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Economic Experiments for the Management Accounting Classroom

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INTRODUCTION

This paper presents three management accounting experiments designed for classroom use. Our approach is similar to that in Boylan (2004) and Schwartz et al. (2005), who describe audit experiments that can be administered without the aid of computers in a relatively short amount of time. Further, the experiments employ simplified settings, which facilitate a focus on first-order effects and ease both implementation and interpretation. However, despite their simplicity, we maintain they can be introduced successfully into courses ranging from introductory management accounting through first-year doctoral seminars.

The advantage of using an experimental economics approach to instruction, where students assume decision-making roles, is it allows complex material to be introduced intuitively. Role-playing helps students experience both the economic and non-pecuniary aspects of the settings, without much preparatory work on the tools of economic analysis.[1] This approach can be especially helpful when students have not had a lot of real-world business experience to use as a reference. A further advantage of economic experiments is, due to their enjoyable nature, they often stimulate student interest in the material beyond that achieved by traditional instruction alone. Schwartz et al. (2005) cite evidence on the efficacy of classroom experiments in promoting interest and learning.

The experiments described herein address the issue of misaligned goals within an organization, a condition that afflicts almost all organizations to some degree. Naturally, organizations attempt to design mechanisms and protocols to alleviate such goal incongruence; these activities are known as *management control*. Management control is a broad topic, and our intent is to provide experiments especially suited for *management accounting* courses. Therefore, the experiments concentrate on the role of *information* in management control settings. Information voids are often at the heart of management control problems,

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[1] This is particularly important when the underlying theory involves advanced concepts such as equilibrium analysis and constrained optimization. These tools are typically not introduced until the advanced undergraduate or graduate level, but we have found that experiments such as these have been helpful for providing intuition for the economic and behavioral forces at work, even in sophomore-level management accounting classes.

because direct monitoring of management and their subordinates is often impossible or prohibitively costly in all but the smallest organizations. Accounting information can serve as an indirect but low-cost monitor of employees, and so is often used to better align the goals of individuals within an organization.[2]

Each of the experiments we present illustrates a distinct manner in which information can affect the alignment of goals within an organization. By having students play the role of various organization members, the experiments provide students with a hands-on experience regarding how information may either help or hurt the organization, depending on the nature of the setting. Experiment 1 concerns a resource allocation problem with a privately informed subordinate. It is designed to illustrate the effects of information asymmetry, commitment by the superior, and non-pecuniary motivations on the subordinate's possible inclination to "pad the budget." Experiment 2 employs a setting where a subordinate chooses a productive act, and a superior and subordinate interact repeatedly. It is designed to capture important elements of an employee-employer relationship in cases where current compensation is not explicitly tied to current performance, but may depend implicitly on past performance. Experiment 3 also involves productive acts by a subordinate, this time in a multi-task setting. It is designed to illustrate the counterintuitive idea that increasing the amount of information available to both the subordinate and superior may exacerbate rather than mitigate management control problems.

This paper adds to a growing catalog of pedagogic economic experiments. In general, the increasing popularity of classroom experiments is likely due to students' desire for a more active learning environment and increased ease of administration afforded by advances in technology. Experimental economics tools used in economics instruction include numerous articles (Holt 1999; Wells 1991), a textbook (Bergstrom and Miller 1997), and an instructor website (Holt 2005). The introduction of economic experiments into the accounting classroom has occurred somewhat more recently. Experiments for the classroom have been presented on auditing (Boylan 2000, 2004; Schwartz et al. 2005), financial accounting (Berg, Dickhaut, Hughes, McCabe, and Rayburn 1995; Kachelmeier and King 2002), and the effects of taxes on decision-making (Frischmann 1996). Our paper builds on this literature by extending classroom experiments to the instruction of management accounting.

For each experiment we include a list of materials, suggestions for the assignment of roles, and discussion aids. As part of the discussion aids we present economic predictions based on perfectly rational, self-interested behavior, as well as on regularly observed behavioral deviations from standard predictions, such as preferences for fairness or honesty. We believe that an integration of standard economic analyses with regularly observed behavioral deviations is the best way to help students understand the various forces at play. In addition, we provide sample results from actual classroom implementations, as well as an accompanying pedagogic or other non-technical reading. The approach we prefer is to first run the experiments in their simple, abstract form. In this way, students can make their experimental decisions without being led by any preceding discussions. After the administration of each experiment, classroom discussion can focus on different theories of management behavior as well as on relevant business settings and the students' own experiences.

This paper proceeds as follows. The second through fourth sections present Experiments 1, 2, and 3, respectively. The fifth section provides a general discussion of several issues related to the implementation of classroom experiments. The last section offers conclusions.

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[2] One reason it may be less costly to use accounting information in management control is it is already being produced for financial reporting purposes (Kaplan 1984).

EXPERIMENT 1: THE ROLE OF INFORMATION IN A SIMPLE BUDGETING SETTING

Learning Objective of Experiment 1

Experiment 1 addresses several aspects of resource allocation, a fundamental responsibility of firm management. In general, resource allocation activities can induce management control problems for three reasons. First, subordinates are typically closer to operations and so have private information about the firm's prospects. Further, absent outright theft, it is difficult and costly for *ex post* audits to detect misused funds or inefficiencies without error. Second, employees have limited resources, so they cannot be asked to be the residual claimant for projects that might fail. Therefore, we typically do not observe project directors being held responsible for making up budget over-runs out of their own pocket. Third, over-funding of projects, or slack, is generally thought to be desirable from the viewpoint of subordinates. Slack in the budget may allow for more leisure, create a greater margin for error, and may even be divertible to a subordinate's expense account. These three conditions imply the subordinate has both opportunity and motive to take actions undesired by the superior.

Inefficiencies arising within a budgeting setting can be substantial in practice. Schiff and Lewin (1968) estimate that slack composes 20 to 30 percent of divisional expenses, while Leibenstein (1979) arrives at an estimate of 30 to 40 percent.[3] In a more focused study of a disk drive manufacturer, researchers document the provision of budgetary slack (Davila and Wouters 2005). What is interesting is that slack appears, to a large extent, to be provided intentionally. The putative cause is to allow local managers more flexibility when complex or difficult situations arise. This reflects the notion that subordinates cannot make up shortfalls from their own resources and that under-funding divisions may lead to undesired cutbacks in customer service or other areas.

The major learning objectives of this experiment are to:

(1) illustrate the loss to the organization arising from information asymmetry in a resource allocation setting;
(2) demonstrate how providing the superior with more precise information can reduce the loss due to the information asymmetry; and
(3) explore the roles of commitment by the superior and non-pecuniary motivations in management control.

The experimental setting is based on Antle and Eppen (1985) and is quite simple, consisting of one subordinate and one superior. The superior has access to resources and the subordinate has access to superior information about an investment project. Three variations on this setting are used to address the above learning objectives.

The experiment illustrates a variety of management control issues associated with resource allocation. Therefore, if the experiment is used in an undergraduate cost accounting or a managerial accounting class (introductory or advanced), we suggest placing it in the context of participative budgeting or capital budgeting. In more advanced courses on management control or agency theory, the experiment might be helpful in illustrating the role of superior commitment and non-pecuniary motivations such as honesty and reciprocation.

[3] After these early studies attention shifted from determining whether budgetary slack was significant to causes of budgetary slack and to effective control mechanisms. Dunk and Nouri (1998) provide an extensive review. Later studies that provide evidence of significant slack in practice, without quantifying it, include Merchant (1985) and Walker and Johnson (1999).

If the instructor is interested in related pedagogic readings, we suggest Arya et al. (1998) and Arya et al. (1996).[4]

Materials and Role Assignment for Experiment 1

The instructor should prepare a list of 20 to 50 random integers uniformly distributed between 0 and 1,000. For reasons discussed in a later section, we suggest the instructor place students in teams. Two teams, designated as Team A and Team B, participate during each round of the experiment. Team A and Team B play the role of superior and subordinate, respectively. The purpose of using generic labels is to encourage the students to focus only on the fundamental aspects intentionally built into the experiment.[5] Team B, which will make decisions about its budget proposal, should be moved outside the classroom during the administration of the experiment. This allows its members to more freely discuss their decision, without fear of being judged by the rest of the class. To ensure that all aspects of the setting are common knowledge, instructions for this and all succeeding experiments should be read aloud to the entire class before starting the experiment.

Administration of Experiment 1

Variation 1

Team A is designated as the residual claimant to a profitable investment. Team B, being close to operations, privately observes the eventual cost of the investment. The investment, if taken, would yield revenues of 1,000 with certainty. The cost of the investment can be any integer between 0 and 1,000; each value is equally likely. Only Team B will learn the cost. The sequence of events is as follows.

(1) Team B steps outside the classroom.
(2) Team A chooses a *limit* on the maximum amount that it is willing to provide to Team B in order to fund the investment. This *limit* is then transmitted to Team B.
(3) The instructor chooses a *cost* at random from the list prepared in advance and informs Team B. Neither Team A nor the rest of the class will ever be informed of the *cost*.
(4) Team B chooses its *budget*. The *budget* cannot be below the *cost*. The instructor enforces this restriction.
(5) If the *budget* is less than the *limit* set by Team A, funds equal to *budget* are provided to Team B and the investment is accepted; otherwise, the investment is rejected.
(6) The instructor places the following information on the board: *limit*, *budget*, Team A's payoff (either "1,000 − *budget*" or "0"), and Team B's funds received from Team A (either "*budget*" or "0"). The instructor may remind the class that the amount of slack is known only by Team B.

Items (2) and (5) are important because they capture the idea that superiors may be able to make commitments as to how they will use the budgets supplied by their subordinate. Items (1) and (3) are important because they guarantee the subordinate has opportunity and motive to consume slack. Item (4) enforces the assumption that subordinates cannot make up any shortfalls in their budget out of their own pockets.[6] The payoffs to the two teams are summarized in Figure 1.

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[4] Antle and Fellingham (1997) is a somewhat more technical review of this branch of the capital budgeting literature that may be useful for advanced undergraduates and graduate students.

[5] The students may be invited to bring in their own experience or conjectures about analogous business settings in the subsequent classroom discussion.

[6] In addition to being an assumption of the theory, informing the students that they should choose a budget that is not less than the actual cost simplifies the decision-making. If this were a true scientific experiment, then one might want to permit subjects to understate the cost, even though it is not in their pecuniary interest.

FIGURE 1
Payoffs in Experiment
Variation 1

Decision	Team A	Team B
Investment rejected	0	0
Investment accepted	1000 – *budget*	*budget* – *cost*

The class observed *budget* but did not observe *cost*.

If time is not an issue, then each Team A should be paired with a new Team B for each iteration of the experiment. However, we find that administering the experiment in this way is a little cumbersome and time consuming, as Team B members would have to be moved in and out of the classroom at the end of each iteration. We find it satisfactory to simply allow one Team A and one Team B to play together a few times before choosing a new pair of teams. We suggest a limit of three consecutive pairings, however, to avoid reputation effects. Letting Team A participate in a few consecutive iterations is especially helpful, as it may require some trial and error for them to understand the trade-offs involved in setting the limit. Team B's task is simpler, as any budget under the limit necessarily leaves money on the table. The instructor should end this variation after all teams have had a chance to participate.

Variation 2

Variation 2 is based upon Antle and Fellingham (1995). It differs from Variation 1 in that, before choosing the limit on what it will fund, Team A receives imprecise information regarding the cost. In particular, Team A learns in which of the following ranges the cost appears: {0,...,250}, {251,...,500}, {501,...,750}, or {751,...,1,000}. The instructor provides this information to the entire class. Upon observing in which range the cost lies, Team A chooses the limit, which is then communicated to Team B outside the classroom.

Variation 3

Variation 3 is identical to Variation 1, except that Team A does not commit to a limit. Instead, Team A announces an *intended* limit. After Team B submits its budget, Team A decides whether to fund the project at a level equal to the budget, but Team A's decision is not constrained by its prior announcement.

Discussion of Experiment 1

In Variation 1, assuming slack-maximizing behavior on the part of Team B, the optimal strategy for Team A is to set the limit on the amount of funds it will supply at 500. This strategy yields an expected residual of 250 for Team A and an expected slack of 125 for Team B.[7] This result rests on the assumption that whenever the cost is less than or equal to the limit, Team B will behave selfishly by padding the budget to the maximum possible.

[7] See Farlee et al. (1996) for a derivation of the optimal funding rule for the superior.

Padding the budget to the maximum possible means that, whenever the cost is less than the limit, Team B will submit a budget equal to the limit set by Team A. When the cost is greater than the limit, Team B is willing to submit an honest budget, because Team A has committed to turn down the investment whenever Team B's budget exceeds the limit. In all such cases where the cost exceeds the limit, Team B will receive no slack, regardless of whether it overstates the cost.

The setting we describe is identical to the "modified trust" contract in Evans et al. (2001), in which subordinates receive their budget if it is less than or equal to the limit. In contrast, much of the academic literature on this subject employs the "hurdle rate" contract in Antle and Eppen (1985). In the latter, subordinates receive the limit if their budget is less than or equal to the limit. If subordinates are selfish and fully rational, both contracts produce the same payoff outcomes. However, the modified trust contract allows for subordinates' non-pecuniary motivations, particularly a distaste for lying, to have a payoff-relevant effect.[8] This makes the modified trust contract an interesting one to use in a classroom setting, highlighting the role that honesty can play in budgeting.

Although some formal mathematics is required to derive the theoretical result, we have generally found that students come close to behaving in a manner consistent with the theory, with one important exception. It is possible that a significant concern for distributional equity or for reporting honestly will be observed in the classroom experiment. In light of this phenomenon, the instructor might wish to compare the observed class behavior to that in Evans et al. (2001), which found many participants claimed less than the maximum available slack when responding to essentially the same modified trust contract. Other studies that have employed somewhat different investigative methods and found some evidence of distaste for lying include Baiman and Lewis (1989), Lindskold and Walters (1983), and Stevens (2002). The instructor may also wish to discuss the relationship between the limit and the willingness to return slack. A higher limit is suggestive of a more trusting superior, which can potentially induce more concern for the superior's welfare on the part of the subordinate, as observed in Evans et al. (2001).

Students generally bring up several issues during discussion. First, it is evident to all that there is a significant amount of budget padding taking place. Second, students tend to notice the waste occurring in the funding decisions. Despite the fact that all projects *can be* implemented profitably, only about half *are* actually implemented.[9] In this context, instructors should point out that the only way for the superior to extract any of the subordinate's slack is to restrict production. This illustrates a common finding in management control research: control problems often come at a social cost, either in the form of a productive inefficiency or in the form of an inequitable distribution of wealth.[10] The students may also notice that the superior would prefer to renege on her announced limit if the

[8] For example, suppose the actual cost is 300 and the limit is 500. In the hurdle rate contract, a budget of 400 and a budget of 500 yield the same payoff to the superior, whereas in the modified trust contract a budget of 400 yields a greater payoff to the superior than a budget of 500. The modified trust contract allows a superior to benefit in cases where subordinates have a concern for the welfare of the superior or a distaste for lying.

[9] Antle and Eppen (1985) cite evidence that in practice firms turn down projects with rates of return that exceed their cost of capital.

[10] The experiment can be used to illustrate that equity concerns can interact with productive efficiency when there is private information. For example, suppose society wishes that the superior receive strictly positive profits from the investment opportunity. The only way to accomplish this, given a self-interested and privately informed subordinate, would be to restrict production. These notions are related to Coase's theorem on property rights, bargaining costs, and productive efficiencies (Coase 1960).

subordinate were to submit a budget that exceeds the limit.[11] This illustrates another common result found in management control research: it is often optimal for the superior to commit to actions that she later wishes to avoid. Finally, students will probably notice the important role information plays in this setting and how providing better information to the superior could potentially alleviate the inefficiencies caused by the management control problem.

One approach an organization might take is to invest in a perfect information system that reveals the cost to the superior, such as an extensive *ex post* audit of projects. While a perfect information system would alleviate the inefficiencies, it is likely such a system would be prohibitively costly. Therefore, a more realistic approach is that an organization would invest in obtaining some additional but imperfect information about the cost. This is our motivation for introducing Variation 2.

Given the parameters for Variation 2 described above and the assumption of self-interested behavior by Team B, the optimal strategy for Team A can be described as follows. For every range except the highest, set the limit at the top of the range; for the highest range, {751,...,1,000}, set the limit at 875. This strategy yields an expected residual of 360.625 for Team A and expected slack of 109.375 for Team B, and leads to funding 87.5 percent of the projects in expectation. While the optimal strategy for Team A may seem a bit complex, the students should be able to recognize that better, but still imprecise, information can potentially help control the consumption of slack. Less obvious, but perhaps even more important, imperfect information can improve productive efficiency. Finally, instructors should point out that, independent of financial reporting requirements, potential management control problems create a demand for accounting information, such as reports of project profitability or cost.

As noted above, the effectiveness of Team A's announcement rests on the assumption that it has made a binding commitment. Without such commitment, standard economic analysis predicts Team A should accept any proposal that leaves it with a positive profit, no matter how small. Team B, anticipating Team A's behavior, would then submit a budget equal to 999. While the prediction in the no-commitment case implies productive efficiency is achieved, meaning all projects get funded, it is a highly disadvantageous outcome from Team A's point of view. However, prior research has demonstrated that not all predictions from standard economic analyses are empirically valid. Therefore, we present Variation 3 as an empirical investigation into the role of commitment.

During the discussion of Variation 3 students may remark that they are surprised by how the mere threat of denied funding can partially ameliorate the control problem from the superior's perspective. This finding was documented in Rankin et al. (2003). Variation 3 illustrates that the role of commitment may not be as crucial as it would seem, based on standard economic analysis alone. The discussion should center on why there would be any motivation for Team A to honor its announced limit. That is, why would it not accept any budget proposal less than 1,000, independent of its announced limit? In this context, it is likely that the notions of fairness and fair play will be raised by the students. For example, they may comment that it is unethical for Team B to completely exploit the vulnerability of Team A by building a significant amount of slack into the budget and, hence, Team A is justified in rejecting some high cost budgets.[12] In general, this experiment

[11] Another interesting aspect of this budget setting is that *both* the superior and subordinate would prefer to renegotiate the contract if the subordinate submits a budget that exceeds the limit.

[12] A helpful and relatively nontechnical paper discussing these issues is Fehr and Falk (2002).

may be used to illustrate that non-pecuniary motivations can be important in understanding interactions between superiors and subordinates in a firm.

Students' own experiences may also serve as a basis for discussion. Students may have on occasion been given a *per diem* from an employer, wherein if the employee spends less than the *per diem* amount then the remainder can be consumed as slack. The practice of allowing slack for employees through the use of *per diems* may be efficient for two reasons. First, the cost of auditing expense reports may be high. Second, employees may end up consuming fewer organizational resources under a *per diem* system than under a reimbursement system, if they are allowed to keep the difference between the *per diem* and actual expenditures. Students might also recall specific instances where they refused to engage in a transaction they deemed unfair, even though the refusal came at personal cost, just as budgets were rejected in the Variation 3 even though such rejections were costly.

Table 1 provides data from a recent administration of Variation 1 in a sophomore-level management accounting class. The class was divided into six teams, three in the role of A and three in the role of B. Each Team A was matched with a Team B. Each pair of teams played the game three times. As can be seen from Table 1, the median choice of limit by those in the role of superior is 550, which is reasonably close to the theoretical prediction of 500. Further, teams in the role of subordinate did not deviate from the theoretically optimal strategy based on self-interest in any of the iterations; whenever the actual cost was less than the limit, they submitted a budget equal to limit. These results are generally consistent with our experiences. On different class days, we administered Variations 2 and 3 with those same students. In Variation 2, the median choices for limit in each quartile were 250, 499, 750, and 870, which again were very close to the theoretical predictions. Also consistent with standard economic theory was the finding that Team A performed best in Variation 2 and worst in Variation 3, and Team B performed best in Variation 3 and worst in Variation 2. Finally, we found that Team A was willing *ex post* to reject positive profits in Variation 3 even though they had not committed to do so, which in turn resulted in non-negligible profits for Team A due to Team B's fear of proposal rejection. This is very much inconsistent with predictions of economic behavior, but is in fact consistent with the literature on ultimatum games as well as Rankin et al. (2003).

TABLE 1
Sample Results for Experiment 1
Variation 1

Round	Cost	Limit	Budget	A Earnings	B Earnings
1	585	650	*650*	350	65
1	383	550	*550*	450	167
1	507	475	*507*	0	0
2	706	*500*	*706*	0	0
2	395	600	*600*	400	205
2	452	*500*	*500*	500	48
3	203	499	*499*	501	296
3	924	600	*924*	0	0
3	148	600	*600*	400	452

Actions conforming to economic predictions are in italics.

In addition, we conducted a survey for this same group of sophomores to test their comprehension of economic aspects of the experiments and also to obtain their self-assessment of what they learned. We found, among other things, that 70 percent of the students responded that the experiments helped them "a great deal" (8 percent) or "somewhat" (62 percent) to appreciate budgeting issues. The majority of the students found the experiments were "very useful" (18 percent) or "somewhat useful" (60 percent) in helping them appreciate the ethical issues in budgeting and that the experiments illustrated "a great deal" (40 percent) or "somewhat" (40 percent) how project auditing could be beneficial to the firm.[13]

EXPERIMENT 2: THE ROLE OF INFORMATION IN REPEATED INTERACTION

Learning Objective of Experiment 2

A prominent feature of organizations is there are repeated interactions among its members. With respect to management control issues, repeated interactions may allow its members to achieve mutually beneficial outcomes, without the need for explicit, enforceable contracts. For example, a firm might reward strong performance with a raise in the following year. Despite the lack of commitment by the firm, employees have a good idea of what level of performance will lead to a raise, based on their observations regarding prior years' raises. Both the firm and the employee benefit from such an informal arrangement, even though the terms are not made explicit. The firm realizes that if it does not reward strong performance, employees will lose motivation or leave the firm. However, the firm also retains the ability to modulate the size of the raises in light of overall firm performance. Why might such arrangements not be codified? One answer is it is costly and sometimes impossible to anticipate every eventuality. Repeated interaction allows the firm to motivate employees, yet remain flexible.

An important condition for such informal arrangements to emerge and persist is that the actions of organization members be visible to others. However, in many cases the observed measures of employee performance are only an imperfect indication of employee actions. Suppose that the observable outcome is affected by employee behavior and also influenced by random, unobservable conditions. In this case hard-working employees might not necessarily be rewarded, due to unfavorable circumstances alone. Similarly, shirking employees might be rewarded, due to favorable circumstances alone. The effect on employee attitudes is predictable: resentment and disillusionment. Therefore, even if no formal arrangements are available, in a repeated setting there is a potential benefit to gathering more precise information about an employee's action.

Although not directly related to employment situations, an excellent and familiar example of how present behavior is influenced by expected future interactions is the online auction firm eBay. Buyers generally are willing to transfer money to sellers in expectation of receiving the described goods or services. Buyers often rely on the past descriptions of transactions with the same seller left by other buyers. These ratings are the information system employed by eBay. Sellers understand that the value of their reputation is greater than the potential short-term gain of exploiting buyers. Although the ratings are not perfectly informative, they appear to be informative enough to function as a disciplining force

[13] The student survey was administered before any formal instruction of budgeting took place.

(Resnick et al. 2006). There are certainly differences between eBay and employment situations, most noticeably that enforcement is indirect because current buyers rely on the ratings of previous buyers. However, the underlying mechanism is essentially the same: economic agents forgo opportunistic behavior today in order to obtain a benefit in the future.

The primary learning objective of Experiment 2 is to illustrate that mutually beneficial arrangements that evolve through repeated interaction are crucially dependent on the informativeness of feedback from prior interactions. A secondary objective is to provide students with a greater understanding of the process of reputation formation, and how it depends upon the trade-off between immediate and future rewards. The setting captures several important elements of many employee-employer relationships, including repeated interaction, a fixed wage, and a costly act to the employee that is beneficial to the employer. In Variation 1 employers observe only their payoff, which is a noisy signal regarding the subordinate's action. In Variation 2 employers observe both their own payoff and the randomly obtained state of nature, allowing them to sometimes perfectly infer the employee's action.

This experiment addresses aspects of the ongoing evaluation and reward of employees, specifically through the use of accounting-based measures. Therefore, an appropriate placement in an undergraduate management accounting class is where performance evaluation is discussed. A good example is variance analysis, where one objective is to determine to what extent variances are due to employee actions and to what extent they are due to external factors, such as a general rise in raw material prices. In a more advanced class, this experiment can be placed in conjunction with the discussion of how there are opportunities for improved efficiencies in many realistic situations, because there are repeated interactions. As an accompanying reading we suggest Kreps (1990), which while not specifically pedagogic in nature, is fairly nontechnical.

Materials and Role Assignment for Experiment 2

In each game one pair of teams interacts repeatedly with each other. The teams are designated as Team A (employer) and Team B (employee). Team B is situated outside the classroom during the administration of the game. The instructor uses coin flips to determine the outcome of random events.

Administration of Experiment 2

Variation 1

The setting is loosely based on the gift exchange game in Kirchler et al. (1996). One iteration of the game proceeds as follows.

(1) Team A chooses how much to pay Team B as a fixed wage, denoted W, between 0 and 20. The fixed wage must be paid regardless of what subsequently transpires in that iteration.
(2) Team B is informed of W and then chooses an action, either *a* or *b*.
(3) If Team B chooses *a*, the payoffs to Team A and Team B are −W and W, respectively.
(4) If Team B chooses *b*, the payoffs depend on a coin flip. If heads (state H), the payoffs to Team A and Team B are 60 − W and W − 5, respectively. If tails (state T), the payoffs to Team A and Team B are −W and W − 5, respectively.
(5) Both teams observe their own payoffs. In addition, in Variation 2, Team A observes the state of nature.

The payoffs are summarized in Figure 2.

FIGURE 2
Payoffs in Experiment 2
Entries are (Payoff to Team A, Payoff to Team B)

		Result of Coin Flip	
		Heads	**Tails**
Decision	*a*	(–W, W)	(–W, W)
	b	(60 – W, W – 5)	(–W, W – 5)

W is the fixed wage chosen by Team A each period.
Decision *a* or *b* is chosen by Team B each period.

The experiment is designed to resemble a typical employee-employer relationship. Item (1) captures the idea that most employees are paid a non-contingent, fixed wage. Items (2), (3), and (4) capture the idea that employer payoffs are dependent upon employee actions and that employee and employer typically disagree, to some extent, on the preferred action. Item (5) captures the idea that employers often cannot perfectly infer employee actions. One important feature we have incorporated is that employee actions do not directly map into firm profits. Thus there is an element of chance regarding firm profits, even when employees act as desired by the employer. In Variation 1, the members of Team A observe only their own payoff: 60 − W or −W. They do not learn the state. As Figure 2 indicates, if Team A observes a payoff equal to −W, it does not know whether Team B chose decision *a*, or chose decision *b* but state T obtained.

The instructor administers three iterations with the same teams. After the third iteration, the instructor flips a coin, this time in view of all participants. If heads appears, another iteration is administered; if tails appears, the game between this pairing ends. In this way no one, not even the instructor, can predict whether the current iteration is the last.[14] After a game ends, two different teams are then chosen to play the repeated game as described above. After several games have been played involving different pairs of teams, the instructor should move to Variation 2.

Variation 2

In Variation 2 the randomly determined state is announced to both teams at the end of each iteration. In this setting Team A can infer Team B's decision in the event State H occurs. This aspect of the information system allows Team A to justifiably punish Team

[14] Our use of an indeterminate endpoint can be justified as follows. Suppose all participants knew it was the last period with certainty. Then Team B would have no incentive to choose *b*, because such a choice is costly and cannot be rewarded in the future. Hence, Team A would have no incentive to pay a fixed wage greater than zero. Now suppose it is the penultimate period. Team B knows it will receive a fixed wage of zero in the following period and, hence, picks *a*. Team A, in anticipation, pays a fixed wage of zero. This reasoning, referred to by economists as *backward induction*, can be continued to the beginning of the game. It implies that with purely selfish, perfectly rational participants, there can be no cooperative solution to this game if there is a known, finite endpoint. However, exceptions to this behavior have been documented in the laboratory (Cooper et al. 1996).

B, given a payoff of −W and State H, by choosing a low wage in the subsequent period. The threat of punishment in this case may motivate Team B to choose *b*. We suggest that the instructor administer several games with this modification.

Discussion of Experiment 2

In a one-time interaction Team B would be better off by 5 points if it chose *a*, no matter the choice of W. However, expected combined payoffs for Team A and Team B are greater if Team B chooses *b*, equal to .5(−5) + .5(55) = 25, than if it chooses *a*, equal to 0. Therefore, this setting provides a stark contrast between maximization of individual welfare and productive efficiency.[15] Given the repeated nature of the game, in Variation 2 one might consider the following behavior plausible: Team A offers a generous fixed wage as long as Team B is not revealed to have chosen *a*. If Team B is revealed to have chosen *a*, thereafter Team A offers a fixed wage of zero. Such a strategy provides incentives for Team B to choose *b*. However, with the reduced information in Variation 1, this intuitive approach to reward and punishment is not available, as a choice of *a* by Team B is never perfectly revealed.

The results from the two variations should be compared for the class. We expect a greater level of efficiency under Variation 2, that is, more frequent choice of *b*. We also expect that in Variation 2 *both* teams will obtain greater earnings. It would be especially meaningful if Team A were to obtain greater earnings, because it makes the first move in each iteration when it announces its choice of W.

The ensuing discussion will likely center on the demand for feedback when persons repeatedly interact, yet cannot enter in binding agreements. A good example from practice, other than employer-employee relationships, would be teams of equal-rank employees. For instance, several employees might be assigned the task of designing a new product. Shirking by one of the members of the team may lead to sanctioning by the other team members, even if such sanctions are costly to the sanctioners.[16] It is often the case that participants in teams become strongly attentive to the amount of effort put in by other team members.[17]

Students should be encouraged to think about their personal experiences as well as their conception of business practices in analyzing this issue. For example, many students will have worked in repeated interaction settings in school environments. Discussion can focus on the reaction of students undertaking group assignments when an unsatisfactory grade was received. Did group members question their partner's efforts? Did group members sanction an individual who apparently shirked? Did group members wish their efforts were more visible, in order to prove to others they worked hard?

Recently Experiment 2 was run in a Master of Accounting class. The students in the class were placed into four teams of three. There were four games administered under Variation 1 and five under Variation 2. In the Variation 1 games, no pair managed to arrive

[15] Conceivably, individuals may reciprocate a large fixed wage by choosing the desired action, even in the absence of any material incentives to do so. This is exactly what was observed by Kirchler et al. (1996). In a related experiment Berg, Dickhaut, and McCabe (1995) found similar results. This latter experiment is important to accountants, because Dickhaut and McCabe (1997) used their results to relate the reciprocation of trust to the concept of accountability.

[16] Falk et al. (2005) conduct a laboratory experiment confirming the existence of costly sanctioning behavior aimed at punishing defectors.

[17] Another good example, although perhaps beyond the recollection of most students, is the armaments limitations talks of the Cold War (Poundstone 1992). Both sides wished to reduce spending on arms, and would have benefited from doing so, if they could be certain the other side was doing so as well. Monitoring issues were one of the main sticking points in the treaty negotiations.

at a cooperative understanding, although there were scattered attempts to do so. In particular, in only 3 of 21 iterations did Team B choose *b*, and those were early in the game. Also, after a few iterations Team A essentially "gave up" and chose a wage of zero. In the Variation 2 games, two of the five pairs managed to substantially cooperate. In two of the remaining pairs in Variation 2, Team A tried to initiate cooperation, but was rebuffed by Team B. Several of the Team A participants expressed frustration during Variation 2, and wished to go outside and negotiate with Team B. These observations suggest that cooperation might not necessarily ensue even when participants have both motive and opportunity to do so—they may require a mechanism to coordinate to a cooperative arrangement.[18]

EXPERIMENT 3: THE MANAGEMENT CONTROL BENEFITS OF REDUCING INFORMATION

Learning Objective of Experiment 3

The two previous experiments illustrate the potential benefits of additional information in evaluating and rewarding employees. After participating in those experiments the students might be tempted to conclude that if information can be obtained without incurring an out-of-pocket cost, then more information is always better. However, this may not be the case. For example, imagine a professional sports team finds it is losing at halftime by an insurmountable margin. The team owner wishes the team to display maximum effort at all times, regardless of the score. How can the coach motivate the team to do as the owner wishes? The coach often resorts to the old adage "forget about the score" in exhorting the team. In this instance the coach wishes the players had less information. As a second illustration, consider an auto manufacturer that will pay a bonus to the dealer with the highest monthly sales in a region. The auto manufacturer may choose not to collect up-to-the-minute information on sales because, were this information to become available, some dealers may find out they have little or no chance at the bonus before month's end. Due to this possibility arising, the auto manufacturer may choose to design an information system that precludes the release of some information.

The 1980 United States presidential election provides an interesting illustration of the problems associated with continual feedback. The television networks, using exit polling data, declared the winner of the presidential election before many state polls had closed. It was thought that this decreased the motivation to vote in those states with polls still open, possibly affecting the outcome of local elections that had not been called (Seager and Handman 2001). Another interesting example is found in World Cup soccer, where the final games in group play are played simultaneously, in part to prevent teams from learning whether they had qualified for the next round before playing the game. This approach to scheduling significantly decreases the potential of having a team put in minimal effort due to knowledge of their qualification status and, hence, affecting other teams' ability to qualify. Of course, the preceding examples are not intended to imply that accurate or continuous feedback is never desirable. For example, detailed feedback may allow for better fine-tuning of decisions. We simply point out that there are potential motivational costs associated with increasing the timeliness and accuracy of feedback.

The learning objective of Experiment 3 is to illustrate the potential motivational benefits of *reducing* the amount of publicly available information. Specifically we examine the role

[18] It is typically difficult for participants to arrive at equilibria in a repeated game that are not available in the single-stage game (Van Huyck et al. 2001).

of aggregation, which reduces information. Aggregation of data is fundamental to the production of accounting information, although often for reasons unconnected to management control. Therefore, a connection between aggregation and management control is of particular importance to the study of management accounting.

Our experiment is based on theoretical research by Arya et al. (2004) and Gigler and Hemmer (2002). Participants, acting as subordinates, are asked to perform two tasks sequentially. The instructor rewards participants only if they complete *both* tasks successfully; the role of superior is otherwise suppressed. In Variation 1, the only information collected is whether there has been a success on both tasks, and this necessarily arrives after the completion of the second task. In Variation 2, information on the first task outcome arrives before the beginning of the second task.

The experiment illustrates that, from a management control perspective, decreasing the amount of information available through aggregation can mitigate rather than exacerbate control problems. Given the prominence of aggregation issues in undergraduate management accounting courses, there are numerous opportunities to usefully place this experiment, such as the discussion on the level of disaggregation in the determination of product costs. A second idea is to use this experiment as a capstone illustration. After students have been analyzing the role of information in relatively simplified settings, where more information is always preferred, this experiment provides some perspective on the complexities involved in determining the optimal level of information to be produced. In more advanced classes the experiment should be introduced concurrently with discussion on aggregation and contracting. As an accompanying pedagogic reading, we suggest Nikias et al. (2005).

Material and Role Assignment for Experiment 3

The instructor should acquire several identical books of word search puzzles, available at retail stores. The number of teams that can participate simultaneously is equal to the number of word search books, with only one member of each team partaking in the activities in a single iteration of the experiment. Teams should be asked to nominate one player per iteration for this purpose. Multiple iterations can be run with a different team representative participating each time. Thus, if the class is not too large, all team members can have an opportunity to act as their team's representative. Also one student in the class should be designated as a grader. The grader determines whether a task has been completed successfully and informs the instructor of such.

Administration of Experiment 3

In Variation 1, the representatives of each team are told they must successfully complete two tasks in order to be rewarded. The first task involves solving a word search puzzle. The instructor selects a puzzle and distributes it to each student participant. The instructor chooses one or more words in the puzzle, but does not inform the participants of the choice. Participants are given a fixed amount of time, say two minutes, to find as many words as possible. The time limit should allow the students to find some, but significantly less, than all of the words. After the time has elapsed the word search puzzles are collected and given to the grader. The team is considered to have successfully completed this first task if it has found at least one word selected by the instructor. The second task is a long division problem, to be completed without the use of a calculator. Participants must find the correct quotient in the time allotted to complete the task successfully. The worksheets are collected and also given to the grader. Sheets and puzzles should be marked so that the grader can match the two tasks to one team. The grader then announces which teams have completed the two tasks successfully.

The tasks have been selected to have two important attributes. Participants will find it difficult to determine whether they have performed the first task successfully. The second task is one that participants are not likely to find inherently enjoyable. Thus, after having completed the first task students will be uncertain about whether they have succeeded unless informed by the instructor. Further, because they are only rewarded if they succeed on both tasks, they would not be motivated to perform on the second task if they were to be informed they had not succeeded on the first task.[19]

The instructor should administer Variation 1 several times, appointing different team representatives each time. Variation 2 is identical to Variation 1, except the grader determines success or failure on the first task prior to the commencement of the second task and discloses this information to the class. Variation 2 can be run immediately after Variation 1 has been completed.

Discussion of Experiment 3

Unlike the first two experiments, in this experimental setting there is insufficient structure to allow for a mathematical solution.[20] Rather than pursue an optimal solution, we suggest that the instructor begin by mentioning the ubiquity of aggregation in accounting data, and the reasons thereof. These reasons might include the limited cognitive resources of users and the cost of obtaining more detailed information. Next, the discussion may shift toward the notion that the manner in which accounting data is structured for one purpose may have consequences for another. For example, the manner in which income is calculated for release to shareholders may affect policy-makers' decisions concerning taxes and other types of regulation. Likewise, the manner in which product costs are calculated for use in the financial statements may affect a manager's decisions related to manufacturing or buying a component. Students should become aware that the variety of activities and decisions affected by accounting information often interact and cannot properly be thought of separately.

With respect to the experiment, the most obvious topic for discussion is participants having little motivation to perform the long division task successfully if they already know they did not succeed on the first task. The grader should be thought of as the information system. Under Variation 1 the grader only reports the total numbers of successes on the two tasks, and only after both tasks are completed. It should be clear that reducing the amount of public information available immediately after the first task is completed can increase incentives to put effort into the second task.

Thoughtful students may notice that having the grader announce on which individual task a success has been achieved, but doing so only after completion of the second task, would yield identical motivational benefits. However, if the information were collected but withheld from the employee, it would create an incentive for the employee to attempt to acquire the first-task information prior to undertaking the second task. In fact, during administration of Variation 1 students may express a desire to have their puzzle grade announced before the division problem is attempted. This setting is a good one for introducing the problem of information security. Creating a system wherein employees seek information that their employer does not want them to have creates security issues, which can be costly.

[19] The instructor may, of course, substitute other tasks having these properties.

[20] A more structured setting that lends itself to a mathematical solution is found in Nikias et al. (2005). If the instructor wishes a more formalized presentation of aggregation and related management control issues, then we refer the instructor there.

One way to circumvent these data security issues is to commit not to collect the information at all.

Students may also note that one way to counteract the ill effects of early release of first-task information is to provide separate incentives for each task. For example, a superior might offer half a point for each task. While such a scheme may work in the simplified classroom experiment, a more thorough formal economic analysis would reveal that providing separate incentives would not always be efficient (Arya et al. 2004; Nikias et al. 2005).

Finally, students may be asked to recall incentive schemes from their own experience. The most obvious example for students would be academic grading, which is an especially good setting because the grade itself is truly an aggregated measure. Students can be asked whether they know what they need to score on upcoming exams or assignments to get a particular grade. Students can be asked how their answers would depend on different grading schemes, such as an absolute scale versus a curve. They might be asked to think about their motivations to study if they knew a final exam was unlikely to affect their grade. Students might find themselves designing a grading scheme completely different than what they might otherwise have thought optimal. In general, grading schemes illustrate the delicacy of designing information systems with just the right level of feedback.[21]

Experiment 3 was conducted recently in a sophomore-level undergraduate accounting class. Six teams, each consisting of approximately eight students, were formed. In the word search task students were instructed to find as many words as possible in two minutes. Two words in the puzzle were pre-selected by the instructor; the students had to find at least one of these two words to successfully complete the first task. The task fulfilled the requirement that students would have little idea about whether they were successful unless they were provided with feedback. In the long division task the students were instructed that they had 90 seconds to divide a three-digit number into a six-digit number. Teams earned one point for completion of both tasks. The team with the most points at the end of the session was awarded with movie passes. Five iterations without interim feedback were run, followed by several more with interim feedback. Total scores for the teams ranged from 0 to 3. In the Variation 1 iterations it was evident that the team representatives were putting in significant effort in the long division task. In contrast, in Variation 2 no team representative attempted the division task after being informed the word search task had not been properly completed.

OTHER IMPLEMENTATION ISSUES

Previously we asserted that students working in teams may provide the best results for these types of experiments. There are several reasons for this claim. First, by having students work in teams they face less pressure and may respond in a manner more consistent with the material incentives of the experiment. Also the assignment of teams creates an atmosphere of healthy competition that may better simulate the environment existing within a firm. Finally, by administering the experiment in teams it is easier to have a larger proportion of the class participate in each experiment. Clearly there is a trade-off involved

[21] So as not to overstate the point, most students have incentives to study for final exams across grading schemes. It is the students at the upper and lower tails that may perceive themselves to be "locked in" that might have diminished motivations. The authors address this issue by not announcing an absolute scale. In this way students cannot tell how many points they need on the final examination to earn a particular course grade, because they are unaware of the scores of other students. However, we do not go as far as concealing numerical scores from the students as this would certainly lead to resentment and frustration, likely diminishing rather than enhancing motivations.

in choosing team size, with smaller teams allowing for greater participation from each student, but increasing the amount of trials necessary to involve all teams. We find that keeping the team size to no more than five members is best, whenever possible. Team composition should be kept consistent throughout the course for the purposes of compensation, as discussed below.

Experiments conducted for scientific purposes must provide sufficient material incentives in order for the results to be interpretable. Likewise, incentives in the classroom should also be meaningful in order to overcome student inattention or apathy. However, it is generally agreed that the level of remuneration in the classroom can be significantly less than in the research laboratory, while maintaining sufficient incentives for the participants to perform earnestly.

In general, the instructor may choose between three forms of remuneration: hypothetical, monetary, and extra credit. Schwartz et al. (2005) provide an extended discussion of each and conclude that in many instances hypothetical remuneration is sufficient, as students tend to be competitive in the administration of classroom experiments. We have found that while this may often be the case, some material incentives can induce greater participation and better results for the purpose of classroom discussion. One method used by the authors with success has been to have students play for prizes. Prizes we have used in the past are university sweatshirts, movie passes, and gift certificates. Prizes that cannot be shared can be raffled off within the winning team. The instructor may choose to provide prizes for each individual experiment, or alternatively for total accumulated points across all experiments. However, such a "tournament" approach can induce risk-seeking or risk-averse behavior if teams can figure out how well they are doing relative to other teams. One way to reduce or possibly eliminate this effect is to conduct a lottery for the prize. The probability of a team winning the prize can be made strictly increasing in the number of points it accumulates across the experiments. Given such a scheme, it is best to maximize the expected payoff in each experiment (Berg et al. 1986).

One possibility that may be particularly worrisome to an instructor new to administering classroom experiments is that he or she does not obtain the expected results. However, the purpose of any experiment, scientific or pedagogic, should not be to achieve a particular result.[22] The main purpose of the particular experiments we describe is to allow students to think about management control situations that they are otherwise unlikely to have encountered. The instructor should focus on the creation of the desired setting and the discussion of economic and non-pecuniary motivations faced by the participants, rather than on obtaining a specific result. The above concern notwithstanding, Experiments 1 and 3 are quite likely to produce results similar to those we describe. Deviations, should they occur, would typically be attributable to non-pecuniary motivations, such as honesty (Experiment 1) or a strong work ethic (Experiment 3). In contrast, Experiment 2 generally provides the most unreliable results, due to the unpredictability of repeated games.[23] For these reasons, and also because it is the easiest to administer, instructors new to the use

[22] In the physical sciences, it is often perceived that students are expected to get a certain result from pedagogic experiments. This is due to the predictability of physical phenomena. For example, if two chemicals are mixed, then it is highly likely a specific reaction will occur. If the expected reaction did not occur, then there must have been a violation of the experimental protocols. In the social sciences, however, reactions to stimuli are not as predictable, and therefore experiments may be valid even if the results are not what was expected. Even in the physical sciences, deviations can be valuable from an instructional standpoint, as they highlight the need for carefully following experimental protocols.

[23] Unexpected results in any of the three experiments can provide just as good a basis for discussion as expected results. For example, if a preference for honesty affected the results in Experiment 1, the instructor may ask the students how likely it is that such a preference would affect behavior in a business organization.

of experiments in management accounting classes may want to start out running Experiment 1.

CONCLUSION

This note presents classroom experiments designed to address management control settings. Classroom experiments can be useful for addressing management control settings, because they involve rich settings with multiple interacting individuals and so are difficult to analyze formally. Because they are designed for accounting classes, the experiments are further focused on the role information. The individual experiments have the following learning objectives:

Experiment 1: To illustrate the loss in profitability and social efficiency arising from information asymmetry in a resource allocation setting.
Experiment 2: To illustrate the potential for mutually beneficial arrangements arising from repeated interaction and the role played by feedback mechanisms.
Experiment 3: To illustrate the potential for more public information to exacerbate management control problems in multi-task settings.

Each of these experiments is designed to be as simple as possible, while still providing important insights regarding the use of management accounting information. To this end, we try to minimize the need for materials, complex instructions, and, most importantly, class time. Each experiment can be administered within 20–40 minutes.

We believe that the instructor should view these experiments as a starting point, rather than a definitive guide. Our own experience has been one of continually modifying the experiments; we would expect instructors who use classroom experiments to do the same. There are many possibilities for modifying these experiments. For example, the first two variations of Experiment 1 may be implemented with a "hurdle rate" contract as in Antle and Eppen (1985), rather than the "modified trust" contract in Evans et al. (2001), enabling a further discussion of the role of honesty. Experiment 2 may be run with an intermediate feedback system that provides finer information than that used in Variation 1, but still less information than that occurring in Variation 2. Students can then experience the difficulty of maintaining an implicit cooperative arrangement when there is only a modest amount of information regarding the actions of others. Similarly, Experiment 3 may be administered with an intermediate information system. For example, prior to the commencement of the second task the instructor may announce how many teams have successfully completed the first task, without naming the individual teams. This may heighten students' awareness of the information security issue, because it is clear that information they want is being collected, but not distributed. In addition to modifying the experiments found in this note, the instructor may wish to create his or her own experiments based on other scholarly management control research, such as Arya et al. (1996) and Waller and Bishop (1990).

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