose that this increase is due to a "boundary effect" that arises due to the cutoffs for the fine signal. When the cost is in the upper half of a coarse signal's distribution (as is the case for costs between 150-126), the agent may be using the fine signal to give the principal a better understanding about costs so that they can capture more budget slack without appearing unfair. For example, compare the options available to the agent when actual cost is 126 versus 125. In the 126 case, the agent could send a coarse signal of [101-150] and could assume that the principal would estimate that actual cost is around 125 (one half of the costs signal range) or the agent could send a fine signal of [126-150] and could assume that the principal would estimate that actual cost is around 138 (one half of the cost signal range). By using the fine signal, the agent can increase his budget request without making the principal think he is being

greedy or unfair. Alternatively, using the coarse signal would force the agent to be more conservative with his budget request so as still to appear fair to the principal because the principal's estimation about actual cost is lower. In the 125 case, the use of a fine signal decreases the principal's estimate about actual cost and is therefore less attractive for the 101-125 cost range.

[H7] predicted that an agent who did not include a cost signal would have their investment rejected by the principal more often than in similar cases where no signal was possible. To better analyze this hypothesis, I controlled for the agent's request (in ranges) and compared the mean acceptance rates between the OS treatment (with no signal sent) and the NS benchmark.

Table 6: Mean AR in OS No-Signal v. NS Benchmark

		OS Treatment with no signal sent			**NS Benchmark**		
		Mean AR	N	%	Mean AR	N	%
Request Range	200 - 161	0.27	11	14%	0.48	294	58%
	160 121	0.86	50	65%	0.90	194	38%
	<120	1	16	21%	1	22	4%
	Total	0.81	77	-	0.66	510	-

Table 6, above, shows the result of that analysis and provides support for my hypothesis. For every request range, the agents that sent no signal in the optional signal treatment had a lower acceptance rate than in the no signal benchmark. More interesting to this analysis is which requests the agent sends in the OS treatment with no signal sent compared to the NS benchmark. In the no signal benchmark, agent's chose to send high budget requests 58% of the time but, in the optional signal treatment when no signal was sent, this request was only chosen 14% of the time. Instead, agents in the OS case recognized the negative image associated with sending no signal and requesting a high amount when the principal is aware that a cost signal was an option. When no signal was sent (and the option to send was present), the agent requests a more

conservative amount of slack. This results suggests that giving an agent the option of sending a signal can cause him to lower requests regardless of whether he chooses to utilize the signal or not.

To further understand how the agent is using the cost signal in the optional signal treatment, I controlled for both cost and request and analyzed the type of signal used in each case. The results of this analysis are contained in Table 7, below.

Table 7: Optional Signal use by Cost and Request

		Requests Are Between			
		101-125	126-150	151-175	176-200
Cost is between	101-125	0 # of NS 1 # of FS 0 # of CS	0 # of NS 0 # of FS 8 # of CS	2 # of NS 0 # of FS 5 # of CS	0 # of NS 0 # of FS 1 # of CS
	126-150		0 # of NS 5 # of FS 0 # of CS	7 # of NS 12 # of FS 0 # of CS	1 # of NS 0 # of FS 0 # of CS
	151-175			1 # of NS 0 # of FS 3 # of CS	1 # of NS 4 # of FS 15 # of CS
	176-200				1 # of NS 12 # of FS 1 # of CS

NS = No signal, FS = Fine signal, CS = Coarse signal

This table provides additional support for the ideas discussed in analyzing hypothesis six and also provides additional insights into how the agent engages in image management. When the cost is between 151 and 176, the agent sends a coarse signal in most cases and requests in the upper portion of that signal. This implies that the agent is using the optional signal efficiently and uses the coarse signal's incomplete information to capture additional slack. Also, the 126 to 150 cost range has the agent mostly using the fine signal and requesting within 25 of that signal. So, the fine signal is used by the agent to reduce information asymmetry and is beneficial to the principal because the agent's requests are tethered to that cost signal.

In the 101 to 125 cost range, the use of the fine signal when the agent requested within that range suggest that the agent is participating in some image

management. The use of any signal when costs are that low is unexpected and the only plausible reason that an agent would use the fine signal in this case would be to show the principal what a nice person he is. It is also important to note that the principal utilizes the coarse signal in the 126 to 150 and 151 to 175 request ranges in a manner that allows him to increase the principal's estimation about actual cost and capture additional slack.

Another complexity that I have yet to analyze is the effect that random repairing may have on the OS treatment. In all treatments, agents are randomly repaired with different principals after every decision round. As Table 8 shows for the OS treatment, each principal exhibits a different type when making their investment decision. For example, principals 7, 11, and 21 only rejected 1 project in all 15 rounds of play. For an agent that was randomly paired with these three principals, his use of a cost signal might not be important for getting his project approved but, when he is randomly repaired for the next round, his new principal pairing could put more weight on the cost signal when making their investment decision. Therefore, it is harder for agents to learn how to effectively utilize the cost signal because the agent's use depends on how he believes the principal will use a cost signal and the principal's type of play is an important component that is unknown to the agent.

Table 8: A/R by Principal		OS Treatment			ASF Treatment			ASC Treatment		
		Reject	Accept	AR	Reject	Accept	AR	Reject	Accept	AR
		Count	Count	Mean	Count	Count	Mean	Count	Count	Mean
Principal Number	*1*	4	11	0.73	5	10	0.67	0	15	1.00
	3	2	13	0.87	2	13	0.87	0	15	1.00
	5	8	7	0.47	4	11	0.73	8	7	0.47
	7	1	14	0.93	3	12	0.80	0	15	1.00
	9	8	7	0.47	0	15	1.00	5	10	0.67
	11	1	14	0.93	2	13	0.87	7	8	0.53
	13	2	13	0.87	5	10	0.67	4	11	0.73
	15	5	10	0.67	3	12	0.80	7	8	0.53
	17	4	11	0.73	1	14	0.93	8	7	0.47
	19	2	13	0.87	3	12	0.80	-	-	-
	21	1	14	0.93	-	-	-	-	-	-

Table 8 also includes the principle mean acceptances for the ASF and

ASC treatments. Although these types do not have any affect on signal use, the importance of principal type to the amount requested would be similar. In comparison, the ASC treatment had the most habitual approvers and more principals who rejected about 50% of the investments they were presented with. These principal types may have led to the decreased approval rates in the ASC treatment.

For the OS treatment, these challenges to agent learning give more meaning to the results displayed in table 7 provide additional evidence that the strategic use of the signal survived, despite issues of principal type (for example always approvers). Additionally, I analyzed how the agent used the cost signal in the first three rounds of the experiment compared to the remaining decision rounds. These results are contained in Table 9, below.

Table 9: Cost Signal Use by Round

		First Three Rounds		Last 12 Rounds	
		N	%	N	%
Cost Signal	No signal	17	52%	60	46%
	Coarse Signal	6	18%	41	31%
	Fine Signal	10	30%	31	24%
	Total	33	-	132	-

As I predicted, the agent faces a certain amount of learning on how to use the cost signal. The data suggests that the agent overuses sending no signal in the first three rounds and, as the decision rounds continue, learns how to more effectively use his cost signal options. The coupling of the principal type playing, dependent on cost signal sent, and the agent's learning process in the first rounds of the experiment can help to explain why the OS treatment had a lower mean acceptance rate than the ASF treatment. These effects were not as strong in either always signal treatment because the principal did not have to take the agent's choice of signaling into consideration for her investment decision.

VI. Conclusions

I conducted an experiment designed to investigate the effect of a verifiable cost signal and an agent's optional use of that signal in a budgeting setting. This setting incorporates many key elements of budgeting settings including: information asymmetry, limited liability of employees, and limitations on commitment by superiors. Within this setting, I administered three treatments: [ASF] Always Signal Fine, wherein the agent has to include a truthful cost signal that indicates which eighth of the cost distribution the actual cost lies, [ASC] Always Signal Coarse, wherein the agent has to include a truthful cost signal that indicates which quarter of the cost distribution the actual cost lies, and [OS] Optional Signal, wherein the agent has the option of including either a fine signal, a coarse signal, or no signal. For my analysis, I was able to use the data gathered during the RSY no-announcement treatment as a benchmark [NS] no-signal case.

This study has four main findings:

1. That the existence of a cost signal leads to a higher number of approvals when actual costs are high.
2. That, when given many signaling options, the agent strategically chooses the signal that is appropriate for observed cost in order to get the investment approved. This includes both the use of the fine signal in the high cost case and the use of no signal when costs are low.
3. That forcing an agent to signal provides the principal with enough information to set a maximum amount over the cost signal that the principal sees as unfair. I found that this signal exists at approximately 50 greater than the upper bound of the cost signal.
4. That, when an agent has the option of signaling and chooses not to, the agent also sends a lower budget request then when no signal was possible.

The first findings effect was strongest for the ASF treatment and has impacts for the overall social efficiency that is possible by utilizing a cost

signaling mechanism. It is important to note that this effect was not statistically significant for the ASC treatment and indicates that the range around cost of the signal being sent is important, especially in the high cost case. The second finding supports the notion that agents are able to understand that strategic elements of a cost signal and use them in budgeting. The best display of this efficiency is when the agent chooses to send a coarse signal when costs are between 151 and 176 because doing so allows his request to be within the signal without providing the principal with excessive information.

The third finding indicates that the cost signal serves a monitoring mechanism for the principal and she is able to make her investment decision contingent on both the signal and the agent's request. Assuming that a firm had resources in place to force agents to send verifiable cost signals, such as internal audit departments, the enforcement of such a signaling scheme could keep agent requests within a reasonable amount of the cost signal. The fourth finding suggests that giving the agent the option of signaling causes him to be more conservative with his requests when he chooses not to utilize the optional signal. This result implies that, even though an option is not pursued, the fact that the option was available was common knowledge had an effect on agent behavior. This is a important finding of this study and needs to be analyzed further.

My study adds to the ongoing work in using budgeting studies to explore the conflict between standard agency assumptions and the addition of non-pecuniary motivations in hopes of improving our knowledge of the budgeting process. This study highlights the potential importance that verifiable and optional cost signals can make in improving budgeting scenarios. One possible extension of this work would be to include treatments where the agent has the choice between no signal and each signal, individually. Further studies in this area should explore the continued choice of the agent beyond just two signals and the ability of an agent to choose the correct cost signal in such complex settings.

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Appendix A: Instructions

Welcome and thank you for participating in this experiment. Your pay will depend on the decisions you make in today's session. At the end of today's session, you will be paid in private and in cash. It is important that you remain silent and do not look at other people's work. If you have any questions, or need assistance of any kind, please raise your hand and an experimenter will come to you.

Before the first decision round begins, half of the participants will be assigned to be a Player One and half will be assigned to be a Player Two. You will then remain in that same role for all decision rounds. Each of you has an assigned subject number. At the beginning of each decision round, subjects are randomly paired by subject numbers. There will be X decision rounds. Both players will receive $10 for participating in the experiment.

Overview

Each period, the cost of implementing a project is randomly determined and revealed only to Player Two. The cost is randomly drawn each period from the set of possible costs (0,1,2,3,...,199,200). These numbers represent pennies (i.e., 200=$2.00). Each number is equally likely to be drawn each period. Player Two then learns the cost. Player One NEVER LEARNS THE ACTUAL COST. If approved, the project yields revenue of 200 ($2) to Player One. If the project is rejected, both players receive nothing from the investment.

Always Signal Setting

Player Two's Task

At the beginning of each decision round, Player Two privately observes the actual cost. After observing the actual cost, Player Two submits a budget request to Player One. The budget request must be equal to or greater than the actual cost. In addition to submitting the budget request, Player Two also submits a signal that indicates in which $1/4t^h$ of the cost distribution the actual cost lays. The signal can be 0-50, 51-100, 101-150, 151-200 and will always be consistent with the actual cost.

Player One's Task

Each decision round Player One receives a budget request and cost signal from Player Two. Based on the request and signal, Player One chooses to either accept or reject the budget request made by the Player Two with whom they were matched in the round. If accepted, Player One pays the budget request to Player Two and receives the project revenue of 200 ($2). The payoff for Player One is the 200 minus Player Two's budget request. The payoff for Player Two is the budget request minus the actual cost of the project. If rejected, both players receive nothing from the investment.

Example

If Player Two observes an actual cost of 136, Player Two can submit a request equal to any integer between 136 and 200. For example, assume that Player Two submits a request of 157. In addition to this budget request, Player Two sends a cost signal which will be 126-150. Player One will then observe both the request of 157 and the cost signal of 126-150. Using this information, Player One decides either to accept or reject the investment. If accepted, Player One receives 200 and pays 157 to Player Two (meaning that Player One's net earnings are 43). Player Two receives 157 – 136 = 21 (meaning that Player Two's net earnings are 21). If rejected, neither player receives anything from the investment.

Optional Signal Setting

Player Two's Task

At the beginning of each decision round, Player Two privately observes the actual cost. After observing the actual cost, Player Two submits a budget request to the Player One. The budget request must be equal to or greater than the actual cost. In addition to submitting the budget request, Player Two has the option of submitting a cost signal that indicates which $1/4^{th}$, or $1/8^{th}$ of the cost distribution the actual cost lies in or Player Two can choose to send no cost signal whatsoever. The signal can either have $1/4^{th}$ accuracy (which would indicate 0-50, 51-100, 101-150, or 151-200), or $1/8^{th}$ accuracy (which would

indicate 0-25, 26-50, 51-75, 76-100, 101-125, 126-150, 151-175, or 176-200) and will always be consistent with the actual cost. In other words, Player Two can choose to send a truthful signal with either 1/4th, or 1/8th accuracy or no signal at all. Remember that Player Two can choose to send no signal and Player One will observe just Player Two's budget request.

Player One's Task

Each decision round Player One receives a budget request and cost signal from Player Two, if Player Two chooses to send a cost signal. Based on the request and signal (if available), Player One chooses to either accept or reject Player Two's budget request. If accepted, Player One pays the full budget request amount to Player Two and receives the entire project revenue of 200 ($2). This makes the payoff for Player One is the 200 minus Player Two's budget request and the payoff for Player Two is the budget request minus the actual cost of the project. If rejected, both players receive nothing from the investment.

Example

If Player Two participant observes actual costs of 136, Player Two can submit a request equal to any integer between 136 and 200. For the purpose of this example, assume that Player Two submits a request of 157. In addition to this budget request, Player Two can choose to send a cost signal with 1/4th accuracy (101-150), 1/8th accuracy (126-150), or no cost signal at all. Player One will observe both the request of 157 and the cost signal, if Player Two chooses to send one. Using this information, Player One decides either to accept or reject the investment. If accepted, Player One receives 200 and pays 157 to Player Two (meaning that Player One's net earnings are 43). Player Two receives 157 – 136 = 21 (meaning that Player Two's net earnings are 21). If rejected, neither player receives anything from the investment.

Appendix B: Post-Hoc Questionnaire

Participants were provided with the following statements and a seven point scale that asked them to rank how much they agreed or disagreed with the statement. 1 indicated that the participant completely disagreed with the statement, 4 was neutral, and 7 meant that they completely agreed.

Agent Questions

1) I wanted to leave the other player with a fair amount of profit.
2) I wanted to report honestly to the other player.
3) I used the cost signal as a means of indicating my honest reporting.
4) I cared about sending a budget report that was within the cost signal's range.
5) The possibility that the other player could reject a project kept my budget request conservative.
6) I did not consider the other player's profit when making my budget request.

Principal Questions

1) The other player's budget request had to provide a fair allocation of profit in order for me to approve the project.
2) If the other player did not include a cost signal, I was more likely to reject the project.
3) If a high budget request from the other player was coupled with a cost signal indicated a high actual cost, I was still willing to approve the project even though it offered me very little profit.
4) If the other player's budget request was outside of the cost signal, I was more likely to reject the project.
5) I used my power of rejection to punish the other player for unfair budget requests.