BuR - Business Research
Official Open Access Journal of VHB
Verband der Hochschullehrer für Betriebswirtschaft e.V.
Volume 4 | Issue 1 | March 2011 | 10-30

Centralization versus Delegation in an Experimental Capital Budgeting Setting

Markus C. Arnold, *School of Business, Economics, and Social Sciences, University of Hamburg, Germany,*
E-Mail: markusc.arnold@wiso.uni-hamburg.de
Robert M. Gillenkirch, *Faculty of Economics and Business, University of Osnabrück, Germany, E-Mail:robert.gillenkirch@uni-osnabrueck.de.*

Abstract
In an experiment, we model two stylized facts about capital budgeting practice, budgetary slack creation and delegation of decision-making authority. In our setting, under centralization, headquarters announces a budget, the division manager gives a cost report, and headquarters decides on the project. Under delegation, headquarters allocates a budget to the manager, and the manager is authorized to make the investment decision. We argue that the ability of headquarters to commit to a budget moderates the effect of delegation, and we find evidence in favor of our argument as there is an interaction effect of delegation and commitment to budgets. The effects of delegation are particularly strong when budgets are non-binding as delegation serves as a substitute for commitment in this case. This leads to smaller expenditures and to a higher headquarters' payoff under delegation than under centralization. In contrast, when headquarters can commit to the budget, the descriptive data are consistent with our conjectures about the effects of honesty preferences, but the effects are too small to be significant.

Keywords: capital budgeting, slack, centralization, delegation, behavioral accounting, experimental economics

Manuscript received January 29, 2010, accepted by Rainer Niemann (Accounting) October 7, 2010.

1 Introduction

This paper reports a capital budgeting experiment that was inspired by two distinct characteristics of capital budgeting processes in practice. First, the budgeting process in firms has long been recognized as susceptible to informational asymmetries exploited by division managers having preferences for building slack into their budgets (Merchant 1985). This means that managers may use their informational advantage for strategic communication in a participative capital budgeting setting. As a result, budgeting processes may include hurdle rates that exceed a firm's cost of capital and thus may be characterized by capital rationing (Poterba and Summers 1995). Second, capital budgeting practice is usually characterized by partial delegation: Headquarters neither centralize nor delegate all investment decisions, but usually delegate some decisions to division managers (Harris and Raviv 1996, with further references). Prominent criteria for delegation are the size of a project or its strategic importance.

This is the first paper to reflect both observations – capital rationing and partial delegation – in an experimental capital budgeting setting. The focus of the paper is on the interaction between the organizational design of the budgeting process (centralization versus delegation) and headquarters' ability to commit to a budget that rations capital (binding budget versus non-binding budget). In particular, we analyze whether the ability of headquarters to commit to a budgetary announcement moderates the effects of delegation in a capital budgeting setting with asymmetric information and a division manager's preference for slack. Our experiment provides a direct test of the effects of delegation and of (the loss of) commitment to budgets on the behavior of the involved parties and thus allows us to study cause-effectrelations in budgeting processes under controlled conditions (Sprinkle and Williamson 2007).

Whether delegation is a useful organizational design alternative is a question of long-standing interest (see, e.g., Holmström 1984, Jensen and Meckling 1992). When a division manager possesses decision-relevant information, centralization will be characterized by the manager's cost report to headquarters and a signal-contingent decision by headquarters, whereas under delegation, the division manager is given authority to make a decision (subject to re-

BuR - Business Research
Official Open Access Journal of VHB
Verband der Hochschullehrer für Betriebswirtschaft e.V.
Volume 4 | Issue 1 | March 2011 | 10-30

strictions set by headquarters). The central idea of the paper combines two arguments: first, we suggest that even if centralization and delegation are equivalent under standard theoretical assumptions, delegation might be behaviorally relevant. Second, we claim that the direction of the behavioral effects of delegation depends on headquarters' ability to commit to her budget announcement.

We distinguish between *objective and subjective commitment*. Objective commitment is generated by irreversible moves made by one or both players such as giving up options, whereas subjective commitment results from motives inside a person and cannot be enforced exogenously. We argue that, in a situation where headquarters cannot objectively commit to a specific (centralized or decentralized) mechanism, delegation can serve as a substitute for commitment. As Holmström (1984: 32) stated: "*It appears that delegating authority to an agent, as opposed to asking the agent for information and promising to act on the information in a particular way, is a more convincing form of precommitment (though they are formally equivalent).*" In particular, under centralization, a budget announcement by headquarters establishes subjective commitment, whereas a budget under delegation establishes both objective and subjective commitment. We argue that this difference results in headquarters being more strongly committed to a budget under delegation.

In contrast, in a setting where headquarters is committed to a binding budget, the design choice between centralization and delegation might be behaviorally relevant due to the manager's preferences for honesty. In particular, budgets may contain less slack under centralization than under delegation as the manager's cost reports to headquarters in the former setting make honesty preferences more relevant than in the latter case in which there is no report from the division manager to headquarters at all.

Our paper is related to two streams of research. The first stream builds upon the seminal papers by Harris, Kriebel, and Raviv (1982) and Antle and Eppen (1985) and analyzes capital budgeting processes with privately held information by managers in order to "reconcile investment theory with actual practice" (Harris and Raviv 1996: 1159). Analytical papers in this stream (see Antle and Fellingham 1997, Covaleski, Evans, Luft, and Shields 2003, and Rajan and Reichelstein 2004 for surveys) do not address centralization-versus-delegation issues, as the Revelation Principle implies that centralization weakly dominates delegation (Melumad and Reichelstein 1987). Exceptions are studies that reconstruct a revelation game by setting up a budgeting process in which decision-making authority is delegated to the division manager (e.g., Harris and Raviv 1998, Baldenius 2003, Mookherjee 2006). Our experiment is based upon these studies in that delegation is equivalent to centralization under standard assumptions (full rationality and individual self-interest). Based upon the standard theoretical equivalence result, our paper is the first to analyze the behavioral relevance of delegation. To the best of our knowledge, the only paper that incorporates behavioral aspects of decision making (honesty preferences) in an analytical capital budgeting model is Mittendorf (2006).

The second stream of research comprises prior experimental studies of headquarters' and division managers' behavior in an Antle and Eppen framework or a related setting. This literature is relevant for our study as it analyzes behavioral aspects of capital budgeting processes. It departs from Evans, Hannan, Krishnan, and Moser (2001) who focused on the manager's trade-off between being honest and maximizing income. In a setting in which headquarters has no possibility to control the manager's cost report, they provided evidence that managers' reports are affected by their preference for honesty. However, the experimental design makes it difficult to clearly distinguish between honesty preferences and preferences for income distributions. Rankin, Schwartz, and Young (2008) refined the test for honesty preferences in settings with and without superior decision authority. We will discuss their results in section 2.3. Hannan, Rankin, and Towry (2006) demonstrated that division managers are not only concerned with being honest but also with appearing honest.

Rankin, Schwartz, and Young (2003) analyzed binding and non-binding budget announcements and provided evidence that commitment is valuable but that non-binding announcements also have economic value to headquarters relative to a setting without announcements. While Rankin, Schwartz, and Young (2003) focused on budget announcements as cheap talk, they did not consider organizational issues of the budgeting process and did not analyze whether and how the degree of commitment interacts with the organizational design.

BuR - Business Research
Official Open Access Journal of VHB
Verband der Hochschullehrer für Betriebswirtschaft e.V.
Volume 4 | Issue 1 | March 2011 | 10-30

Our principal findings are: There is overall evidence for our conjecture that commitment moderates the effects of delegation in capital budgeting as there is an interaction effect of delegation and (the loss of) commitment to budgets. That means, delegation indeed possesses behavioral relevance in the setting we study. The effects of delegation are particularly strong when headquarters cannot commit to the budget. Here, slack and the subordinate payoff are lower and headquarters' payoff (the net return to the firm) is higher under delegation than under centralization. These effects are both economically and statistically significant. Our results support the view that delegation represents an (incomplete) substitute for commitment in a situation where contractual or reputational commitment is not possible, and that this commitment is anticipated by managers. When headquarters can commit to the budget, the descriptive data are consistent with the conjecture that honesty preferences negatively affect capital budgeting under delegation but the effects are not significant. Thus, our results give only limited support for honesty preferences to have a major influence on the outcomes of the budgeting process. We conclude that centralization versus delegation is a relevant organizational design issue as it affects capital budgeting processes in different ways contingent on the degree of budgetary commitment.
The remainder of the paper is organized as follows. In section 2, we develop our hypotheses. Section 3 explains the experimental method. Section 4 contains our results, and section 5 concludes.

2 Hypothesis development

2.1 Setting

The experimental design builds upon the setting of Antle and Eppen (1985). It models a single-period bilateral relationship between headquarters (HQ) and a division manager (the DM). All treatments have a common structure: HQ delegates the realization of an investment project to the DM. The revenue of the project is certain, whereas the project costs are uncertain. For simplicity, the maximum cost does not exceed the revenue. The distribution of costs is common knowledge but only the subordinate learns the actual costs at the beginning of a given round. HQ only has the possibility to acquire a costly imperfect signal about the actual costs after having received the cost report from the DM. If the project is realized, the DM's payoff is equal to slack, which is the difference between the budget allocated to him and the project cost, and HQ receives the residual, which is the revenue less the allocated budget. If, in contrast, the project is not realized, the DM and HQ both receive a payoff of zero.
Under centralization, at the beginning of the budgeting process, HQ makes a budgetary announcement specifying the spending limit for the DM, i.e., the maximum costs that will be funded. The announcement may be binding or non-binding. Then the DM learns the actual cost and makes a cost report to HQ. Under a binding budget, HQ is committed to denying funding whenever the cost report exceeds the limit. If the cost report does not exceed the limit, the project is realized and the DM receives a budget equal to his cost report. Under a non-binding budget, HQ receives the cost report and subsequently decides about project realization without being committed to her announcement. Again, if the project is realized, the DM receives a budget equal to his cost report.
Under delegation, HQ first allocates a budget to the DM. The corresponding transfer of decision-making authority is conditional upon whether the actual costs exceed the budget or not: When actual costs are below the budget, the DM can decide whether to accept or reject project realization. If he realizes the project, he also decides about his expenditure. In contrast, when the actual costs exceed the budget, funding is automatically denied under a binding budget but if the budget is non-binding, the DM can either reject the project or request a budget increase. Requesting a budget increase returns decision authority to HQ. If HQ accepts the request, the requested budget is allocated to the DM.

2.2 Equivalence Hypotheses

We first develop hypotheses from the standard assumptions of full rationality and pure financial self-interest. Under these assumptions, centralization and delegation are equivalent. With binding budgets, the DM always reports costs equal to the budgetary announcement under centralization, whereas, under delegation, the DM expends the full budget allocated to him and never returns resources to HQ. With non-binding budgets, the DM's optimal strategy under centralization is to report costs equal to the revenue minus epsilon, and HQ will always accept. The solution is replicated under delegation:

BuR - Business Research
Official Open Access Journal of VHB
Verband der Hochschullehrer für Betriebswirtschaft e.V.
Volume 4 | Issue 1 | March 2011 | 10-30

Although HQ delegates decision-making authority to the DM by allocating a budget to him, the DM will always return the decision to HQ and request a budget increase up to the revenue minus epsilon, and HQ will accept.
The equivalence of centralization and delegation carries over to general assumptions about financial preferences incorporating altruism, inequity aversion or distributional fairness (e.g., Fehr and Schmidt 2006). The reason is that the treatment variable has no direct effect on monetary outcomes. We state the equivalence of centralization and delegation under non-binding and binding budgets separately, as we will formulate an alternative hypothesis for each in the following section.

H1a: For non-binding budgets, centralization and delegation are equivalent with respect to cost reports, expenditures or budget requests, respectively, and with respect to HQ's and the DM's payoffs.

H2a: For binding budgets, centralization and delegation are equivalent with respect to cost reports, expenditures or budget requests, respectively, and with respect to HQ's and the DM's payoffs.

2.3 Behavioral Hypotheses

Our study focuses on two motives outside the scope of financial preferences: honesty preferences and subjective commitment. We will explain their influence in the following, starting with subjective commitment by discussing the role of delegation for the non-binding budgets case.

Non-binding budgets and subjective commitment
In contrast to the standard theoretical predictions, prior experimental evidence (e.g., Croson, Boles, and Murnighan 2003, Rankin, Schwartz, and Young 2003) suggests that non-binding announcements may be useful for HQ. By making a budgetary announcement in the centralization setting, HQ may signal either the maximum cost she is willing to fund or the range of cost reports she is determined to verify by buying information. Signaling presupposes commitment by HQ to her announcement. We distinguish objective and subjective commitment (which is equivalent to Hirshleifer's distinction between pre-emptive and reactive commitment, see Hirshleifer 2001: 79-80). If it arises from irreversible moves by one or both players, commitment is objective, which makes commitment exogenous to the subsequent relationship between the players. Examples are writing binding contracts or giving up options (by other means than a contract). In contrast, commitment is subjective if it can be neither enforced nor established by reputational effects (Frank 2001). Subjective commitment results from motives within a person (Nesse 2000, Hirshleifer 2001, Frank 2001). Two main reasons for HQ's subjective commitment evolving in our setting are reciprocity and its sources (e.g., Elster 1998, Fehr and Gächter 2000, Thaler 2000), and the desire to behave consistently, i.e., to "keep the promise" made by the budget announcement (Cialdini 1993, ch. 3). We interpret subjective commitment to be gradual and not dichotomous, i.e., only present or absent.
In our setting, under centralization, HQ's commitment is purely subjective: HQ announces a budget, but always makes the last move in deciding about project realization. In contrast, under delegation, HQ's commitment is both objective and subjective: It is objective because the budget allocation to DM is irrevocable and thus the DM has the option to decide about project realization whenever the true cost does not exceed the budget. It is subjective because the DM also has the option to request a budget increase, and the initial budget allocation entails the threat to reject the request.
There is prior evidence supporting the view that subjective commitment has an effect on HQ's behavior in a budget setting like ours. Rankin, Schwartz, and Young (2003) considered three treatments. One of them, the non-binding announcement (NBA) treatment, is equivalent to our centralization treatment; another is a no announcement (NA) treatment without any opportunity for HQ to build up subjective commitment. Rankin, Schwartz, and Young (2003) found that HQ-players (DM-players) received higher (lower) payoffs in the NBA treatment, but that this was not accompanied by lower rejection rates in the NBA treatment. This means that, on average, HQ-players rejected lower budget-breaking cost reports from DM-players in the NBA treatment than in the NA treatment, which is exactly what subjective commitment would imply. Given that a non-binding announcement provides *some* subjective commitment under centralization, we conjecture that, under delegation, the budget allocation provides a *stronger* form of subjective commitment. In this sense, we speak of delegation as a substitute for commitment, and that we inter-

BuR - Business Research
Official Open Access Journal of VHB
Verband der Hochschullehrer für Betriebswirtschaft e.V.
Volume 4 | Issue 1 | March 2011 | 10-30

pret Holmström's idea we cited in the introduction. We have two reasons for our conjecture which are related to the sources of subjective commitment.

First, the initial budget allocation to the DM represents a transfer of the decision right to the DM whenever the actual costs are below the budget. In these cases the DM has a riskless alternative: Realize the project and decide about an expenditure that does not exceed the budget. If, in contrast, the DM requests a budget increase, he returns the decision right to HQ and foregoes the riskless alternative. Thus, a budget-breaking request by the DM is likely to be perceived as a more "unkind" act than a budget-breaking cost report under centralization, which is likely to reinforce reciprocity as a source of subjective commitment. Second, objective commitment is likely to have a direct, reinforcing effect on subjective commitment: As HQ transfers capital and a conditional decision right to the DM, the budget provides stronger subjective commitment to "keep the promise" than a mere announcement of a budget limit under centralization.

We expect two consequences from these different impacts of the institutional settings on subjective commitment: First, we expect increased subjective commitment to raise, *ceteris paribus*, HQ's willingness to reject budget requests under delegation. Second, we expect the DM-players to anticipate the first effect, and thus, we expect delegation to induce smaller expenditures or budget requests. Accordingly, we expect the DM's payoff to be smaller and the level of successful budget requests to be lower under delegation than under centralization. These are two countervailing effects on HQ's payoff, and consequently, the theoretical prediction is not unambiguous. However, prior experimental evidence in the same framework has shown that the DM's anticipation of non-monetary preferences can be strong enough to be beneficial to HQ (Hannan, Rankin, and Towry 2006, Arnold and Schreiber 2009). Thus we state:

H1b: When budgets are non-binding, expenditures or budget requests under delegation are smaller than cost reports under centralization, and delegation yields a smaller payoff to the DM and a larger payoff to HQ than centralization.

Binding budgets and honesty preferences

Next, we discuss the role of honesty preferences. In our experimental setting, when budgeting is centralized, the DM reports costs to HQ, and in order to create slack the DM has to lie and overstate the actual costs in the cost report. In contrast, in the delegation setting, the DM expends resources, which has no relation to lying or truth telling. As a consequence, we are able to analyze the role of preferences for honesty by comparing centralization and delegation. If present and sufficiently strong, such honesty preferences will reduce the cost report under centralization, whereas they will not affect the expenditure under delegation.

Our discussion of the effects of honesty preferences under centralization follows Luft (1997) and the recent literature on honesty preferences in budgeting contexts (Evans, Hannan, Krishnan, and Moser 2001, Hannan, Rankin, and Towry 2006, Mittendorf 2006, Salterio and Webb 2006, Rankin, Schwartz, and Young 2008). It applies to a large variety of models of honesty preferences. Suppose that the DM has a preference for own income, a preference for income distributions, and a preference for honesty. Further suppose that the preference for honesty is not dichotomous (i.e., for the DM there exist "big lies" and "small lies", not just lies), and that the DM's utility is a smooth function of the size of the lie. Then, he will trade off his financial preferences against his preferences for honesty. However, this trade-off will not be unaffected by strategic considerations, as these considerations might crowd out intrinsic motives such as honesty preferences (Buller and Burgoon 1996, Gneezy 2005, Rankin, Schwartz, and Young 2008).

In order to categorize the complexity of strategic considerations in our budgeting setting, we identify three factors: The first is the frequency and form of interaction. The second is authority: Interaction may have no strategic dimension if one of the interacting parties has no authority about the budget. The third is the sequence of actions. Of course, HQ's authority is what primarily counts when we study DM's honesty preferences. Thus, we expect interaction to be "more strategic" if HQ moves after DM and "less strategic" if DM moves after HQ. Using these three factors, we can rank different budgeting settings as follows: (1) HQ is passive and accepts any cost report by the DM. This setting was studied by Evans, Hannan, Krishnan, and Moser 2001, by Hannan, Rankin, and Towry 2006 and by Rankin,

BuR - Business Research
Official Open Access Journal of VHB
Verband der Hochschullehrer für Betriebswirtschaft e.V.
Volume 4 | Issue 1 | March 2011 | 10-30

Schwartz, and Young 2008. (2) HQ objectively commits to a budget by making a binding announcement. This is our centralization setting with a binding budget, where HQ has authority, but the DM's cost report is the last move. (3) HQ makes the investment decision after the DM's cost report, i.e., there is no announcement and HQ moves last. This setting was studied in Rankin, Schwartz, and Young 2008. (4) Setting (3) plus a non-binding announcement by HQ. This corresponds to our centralization setting with a non-binding budget.
In comparing settings (1) and (3), Rankin, Schwartz, and Young 2008 found a reduction in slack of about 25% due to honesty preferences in setting (1), but virtually no effect of honesty preferences on the DM's cost reports in setting (3). The authors concluded that strategic interaction between HQ and the DM crowds out the effect of honesty preferences on cost reports. As our centralization setting with a non-binding budget announcement ranks top with respect to the complexity of strategic interaction, we do not expect any incremental effects of honesty in the non-binding treatments. In contrast, our centralization setting with a binding budget ranks intermediate between (1) and (3), and we thus expect honesty preferences to be relevant in this setting, but not in the comparable delegation setting where the DM makes no report. The corresponding hypothesis is H2b.

H2b: When budgets are binding, cost reports under centralization will be lower than budget expenditures under delegation, the DM's payoff will be lower under centralization and HQ's payoff will be higher.

H1b and H2b together establish the research question of the experiment with respect to the moderating effect of commitment on the effects of delegation. When budgets are binding, delegation will lead to higher budget expenditures relative to cost reports under centralization, a higher payoff for the DM and a lower payoff for HQ. When budgets are non-binding, the inverse relationships hold. We now state this interaction effect that follows from H1b and H2b as a hypothesis:

H3: Commitment moderates the effects of delegation, i.e., the effects of delegation on cost reports, expenditures or budget requests and on HQ's and the DM's payoffs depend on the binding or non-binding character of budgetary announcements.

3 Experimental Method

3.1 Experimental design and participants

We used a (2x2) factorial design (commitment yes/no × centralization/delegation) to test our hypotheses. Both factors were manipulated between subjects. The four resulting treatments are: centralization and binding budgets (CB), delegation and binding budgets (DB), centralization and non-binding budgets (CNB), and delegation and non-binding budgets (DNB). 160 students from the University of Göttingen participated in the experiment, 40 for every treatment. Two sessions were conducted for every treatment, and no subject participated in more than one session. Participants interacted through a computer network with full anonymity. Interaction was one-shot. 10 rounds were played. Each subject was assigned to one of two roles: A-players acted as headquarters; B-players acted as division managers. The representative roles in the budgeting game were used only once in the instructions (see Appendix). HQ and the DM were randomly re-matched after each round such that the DM never reported to the same HQ more than once, and this was common knowledge.
Participants received a show-up fee of 5 EUR and collected points during the experiment. Each participant received an account with an initial balance of 100 points. The initial balance served as a minimum wage for the DM and guaranteed HQ not to have a negative income, even if she bought costly information (see below) and received a zero payoff from the project. At the end of the experiment, points were converted into EUR, where 50 points corresponded to 1 EUR. Participants earned between 7.00 and 22.86 EUR in sessions of 60 to 75 minutes. Compensations were paid out directly after the end of the sessions. Participants were recruited on campus, mostly in lectures with large audiences. The experiment was computerized and implemented with the software SOPHIE (Hendriks 2010). When subjects arrived at the laboratory, they were randomly assigned to computer terminals and were separated by blinders to ensure anonymity.
Before the experiment began, instructions (see Appendix) were displayed on the computer screens and were simultaneously read aloud to the participants. We included a set of control questions in the instructions in order to ensure that all participants understood the experimental procedures and the

BuR - Business Research
Official Open Access Journal of VHB
Verband der Hochschullehrer für Betriebswirtschaft e.V.
Volume 4 | Issue 1 | March 2011 | 10-30

payoff functions. Correct answers to control questions were followed by positive feedback; wrong answers were followed by feedback repeating the relevant information given in the instructions.

We chose an experimental approach to analyze our research questions as experiments allow disentangling the effects of different variables that are confounded in studies that are based on field data. In particular, as it is almost impossible to observe the degree of commitment inherent to capital budgeting rules and processes in firms we chose to *manipulate* this variable instead of trying to *observe* it. That way, by controlling all other potential variables, our experimental approach allows us to draw inferences with respect to the effects of delegation as an organizational design variable, the degree of commitment and their interaction on behavior in budgeting processes.

As we explained above, we chose a one-shot or "strangers" design for our experiment. This means that we used a rotation matching scheme (Kamecke 1997) for participants that ensured that a rational participant acted as if he played a separate game in each round of the experiment. We chose the one-shot setting mainly for two reasons: First, our hypotheses are based on the argument that delegation increases commitment to the budget. A one-shot design allows us to analyze this question by simultaneously holding constant all other sources of increased commitment. An alternative means in reality to increase commitment is reputation. Consequently, a repeated interaction design or "partners" treatment would make it more difficult to attribute the observed effects to its causes. Moreover, it is unclear why a repeated interaction per se should eliminate the effects of delegation on commitment. Second, a one-shot design is necessary if we want to compare our results to the results in Rankin Schwartz, and Young (2003 and 2008), as these studies also analyzed a strangers design.

3.2 The Budgeting Process

The revenue of the project was 200 points; the actual costs were drawn from a uniform distribution with support [0, 1, 2, ..., 199, 200]. The first-best solution implies that the project is realized with certainty. The ex-ante expected payoff to HQ would then be 100. Standard analysis leads to an optimal binding budgetary announcement (for both centralization and delegation) of 100, such that the project will be realized with 50% probability. The expected payoffs for this solution would be 50 for HQ and 25 for the DM. Standard analysis implies irrelevance of the non-binding budget, and the DM would report costs or request a budget, respectively, of 199 (as long as actual costs are below this value) such that HQ loses almost the whole expected project value to the DM.

At the beginning of each round, the DM learned the actual cost. For all 10 rounds, 10 different values were randomly chosen as actual costs. The different values were assigned to player pairs such that actual costs were identical for all players. Then, HQ and the DM interacted. In the centralization treatments CB and CNB, HQ sent an announcement to the DM with respect to the maximum cost that she would accept and fund. Then, the DM made a cost report. The DM could not understate the actual cost, but he could overstate the cost up to the revenue. In case of a project approval, the DM received a budget equal to his cost report, and HQ's payoff equaled the revenue less the budget. When the budgetary announcement was binding, the project decision automatically followed from comparing the cost report to the announcement. In the delegation treatments DB and DNB, instead of announcing a budget limit, HQ allocated a budget to the DM such that the DM was given the right to decide about project realization as long as the actual cost did not exceed the allocated budget. If the budget covered the actual cost, the DM had to decide about the expenditure, which was reported to HQ. That is, the DM could return money to HQ. When the budget was non-binding, the DM could also request a budget increase, which transferred the decision back to HQ. HQ could either approve the request and allocate the requested budget to the DM or deny funding. Under delegation and for both binding and non-binding budgets, the DM always had the opportunity to reject project realization. At the end of the rounds, payoffs were realized and the round ended.

In all treatments, HQ was given the chance to acquire information about the actual cost after the DM made his cost report (centralization) or decided about the expenditure or his budget request (delegation). The design of the information technology is similar to the design in Hannan, Rankin, and Towry (2006). HQ could spend 10 points to buy a signal which reported a range for the actual cost. The support [0, 200] was divided into eight ranges [0..25], ..., [176..200]. The signal was correct with 70% probability, but with 30% probability it randomly

BuR - Business Research
Official Open Access Journal of VHB
Verband der Hochschullehrer für Betriebswirtschaft e.V.
Volume 4 | Issue 1 | March 2011 | 10-30

reported a wrong range. The monitoring technology was common knowledge, and the DM was informed about HQ's decision to buy the signal at the end of each round.

Our setting has the structure of ultimatum bargaining under imperfect information with binding or non-binding announcements of the responder about rejection levels. To the best of our knowledge, the only study of ultimatum bargaining with imperfect information and non-binding announcements is Croson, Boles, and Murnighan (2003). In particular, their result that announcements by responders in the ultimatum game affect the proposers' behaviors is closely related to the results in Rankin, Schwartz, and Young (2003) and to our results.

3.3 Measures

In the following we will denote the project's actual costs by ACTUALCOST, which was balanced between treatments and subjects. In all treatments, HQ's budgetary announcement will be denoted by BUDGET, and we will use REPEXP to denote both the cost report HQ receives under centralization and the expenditure or budget request under delegation, respectively. If the project is realized, the DM's payoff equals π_{DM} = REPEXP – ACTUALCOST, whereas HQ's payoff is π_{HQ} = 200 – REPEXP. Thus, if the project is realized π_{DM} corresponds to the slack. If the project is not realized, both payoffs are zero. HQ's payoff is further reduced by 10 if she acquires information. In the binding treatments, the DM's choice of REPEXP was arbitrary for all cases in which the project was not realized (particularly for all cases where the actual costs exceeded the binding budget). Thus, we exclude these observations from our analysis when comparing the CB and DB treatments with respect to REPEXP.

To represent HQ's beliefs at the moment she makes her project decision, we define an additional variable, ESTSLACK. To calculate ESTSLACK, we reconstruct a Bayesian estimation procedure by HQ. For simplicity, we first assume that, after observing REPEXP, HQ estimates every potential level of ACTUALCOST to be equally likely. Consequently, for uninformed decisions, ESTSLACK equals BUDGET – REPEXP/2. For informed decisions, we use Bayes rule to calculate the posterior distribution for ACTUALCOST *given* REPEXP and the signal received and, for an informed decision, ESTSLACK equals the difference between this posterior belief for ACTUALCOST and BUDGET. Thus, ESTSLACK represents HQ's estimation of the maximum slack the DM could have created by *not* breaking the budget, i.e., by making a report or an expenditure REPEXP = BUDGET.

4 Results

4.1 Tests of hypotheses

Table 1 presents descriptive statistics for the measures used in the analysis.[1] For the CB and the DB treatment, the means of π_{HQ} and π_{DM} refer to all ten rounds, whereas the means of REPEXP refer only to the rounds in which the project was realized. Table 1 further presents the corresponding T-tests (we cannot reject the respective measures to be normally distributed; all p-values $\geq$ 0.24). For each test, the unit of observation is the mean value per participant over all rounds (e.g., Rankin, Schwartz, and Young 2003 and 2008). All T-tests are one-sided.

Table 1 shows that HQ-players set binding budgets well above 100 (121.14 for CB, 123.54 for DB), so that the project is realized in more than 50% of the cases, with 100 and 50% being the standard-theoretical predictions for BUDGET and the realization frequency, respectively. In the case of non-binding budgets, budget announcements under centralization are somewhat higher than budget allocations under delegation. However, both in the binding and the non-binding case, the differences in BUDGET between centralization and delegation are statistically not significant.

H1a and H1b refer to potential differences in REPEXP, π_{DM} and π_{HQ} in the non-binding case. In fact, while H1a predicts the equivalence of centralization and delegation, H1b states that delegation implies lower levels of REPEXP and π_{DM} and a higher level of π_{HQ} than centralization. Figure 1a displays the development of the mean REPEXP (left y-axis) and of π_{HQ} (right y-axis) over time in the non-binding case. As can be seen, REPEXP is consistently lower and π_{HQ} is consistently higher under delegation.

The figure does not reveal any significant time or end-game effect. This evidence is consistent with H1b. The data and T-tests included in Table 1 further confirm this hypothesis: HQ-players receive

[1] The raw data and the full instructions in German can be downloaded from www.business-research.org.

BuR - Business Research
Official Open Access Journal of VHB
Verband der Hochschullehrer für Betriebswirtschaft e.V.
Volume 4 | Issue 1 | March 2011 | 10-30

Table 1: Descriptive Statistics (Panel 1) and T-tests (Panel 2)

Panel 1: Descriptive Statistics		**CB**	**DB**	**CNB**	**DNB**
Cases		200	200	200	200
project realized (cases)		115	113	157	152
DNB only: decisions made by the DM (of these: project realizations)					24 (21)
information acquired (cases)		29	18	35	37
BUDGET	mean	121.14	123.54	100.50	91.04
	standard deviation	14.51	15.73	35.47	17.84
REPEXP	mean	124.47	128.83	161.49	156.21
	standard deviation	17.20	15.38	5.66	5.85
π_{HQ}	mean	41.98	39.31	32.80	37.12
	standard deviation	8.76	8.62	9.65	7.98
π_{DM}	mean	34.05	36.22	52.81	45.70
	standard deviation	11.78	8.27	10.95	8.92

Panel 2: T-tests		**CB vs. DB**	**CNB vs. DNB**	**CB vs. CNB**	**DB vs. DNB**
BUDGET	t	-0.5015	1.0655	2.4091	6.1120
	(p-value)	(0.3095)	(0.1467)	(0.0105**)	(0.0000***)
REPEXP	t	-0.9282	n.a.	-5.2210	n.a.
	(p-value)	(0.1795)		(0.0000***)	
π_{HQ}	t	0.9715	-1.5450	3.1519	0.8339
	(p-value)	(0.1687)	(0.0653*)	(0.0016***)	(0.2048)
π_{DM}	t	-0.6725	2.2516	-5.2167	-3.4859
	(p-value)	(0.2625)	(0.0150**)	(0.0016***)	(0.0006***)

This table displays means and standard deviations for all measures in all treatments (Panel 1), and T-tests (Panel 2). The treatments are centralization and binding budgets (CB), delegation and binding budgets (DB), centralization and non-binding budgets (CNB), and delegation and non-binding budgets (DNB).

*All T-tests are one-sided. ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.*

For all variables, we used individual averages across rounds as the unit of observation. Thus, the number of observations used for every T-test is 20 for every treatment, one per participant.

T-tests with respect to REPEXP for binding versus non-binding budgets are not available, as the DM's choice of REPEXP was arbitrary for all cases ACTUALCOST ≥ BUDGET in the binding treatments.

Variable definitions:
BUDGET = headquarters' announced budget limit (CB, CNB) or allocated budget (DB, DNB);
REPEXP = division manager's cost report (CB, CNB), expenditure or budget request (DB, DNB);
π_{HQ} = headquarters' payoff = project revenue (200) – cost report/budget expenditure if the project is realized and 0 else;
π_{DM} = division manager's payoff = cost report/budget expenditure – actual costs if the project is realized and 0 else.

lower budget requests under delegation than budget reports under centralization (REPEXP, 156.21 vs. 161.49, p = 0.0036). This translates into a significantly lower payoff for the DM-players under delegation (π_{DM}, 45.70 vs. 52.81, p = 0.0150) and a significantly higher payoff for HQ (π_{HQ}, 37.12 vs. 32.80, p = 0.0653). Thus, our results reject H1a and are consistent with H1b. DM-players seem to anticipate a higher subjective commitment of the HQ-players to the allocated budget in the delegation case, and this turns out to be overall financially beneficial for HQ. In the supplementary analysis, we will provide further evidence with respect to the question of whether this was indeed the case.

H2a and H2b refer to the case of binding budgets. Again, H2a states the equivalence of centralization and delegation whereas H2b states that honesty preferences will induce lower REPEXP and π_{DM} and higher π_{HQ} under centralization than under delegation. Figure 1b reveals that although REPEXP tends to be lower and π_{HQ} tends to be higher under centralization, the differences are not as unambiguous as in the non-binding case. Again, the figure does not indicate any end-game effect.

BuR - Business Research
Official Open Access Journal of VHB
Verband der Hochschullehrer für Betriebswirtschaft e.V.
Volume 4 | Issue 1 | March 2011 | 10-30

Figure 1a: Non-binding budgets – Development of the DM-players' mean cost reports (CNB), expenditures or budget requests (DNB) over time (REPEXP, left y-axis), and of the HQ-players' mean payoffs (π_{HQ}, right y-axis).

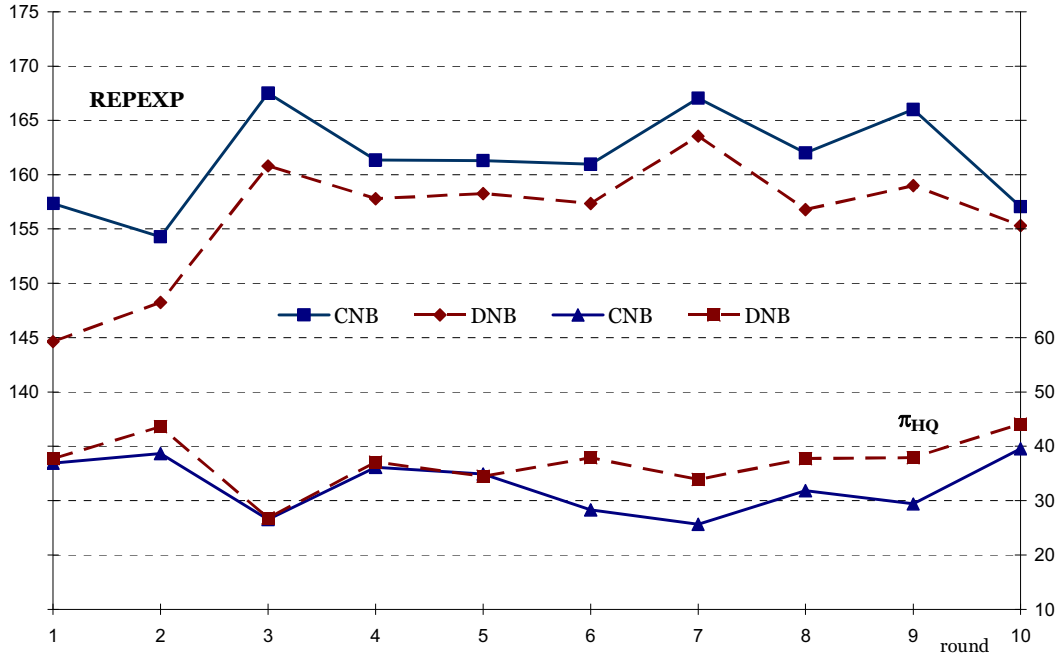
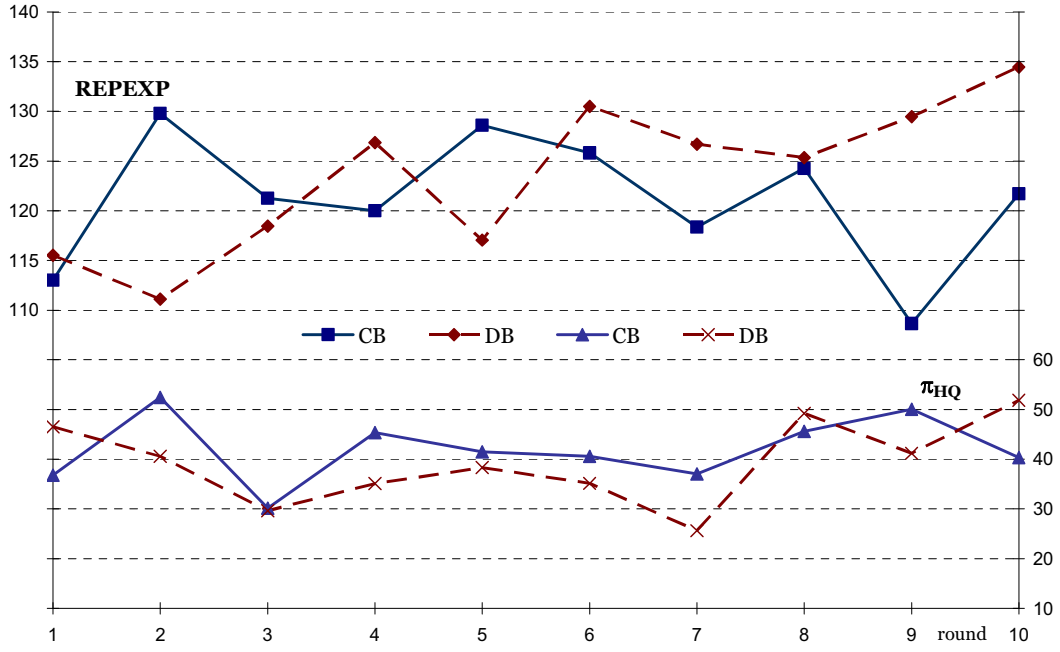


Figure 1b: Binding budgets – Development of the DM-players' mean cost reports (CB), expenditures or budget requests (DB) over time (REPEXP, left y-axis), and of the HQ-players' mean payoffs (π_{HQ}, right y-axis).



BuR - Business Research
Official Open Access Journal of VHB
Verband der Hochschullehrer für Betriebswirtschaft e.V.
Volume 4 | Issue 1 | March 2011 | 10-30

As Table 1 shows, for binding budgets, mean REPEXP is larger (128.83 vs. 124.47), mean π_{DM} is larger (36.22 vs. 34.05), and mean π_{HQ} is smaller (39.31 vs. 41.98) for delegation than for centralization. These descriptive data are in line with the prediction of H2b. However, these differences are small in magnitude, and none of them are statistically significant at conventional levels. We thus cannot reject H2a and find no support for H2b. With respect to the role of honesty preferences, we conclude that even a weak form of strategic interaction, i.e., HQ's binding announcement, seems to be sufficient to crowd out honesty preferences of the DM. Thus, in addition to Rankin, Schwartz, and Young (2008), our results show that it is not necessary that HQ makes the final move in the "budget game" for honesty preferences to be crowded out by strategic considerations.

Hypothesis H3 states that the effects of delegation on REPEXP, π_{DM} and π_{HQ} depend on the binding or non-binding nature of budgets as commitment serves as a moderator with respect to the effects of delegation. Although H2b could not be supported, the descriptive data in this case as well as the results of the T-tests on H1a and H1b are consistent with this hypothesis. Table 2 additionally presents the results of a direct test of H3 by analyses of variance (ANOVA) for the three measures. In the ANOVA, we do not control for ACTUALCOSTS as these are balanced between treatments and participants. In each of the three panels, the table displays the main effects of the treatment variables, here labeled as "nonbind" (nonbind = 0 denotes binding budgets) and "delegate" (delegate = 0 denotes centralization), and the interaction effect. H3 implies that we should not observe a main effect for delegation in the ANOVA, but an interaction effect between "delegate" and "nonbind".

The ANOVA results are consistent with the prediction: The main effect of delegation on REPEXP, π_{HQ} and π_{DM} is not statistically significant, but we observe a statistically significant interaction effect in all three cases which supports the view of commitment as a moderating variable for the effects of delegation. Moreover, for all three measures, Table 2 shows a significant main effect of commitment which implies that commitment is still valuable for HQ. Fig. 2 illustrates the interaction effect for π_{HQ}.

Table 2: ANOVA results for REPEXP, π_{HQ} and π_{DM}.

Panel 1: REPEXP	Sum of Squares	df	Mean Square	F-statistic	p-value
nonbind	23078.48	1	23078.48	152.00	0.0000 ***
delegate	1.20	1	1.20	0.01	0.9294
nonbind × delegate	511.51	1	511.51	3.37	0.0703 *
Residual	11538.88	76	151.83		

Panel 2: π_{HQ}	Sum of Squares	df	Mean Square	F-statistic	p-value
nonbind	646.95	1	646.95	8.41	0.0049 ***
delegate	13.70	1	13.70	0.18	0.6743
nonbind × delegate	244.65	1	244.65	3.18	0.0786 *
Residual	5848.09	76	76.95		

Panel 3: π_{DM}	Sum of Squares	df	Mean Square	F-statistic	p-value
nonbind	3988.90	1	3988.90	39.23	0.0000 ***
delegate	122.27	1	122.27	1.20	0.2763
nonbind × delegate	430.13	1	430.13	4.23	0.0431 **
Residual	7727.65	76	101.68		

This table reports between-subjects effects of ANOVAs for cost reports/budget expenditures (REPEXP), headquarters' payoff (π_{HQ}) and the division managers' payoff (π_{DM}). The factors are non-binding budgets (nonbind: 1/0) and delegation (delegate: 1/0).

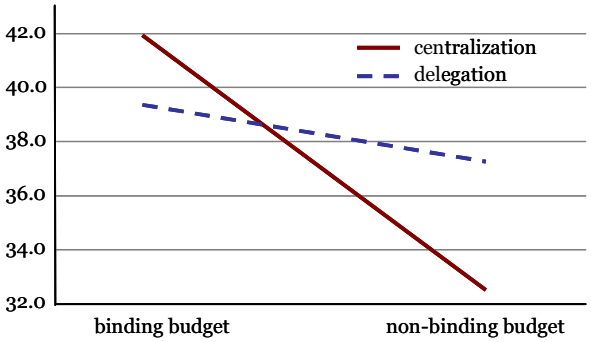
We use all four treatments in the ANOVAs. The average values per subject are used as dependent variables. Every ANOVA includes 4 (treatments) · 20 (headquarters or division managers) = 80 observations.

****, **, and * denote significance at the 1%, 5% and 10% level, respectively (two-tailed tests).*

Variable definitions:
REPEXP = division manager's cost report (CB, CNB), expenditure or budget request (DB, DNB);
π_{HQ} = headquarters' payoff = project revenue (200) – cost report/budget expenditure if the project is realized and 0 else;
π_{DM} = division manager's payoff = cost report/budget expenditure – actual costs if the project is realized and 0 else.

BuR - Business Research
Official Open Access Journal of VHB
Verband der Hochschullehrer für Betriebswirtschaft e.V.
Volume 4 | Issue 1 | March 2011 | 10-30

Figure 2: Illustration of the ANOVA results for π_{HQ}: Main and interaction effects of a loss of commitment to budgets ("nonbind") and of delegation.



4.2 Supplementary analysis

The results reported in the preceding section support the notion of delegation as a commitment device for HQ under non-binding conditions. The results rely on tests of the main measures REPEXP and the payoffs. In the following, we provide supplementary evidence with respect to the subjective commitment of HQ-players. Therefore, we analyze HQ-players' decisions to realize projects and to acquire information. In particular, we address three questions: (i) Did HQ-players reject more and lower budget requests under delegation than budget-breaking cost reports under centralization? (ii) Which factors influenced HQ-players' project decisions? (iii) Which factors influenced HQ-players' decisions to acquire information?

(i) We find that HQ-players' project acceptance rates for cases in which the DM-players broke the budget (REPEXP > BUDGET) are similar for both centralization (136 out of 157 cases, 86.6%) and delegation (131 out of 152, 86.1%). This means that HQ-players did not reject budget requests under delegation more frequently than budget-breaking cost reports under centralization. However, the mean levels of REPEXP in these cases differ: Under centralization, the mean cost report that was accepted by HQ is 155.99 whereas, under delegation, the mean budget request that was accepted is 148.72. This difference is highly statistically significant (T-test, one-sided, $p = 0.006$). Thus, under delegation, the budget request an HQ-player was willing to fund is significantly lower than under centralization. This implies that HQ-players indeed were more strongly committed to the budget they allocated to the DM-players at the beginning of the round, and this effect was anticipated by the DM-players.

(ii) In order to further explore the determinants of HQ-players' project decisions, we conducted regression analyses. We used LOGIT regressions with individual fixed effects and standard errors clustered at HQ level in order to account for multiple observations within subjects.

Panel 1 of Table 3 presents the results of the LOGIT regressions for the CNB and DNB treatments explaining the probability of project acceptance by HQ-players. In these regressions, we use REPEXP, $PAYHIST_{HQ}$ and ESTSLACK as explanatory variables. ESTSLACK represents HQ's expectations with respect to the maximum slack the DM could have created without breaking the budget. The higher ESTSLACK, the more likely HQ will perceive a budget request by the DM to be an unkind act. Consequently, if HQ's subjective commitment is higher under delegation than under centralization, we should observe a stronger reaction of HQ to this measure in the delegation setting than in the centralization setting.

Indeed, the regressions show that in the delegation case, HQ's project decision does not only depend on the absolute level of REPEXP, but also on ESTSLACK. Thus, the more slack the DM could have realized by not breaking the budget, the less likely is HQ's project acceptance under delegation. In contrast, under centralization, ESTSLACK has no statistically significant influence, which means that HQ's decision only depends on the absolute level of REPEXP. These results provide further supportive evidence with respect to the conjecture that HQ-players exhibit higher subjective commitment to their budgets and that a budget-breaking behavior weighs more heavily in this case.

(iii) Panel 2 of Table 3 displays the results of the regression analyses we conducted for the HQ-players' information acquisition under centralization and delegation. As above, individual fixed effects are included in the regressions but not reported in the table. As independent variables, we use BUDGET and the difference REPEXP–BUDGET. Thus, the decision to acquire information is explained by the degree to which the DM's report exceeds the budget and by the budget itself. In particular, if the relation between information acquisi-

BuR - Business Research
Official Open Access Journal of VHB
Verband der Hochschullehrer für Betriebswirtschaft e.V.
Volume 4 | Issue 1 | March 2011 | 10-30

tion and the budget is positive, this implies that the higher the initial budget, the more likely is information acquisition. This means that information acquisition would depend on the initial "generosity" of the budget, a relation that should be particularly relevant for delegation. As a control variable, we use the payoff history, $PAYHIST_{HQ}$, to account for round, learning, and wealth effects. For a given round, $PAYHIST_{HQ}$ equals HQ's aggregate payoff up to this round.

Table 3: Regression analyses of headquarters' decision to accept projects (Panel 1) and to acquire information (Panel 2).

Panel 1

Dependent variable: project choice by HQ	Centralization (CNB)				Delegation (DNB)			
Independent variables	Coefficient	robust st.err.	z	p-value	Coefficient	robust st.err.	z	p-value
Constant	21.966	7.2725	3.02	0.003 ***	23.689	4.7982	4.94	0.000 ***
REPEXP	-0.129	0.0397	-3.25	0.001 ***	-0.138	0.0288	-4.78	0.000 ***
ESTSLACK	-0.010	0.0104	-0.94	0.348	-0.023	0.0099	-2.36	0.018 **
$PAYHIST_{HQ}$	-0.003	0.0034	-0.79	0.428	0.012	0.0031	4.01	0.000 ***
N	160#				143#			
Pseudo-R^2	0.506				0.498			

Panel 2

Dependent variable: information acquisition by HQ	Centralization (CNB)				Delegation (DNB)			
Independent variables	Coefficient	robust st.err.	z	p-value	Coefficient	robust st.err.	z	p-value
Constant	-0.546	1.2578	-0.43	0.664	-3.783	1.2251	-3.09	0.002 ***
BUDGET	-0.009	0.0140	-0.63	0.525	0.014	0.0098	1.42	0.156
REPEXP – BUDGET	0.022	0.0079	2.78	0.005 ***	0.016	0.0067	2.37	0.018 **
$PAYHIST_{HQ}$	-0.008	0.0029	-2.76	0.006 ***	-0.006	0.0022	-2.87	0.004 ***
N	130#				149#			
Pseudo-R^2	0.298				0.182			

This table reports four regressions to analyze headquarters' project decisions (Panel 1) and information acquisitions (Panel 2). We use logistic regressions with standard errors clustered at headquarters' level in order to account for multiple observations within subjects. Individual fixed effects are included but the coefficient values for the subject dummies are not reported in the table.

The dependent variable is headquarters' decision to accept the project (1) or to reject it (0) in Panel 1 and headquarters' decision to acquire information (1) or not (0) in Panel 2.

The independent variables are REPEXP, ESTSLACK and PAYHISTHQ in Panel 1 and BUDGET, REPEXP – BUDGET and PAYHISTHQ in Panel 2.

The treatments included into the regressions are centralization and non-binding budgets (CNB), and delegation and non-binding budgets (DNB).

 # denotes a case in which the number of observations is reduced due to decisions that are perfectly explained by the player dummies: Some players always realized projects (Panel 1) and some players never bought information (Panel 2).

****, **, and * denote significance at the 1%, 5% and 10% levels, respectively (two-tailed tests).*

Variable definitions:

BUDGET = headquarters' announced budget limit (CB, CNB) or allocated budget (DB, DNB);
REPEXP = division manager's cost report (CB, CNB), expenditure or budget request (DB, DNB);
PAYHISTHQ = aggregate payoff of headquarters up to the respective round;
ESTSLACK = headquarters' estimation (using Bayes rule) with respect to the maximum amount of slack the division manager could have realized without breaking the budget.

Panel 2 of Table 3 shows that the difference REPEXP – BUDGET provides some explanation for information acquisition in both treatments: the higher this difference, the more likely is information acquisition. In contrast, while the coefficient of BUDGET is not in the predicted direction under centralization, it has the predicted sign under delegation and its magnitude is comparable to the effect of REPEXP – BUDGET. Thus, under delegation, a more generous initial budget seems to increase the

BuR - Business Research
Official Open Access Journal of VHB
Verband der Hochschullehrer für Betriebswirtschaft e.V.
Volume 4 | Issue 1 | March 2011 | 10-30

probability of information acquisition, although this effect is statistically not significant.

Finally, we study the value of full commitment (i.e., of budgets being binding) in the delegation and the centralization case. Although theoretical considerations would predict a positive value of commitment for HQ in both cases, the effect should be larger under centralization than under delegation due to the interaction effect between delegation and commitment. The effect should also be nonzero under delegation which means that although delegation is a commitment device, it is not a perfect substitute for a binding budget. The descriptive data in Table 1 are consistent with this. Although π_{DM} increases both under centralization and delegation when budgets are non-binding, the increase is larger under centralization (52.81 vs. 34.05) than under delegation (45.70 vs. 36.22). For π_{HQ}, the difference between centralization and delegation is even more pronounced: Under centralization, π_{HQ} decreases strongly (41.98 vs. 32.80, $p = 0.0016$, T-test) whereas under delegation, the corresponding decrease in π_{HQ} is modest and insignificant (39.31 vs. 37.12, $p = 0.2048$, T-test). Thus, under delegation, HQ's financial loss from a loss in commitment to the budget is economically small and even statistically insignificant. This further supports our view of delegation indeed providing a partial substitute for budget commitment.

5 Conclusion

In this paper, we experimentally studied a capital budgeting process that is characterized by superior information for a division manager who has preferences for slack and by headquarters' trade-off between the benefits of slack reduction and the costs of inefficient investment decisions. The main focus of the experiment was on the interaction between the organizational design of the budgeting process (centralization versus delegation) and headquarters' ability to commit to a capital budget. In particular, we studied the moderating influence of headquarters' ability to commit to the budget on the effects of delegation. We hypothesized that delegation should be beneficial for headquarters when commitment is not possible but that the effects of delegation could be negative in a setting with commitment. We argued that the former positive effect of delegation would be due to delegation serving as a substitute for external or reputational commitment and that the latter negative effect could result from honesty preferences of the division managers acting in favor of a centralized setting.

In our experiment, we find overall confirmatory evidence for our conjecture of commitment as a moderating variable for the effects of delegation. In particular, our findings imply that delegation increases subjective commitment of HQ in a setting without external commitment and that this increased commitment is anticipated by the division managers. Under delegation, participants in the role of headquarters are only willing to fund budget requests that are significantly smaller than the cost reports approved under centralization, and division managers' budget requests are in turn significantly smaller than the cost reports under centralization. Overall, the effect is beneficial for headquarters as headquarters' payoff increases. Moreover, in our experimental setting, delegation even makes the decrease in headquarters' payoff from a loss in commitment insignificant.

In contrast, we find only weak evidence for honesty preferences in the setting with commitment. While the effects are in the predicted direction, they are not large enough to be statistically significant. This represents supplementary evidence to Rankin, Schwartz, and Young (2008) with respect to the role of honesty preferences in budgeting as it shows that even under reduced strategic interaction, honesty preferences do no longer seem to have any effect. Thus, with respect to budgeting practice, it seems to be rather unlikely that honesty preferences play a major role.

Our results have implications for the design of budgeting processes. Delegation, or more precisely the allocation of a budget and the corresponding decision right to a division manager, is a behaviorally relevant organizational design alternative as it affects capital budgeting processes in different ways contingent on the degree of budgetary commitment. It is particularly relevant if headquarters cannot commit to the budget, i.e., if the division manager has the option to apply for a budget increase. This underlines the importance of considering deviations from standard individual rationality assumptions when designing budgeting systems.

As a matter of fact, a generalization of our results is limited by our design. Although we modeled an organizational aspect of budgeting which seems to be relevant from a practical perspective, budgeting processes in practice are characterized by far-richer

BuR - Business Research
Official Open Access Journal of VHB
Verband der Hochschullehrer für Betriebswirtschaft e.V.
Volume 4 | Issue 1 | March 2011 | 10-30

and more complex organizational features which are likely to interact. Furthermore, the design of a budgeting process may affect its outcomes also through other factors or individual preferences such as preferences for procedural fairness or for norm enforcement (see, e.g., Frey, Benz, and Stutzer 2004, Wentzel 2004.). Our results were derived from a one-shot setting, where participants played separate games with new partners in every round of the experiment. Consequently, the results are unaffected by reputational motives. Reputation is an alternative source of commitment, and so a repeated design would provide evidence with respect to delegation and reputation being complements or substitutes. Although we think that this question is worth analyzing, the analysis itself is beyond the scope of this paper.
Our results encourage us to suggest further analysis of organizational aspects of budgeting, such as the allocation of decision rights, social distances implied by organizational design choices or communication channels to deepen our understanding of their behavioral effects on the involved agents.

Acknowledgements

We would like to thank two anonymous referees for their helpful comments. Our further thanks go to the participants at the Operations Research Conference 2008, the accounting section meeting 2008 of the German Academic Association for Business Research, the Business Research Conference "Finance, Accounting & Taxation" 2009, and seminar participants at the University of Hannover, where earlier versions of this paper were presented.

Appendix: Instructions to Participants

In the following, we first present the complete instructions (translated from German) for the treatment with delegation and non-binding budgets (DNB). Subsequently, we present extracts from the instructions for all other treatments that refer to the core differences in the treatment designs.

A1 Instructions for the DNB treatment

Preliminary remarks

Welcome and thank you for participating in this experiment. The experiment is funded by the University of Göttingen. The purpose of the experiment is to analyze economic decision making.
You have received a participant code to log in for this experiment. Please keep the participant code with you. You will need it to identify yourself when the money you have earned is paid out to you.
The purpose of the participant code is to ensure full anonymity of the participants, both to each other and to the experimenters. Neither the experimenters nor other participants will be able to identify you by observing your decisions.
For your participation in the experiment, you will receive 5 EUR. Any further remuneration that you will earn during the experiment – contingent on your decisions – will be paid out *additionally* to these 5 EUR.
During the experiment, your income will be measured in points where

50 points = 1 EUR.

All points that you earn during the experiment will be summed up at the end, converted into EUR and immediately paid out to you in cash.
Please note:
- You may not speak during the experiment.
- Make your own decisions and do not converse with other participants.

If you have a question during the experiment, please raise your hand. We will then answer it in private. At the end of the instructions, you will have the opportunity to ask questions if something is still unclear.

Participants and course of the experiment

In this experiment, there are two types of participants that will be called A-players and B-players in the following.

You are an A-player/a B-player.

During the whole experiment, you will make your decisions as an A-player/as a B-player.

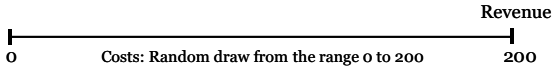
The experiment consists of *ten rounds*. At the beginning of each round, the A-players will be randomly matched with B-players. There will be a new random rematching in each round.
Your decisions will be anonymously transmitted to your partner of the corresponding round via the computer network. No other participant will ever learn your name or your participant code during or after the experiment, i.e., your decisions will remain *completely anonymous*.

BuR - Business Research
Official Open Access Journal of VHB
Verband der Hochschullehrer für Betriebswirtschaft e.V.
Volume 4 | Issue 1 | March 2011 | 10-30

Setting

It may be helpful for you to imagine the experimental setting as follows: An A-player acts as the owner of a firm. His corresponding B-player can realize a project on behalf of the A-player. The project yields a revenue of 200 points. The project costs are between 0 and 200 points.

In every round, the actual costs are randomly determined for every pair of A- and B-players.



The potential cost values will only be integers between 0 and 200.

The actual costs that are randomly determined for a pair of A- and B-players are known only to the B-player. The A-player is not informed about the outcome of the drawing.

Every round of the experiment consists of four steps.

Step 1:

In the first step, the computer randomly determines the actual costs of the round as explained above. The B-player is informed about these costs.

In the first step, the A-player determines a cost budget which is allocated to the B-player. The cost budget has to be an integer between 0 and 200 points. The A-player determines the cost budget without knowing the actual costs.

Step 2:

In the second step, the B-player is informed about the cost budget. The B-player now has two possibilities: He can directly decide about the realization of the project or he can request a budget increase.

Option (1): The B-player decides about the realization of the project. The B-player can either reject the project – in this case, both players will receive zero points from the project – or decide to realize it if the actual costs do not exceed the cost budget determined by the A-player. In this case, the B-player has to specify how much of the budget he will expend. The expended costs cannot be smaller than the actual costs and cannot be larger than the allocated cost budget.

Option (2): The B-player requests a budget increase. If the B-player wants to realize the project, but also wants to expend costs that exceed the cost budget determined by the A-player, the B-player can request a *budget increase* from the A-player. To do this, the B-player reports to the A-player the cost amount which he wants to expend for the project instead of the cost budget. This amount may not exceed 200 points. If the B-player requests a budget increase he no longer decides about the realization of the project. *The decision about the project realization will then be made by the A-player.*

Step 3:

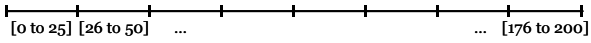
In the third step, the A-player will be informed about the B-player's decision: He learns whether the B-player decided himself or requests a budget increase. If the B-player decided himself the A-player is informed about this decision. In case the B-player realized the project, the A-player also learns how much of the budget (i.e., which cost amount) the B-player expended.

If the B-player requests a budget increase, the A-player is informed about the cost amount the B-player would like to expend.

In both cases, i.e., independent of whether he decides about the project realization or whether the B-player has already decided, the A-player can acquire *information*.

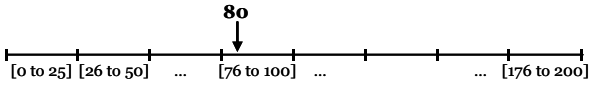
The cost of the information for the A-player is 10 points. The information will be as follows: "The actual costs are within the range [... to ...]."

"[... to ...]" is the range of the actual project costs of the round. There are eight potential ranges:



The information is not 100% reliable. With a probability of 70%, the reported range is correct, i.e., the actual cost lies in the range. With a probability of 30%, the information reports a different, wrong range. Each of the seven other ranges is equally likely in this case.

Please consider the following example for illustration:



The actual costs are 80. With a probability of 70%, the A-player will receive the information "The actual costs are within the range [76 to 100]." In contrast, with a probability of 30%, the information will indicate one of the other ranges.

BuR - Business Research
Official Open Access Journal of VHB
Verband der Hochschullehrer für Betriebswirtschaft e.V.
Volume 4 | Issue 1 | March 2011 | 10-30

Step 4:
In the fourth step, the A-player receives the information if he has acquired it in the third step.
If the B-player has decided about the realization of the project himself, the round ends.
In contrast, if the B-player has requested a budget increase, the A-player will now decide whether the project will be realized or not. The A-player has only two options: Either he decides to realize the project and to allocate a cost budget *equal to the requested amount* to the B-player, or he decides to reject the project. The A-player cannot realize the project without allocating the full amount of the requested budget to the B-player.

Remunerations of the A- and B-player:
Every A-player and every B-player will have a points account during the experiment. At the beginning of the experiment, the account balance will be 100 points. The balance increases or decreases according to the points that every player will receive in the course of the experiment.
In every round, the account balance changes as follows:

– Case 1: The project is not realized.
  If the project is not realized, both the A-player and the B-player will receive zero points from the project. If the A-player acquires the information, the information costs will be charged, and the account balance decreases by 10 points.
– Case 2: The B-player does not request a budget increase and realizes the project.
  If the B-player does not request a budget increase and realizes the project, he receives the expended costs less the actual project costs.
  Thus, for the points of the B-player, it follows:
  B-player points = expended costs – actual costs
  The A-player, as the project owner, receives the net revenue, i.e., the project revenue (200 points) less the expended costs. If the A-player acquires the information, the information costs will be charged (10 points).
  Thus, for the points of the A-player in a given round, it follows:
  A-player points = 200 – expended costs – 10 (in case the information is acquired)
– Case 3: The B-player requests a budget increase and the A-player realizes the project.
  If the B-player requests a budget increase and the A-player decides to realize the project, the B-player receives the cost amount requested and approved by the A-player less the actual costs.
  Thus, for the points of the B-player, it follows:
  B-player points = approved costs – actual costs
  The A-player, as the project owner, receives the net revenue. The net revenue corresponds to the project revenue (200 points) less the costs approved. If the A-player acquires the information, the information costs will be charged (10 points).
  Thus, for the points of the A-player in a given round, it follows:
  A-player points = 200 – approved costs – 10 (in case the information is acquired)

Summary
– You will earn 5 EUR from the experiment plus your collected points that will be converted into Euro as follows: 50 points = 1 EUR. The initial balance of your account is 100 points.
– In the experiment, there are A-players and B-players. You are an A-player/a B-player.
– You will make decisions in ten rounds. In every round, A- and B-players are randomly matched. You will remain anonymous.
– The B-player can realize a project on behalf of the A-player. The project yields revenue of 200 points. The project costs are between 0 and 200 points. The actual costs are randomly drawn by the computer and are only known to the B-player. The A-player is not informed about the outcome of the drawing.
– Every round consists of four steps.
  Step 1: The B-player learns the costs; the A-player determines a cost budget.
  Step 2: The B-player decides about the project or requests a budget increase.
  Step 3: The A-player can acquire information.
  Step 4: If the B-player has requested a budget increase, the A-player decides about the project. The round ends.
– If the B-player requests a budget increase, the A-player decides about the project but cannot change the budget. Either he rejects the project or he realizes the project and approves the requested cost budget. If the B-player decides about the project and realizes it, he has to specify how much of the cost budget he would like to expend.

BuR - Business Research
Official Open Access Journal of VHB
Verband der Hochschullehrer für Betriebswirtschaft e.V.
Volume 4 | Issue 1 | March 2011 | 10-30

– The information indicates a range that contains the actual project costs. It is only correct with a probability of 70%. If the project is not realized, the A-player and the B-player will receive zero points from the project. If the B-player does not request a budget increase and realizes the project, he receives the difference between the expended costs and the actual costs. The A-player receives the revenue less the expended costs. If the B-player requests a budget increase and the A-player realizes the project, the B-player receives the requested cost budget less the actual costs. The A-player receives the revenue less the requested cost budget.
– The A-player's points from the project decrease by 10 if he acquires the information.

A2 Instructions for the CNB treatment: Modifications to DNB instructions

[...]

Setting

[...]

Step 1:
In the first step, the computer randomly determines the actual costs of the round as explained above. The B-player is informed about these costs.
In the first step, the A-player sets a *cost limit* which is communicated to the B-player. The cost limit has to be an integer between 0 and 200 points. The A-player determines the cost limit without knowing the actual costs.
By setting the cost limit, limit the A-player communicates to the B-player the maximum cost he is willing to fund. If the B-player's cost report *exceeds* the cost limit, the A-player intends to deny funding. If the cost report is *lower than or equal to* the cost limit, the A-player intends to approve the budget and to realize the project. However, the A-player is not bound to the cost limit. This will be explained in more detail below.

Step 2:
In the second step, the B-player is informed about the cost limit set by the A-player. The B-player now makes his cost report to the A-player. The cost report has to be an integer. It must not exceed 200 points, and it must not be lower than the actual costs. There are no further restrictions with respect to the cost report. The computer system will check the restrictions and will only pass cost reports that fulfill the requirements.

Step 3:
In the third step, the A-player will be informed about the B-player's cost report. Next, and before deciding about project realization, the A-player can acquire *information*. [...]

Step 4:
In the fourth step, the A-player receives the information if he has acquired it in the third step.
The A-player will now decide whether the project will be realized or not. The A-player only has two options: Either he decides to realize the project and to allocate a cost budget *equal to the cost* report to the B-player, or he decides to reject the project. The A-player cannot realize the project without allocating the full amount of the reported costs to the B-player.
Please note: When deciding about project realization, the A-player is not bound to the announced budget limit. That means that the A-player's decision about project realization, given the B-player's cost report, is *free and independent* of the cost limit announced before.

Remunerations of the A- and B-player:

[...]

In every round, the account balance changes as follows:
– Case 1: The project is not realized.
If the project is not realized, both the A-player and the B-player will receive zero points from the project. If the A-player acquires the information, the information costs will be charged, and the account balance decreases by 10 points.
– Case 2: The project is realized.
If the A-player decides to realize the project, the B-player receives an amount equal to his cost report less the actual costs. Thus, for the points of the B-player, it follows:
B-player points = reported costs – actual costs
The A-player, as the project owner, receives the net revenue. The net revenue equals the project revenue (200 points) less the costs reported. If the A-player acquires the information, the information costs will be charged (10 points). Thus, for the points of the A-player in a given round, it follows:
A-player points = 200 – reported costs – 10 (in case the information is acquired)

BuR - Business Research
Official Open Access Journal of VHB
Verband der Hochschullehrer für Betriebswirtschaft e.V.
Volume 4 | Issue 1 | March 2011 | 10-30

Summary

[...]

– Every round consists of four steps:
  Step 1: The B-player learns the costs; the A-player determines a cost limit.
  Step 2: The B-player makes a cost report to the A-player.
  Step 3: The A-player can acquire information.
  Step 4: The A-player decides about the project. The round ends.
– After receiving the cost report, the A-player decides about the project but cannot change the budget. Either he rejects the project or he realizes the project and approves the reported costs.
– The information indicates a range that contains the actual project costs. It is only correct with a probability of 70%.
– If the project is not realized, the A-player and the B-player will receive zero points from the project. If the project is realized, the B-player receives the costs reported less the actual costs. The A-player receives the revenue less the reported costs.

[...]

A3 Instructions for the DB treatment: Modifications to DNB instructions

[...]

Setting

[...]

Step 1:

[...] In the first step, the A-player determines a *cost budget* which is allocated to the B-player. The cost budget is *binding*: The A-player cannot change it at a later step of the round. The cost budget has to be an integer between 0 and 200 points. The A-player determines the cost budget without knowing the actual costs.

Step 2:

In the second step, the B-player is informed about the cost budget. The B-player now has to make his decisions:

First, he has to decide whether he wants to realize the project with the budget allocated to him or not. He can only realize the project if the budget covers the actual cost. A request for a budget increase is not possible. If the B-player cannot realize the project, or if the B-player decides to reject realization, both players will receive zero points from the project.

Second, if the budget covers the actual costs and if the B-player wants to realize the project, he has to specify *how much of the budget he will expend*. The expended costs cannot be smaller than the actual costs and cannot be larger than the allocated cost budget. [...]

A4 Instructions for the CB treatment: Modifications to CNB instructions

[...]

Setting

[...]

By setting the cost limit, limit the A-player communicates to the B-player the maximum cost he will fund. The cost limit is *binding*. This means that the A-player's decision follows automatically from the B-player's cost report: If the B-player's cost report *exceeds* the cost limit, funding is denied. If the cost report is *lower than or equal to* the cost limit, the project will be realized. [...]

References

Antle, Rick and Gary D. Eppen (1985): Capital Rationing and Organizational Slack in Capital Budgeting, *Management Science*, 31 (2): 163-174.

Antle, Rick and John Fellingham (1997): Models of Capital Investments with Private Information and Incentives: A Selective Review, *Journal of Business Finance & Accounting*, 24 (7-8): 887-908.

Arnold, Markus C. and Dominik Schreiber (2009): Audits, Reputation, and Repeated Interaction in a Capital Budgeting Setting, Working Paper, SSRN.

Baldenius, Tim (2003): Delegated Investment Decisions and Private Benefits of Control, *The Accounting Review*, 78 (4): 909-930.

Buller, David B. and Judee K. Burgoon (1996): Interpersonal Deception Theory, *Communication Theory*, 6 (3): 203-242.

Cialdini, Robert B. (1993): *Influence – The Psychology of Persuasion*, Collins: New York.

Covaleski, Mark, John H. Evans, Joan L. Luft, and Michael D. Shields (2003): Budgeting Research: Three Theoretical Perspectives and Criteria for Selective Integration, *Journal of Management Accounting Research*, 15: 3-49.

Croson, Rachel, Terry Boles, and J. Keith Murnighan (2003): Cheap Talk in Bargaining Experiments: Lying and Threats in Ultimatum Games, *Journal of Economic Behavior and Organization*, 51 (2): 143-159.

Elster, Jon (1998): Emotions and Economic Theory, *Journal of Economic Literature*, 36 (1): 47-74.

Evans, John H., R. Lynn Hannan, Ranjani Krishnan, and Donald V. Moser (2001): Honesty in Managerial Reporting, *The Accounting Review*, 76 (4): 537-559.

Fehr, Ernst and Simon Gächter (2000): Fairness and Retaliation: The Economics of Reciprocity, *Journal of Economic Perspectives*, 14 (3): 159-181.

Fehr, Ernst and Klaus M. Schmidt (2006): The Economics of Fairness, Reciprocity and Altruism – Experimental Evidence and New Theories, in: Serge-Christophe Kolm and Jean Mercier Ythier (eds.): *Handbook on the Economics of Giving, Altruism, and Reciprocity*, North Holland: Amsterdam, 615-691.

Frank, Robert H. (2001): Cooperation Through Emotional Commitment, in: Randolph M. Nesse (ed.): *Evolution and the Capacity for Commitment*, Russell: New York, 57-76.

Frey, Bruno S., Matthias Benz, and Alois Stutzer (2004): Introducing Procedural Utility: Not only What, but also How Matters, *Journal of Institutional and Theoretical Economics*, 160 (3): 377-401.

Gneezy, Uri (2005): Deception – The Role of Consequences, *American Economic Review,* 95 (1): 384-394.

Hannan, R. Lynn, Frederick W. Rankin, and Kristy L. Towry (2006): The Effect of Information Systems on Honesty in Managerial Reporting: A Behavioral Perspective, *Contemporary Accounting Research*, 23 (4): 885-918.

Harris, Milton, Charles H. Kriebel, and Artur Raviv (1982): Asymmetric Information, Incentives and Intrafirm Resource Allocation, *Management Science*, 28 (6): 604-620.

Harris, Milton and Artur Raviv (1996): The Capital Budgeting Process: Incentives and Information, *Journal of Finance*, 51 (4): 1139-1174.

Harris, Milton and Artur Raviv (1998): Capital Budgeting and Delegation, *Journal of Financial Economics*, 50 (3): 259-289.

Hendriks, Achim (2010): SOPHIE – A modular software platform for experiments with human interaction, Working Paper, University of Osnabrück.

Hirshleifer, Jack (2001): Game Theoretic Interpretations of Commitment, in: Randolph M. Nesse (ed.): *Evolution and the Capacity for Commitment*, Russell: New York, 77-98.

Holmström, Bengt (1984): On the Theory of Delegation, in: Marcel Boyer and Richard E. Kihlstrom (eds.): *Bayesian Models in Economic Theory*, North-Holland: Amsterdam, 115-141.

Jensen, Michael C. and William H. Meckling (1992): Specific and General Knowledge, and Organizational Structure, in: Lars Werin and Hans Wijkander (eds.): *Contract Economics,* Blackwell: Oxford, 251-274.

Kamecke, Ulrich (1997): Rotations: Matching Schemes that Efficiently Preserve the Best Reply Structure of a One Shot Game, *International Journal of Game Theory,* 26 (3): 409-417.

Luft, Joan L. (1997): Fairness, Ethics, and the Effect of Management Accounting on Transaction Costs, *Journal of Management Accounting Research,* 9 (9): 199-216.

Melumad, Nahum D. and Stefan Reichelstein (1987): Centralization Versus Delegation and the Value of Communication, *Journal of Accounting Research*, 25 (Supplement): 1-18.

Merchant, Kenneth A. (1985): Budgeting and the Propensity to Create Budgetary Slack, *Accounting, Organizations and Society*, 10 (2): 201-210.

Mittendorf, Brian (2006): Capital Budgeting when Managers Value both Honesty and Perquisites, *Journal of Management Accounting Research*, 18 (1): 77-95.

Mookherjee, Dilip (2006): Decentralization, Hierarchies and Incentives: A Mechanism Design Perspective, *Journal of Economic Literature*, 44 (2): 367-390.

Nesse, Randolph M. (2000): Strategic Subjective Commitment, *Journal of Consciousness Studies,* 7 (1-2): 326-330.

Poterba, James M. and Lawrence H. Summers (1995): A CEO Survey of U.S. Companies' Time Horizons and Hurdle Rates, *Sloan Management Review*, 37 (1): 43-53.

Rajan, Madhav V. and Stefan Reichelstein (2004): A Perspective on "Asymmetric Information, Incentives and Intrafirm Resource Allocation", *Management Science*, 50 (12): 1615-1623.

Rankin, Frederick W., Steven T. Schwartz, and Richard A. Young (2003): Management Control Using Nonbinding Budgetary Announcements, *Journal of Management Accounting Research*, 15 (1): 75–93.

Rankin, Frederick W., Steven T. Schwartz, and Richard A. Young (2008): The Effect of Honesty and Superior Authority on Budget Proposals, *The Accounting Review*, 83 (4): 1083-1099.

Salterio, Steven E. and Alan Webb (2006): Honesty in Accounting & Control: A Discussion of "The Effect of Information Systems on Honesty in Managerial Reporting: A Behavioral Perspective", *Contemporary Accounting Research*, 23 (4): 919-932.

Sprinkle, Geoffrey B. and Michael G. Williamson (2007): Experimental Research in Managerial Accounting, in: Christopher S. Chapman, Anthony G. Hopwood, and Michael D. Shields (eds.): *Handbook of Management Accounting Research*, Elsevier: Amsterdam, 415-444.

Thaler, Richard H. (2000). From Homo Economicus to Homo Sapiens, *Journal of Economic Perspectives*, 14 (1): 133-41.

Wentzel, Kristin (2004): Do Perceptions of Fairness Mitigate Managers' Use of Budgetary Slack During Asymmetric Information Conditions?, *Advances in Management Accounting*, 13: 223-244.

BuR - Business Research
Official Open Access Journal of VHB
Verband der Hochschullehrer für Betriebswirtschaft e.V.
Volume 4 | Issue 1 | March 2011 | 10-30

Biographies

Markus C. Arnold has been Professor of Management Accounting and Management Control at the University of Hamburg since 2009. He was born 1977 in Bad Soden (Germany) and graduated in business administration from the Goethe University Frankfurt and the University Paris IX Dauphine in 2001. Arnold received his Ph.D. from the Clausthal University of Technology in 2005 and his Habilitation from the University of Göttingen in 2008. His research interests include management control with a focus on experimental research and executive compensation.

Robert M. Gillenkirch has been Heinrich W. Risken Professor of Management and Accounting at the University of Osnabrück since 2008. He was born in Möhnesee-Körbecke (Germany), and is a graduate in business administration from the Goethe Universität Frankfurt. Gillenkirch received his Ph.D. (in 1996) and his Habilitation (in 2003) from the Goethe University Frankfurt. His research interests include value -based management, behavioral management accounting, and executive compensation.