Remuneration for Sustainable Value Creation: Incentive Properties of Deferred Bonus Payments

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1 Introduction

1.1 Motivation

Separation of ownership and control, information asymmetries and diverging interests between shareholders and decision makers give rise to organizational control problems within firms. Performance-based compensation is a common tool to address the resulting principal agent problem (Jensen and Meckling 1976; Ross 1973). Over the years, firms have been experimenting with a number of performance measures and a large body of literature has focused on determining the incentive properties of the resulting compensation schemes (Banker, Potter, and Srinivasan 2000; Davila and Venkatachalam 2004; Ittner and Larcker 1998a, 1998b).

Traditionally, incentive pay is based on the performance realization in the current period and payout to managers occurs in the same period. These compensation schemes encourage managers to focus on improving the performance measure in order to increase their bonus. The problem, however, is that managers may concentrate on maximizing their bonus rather than firm prospects (Feltham and Xie 1994; Ittner, Larcker, and Rajan 1997; Dechow and Sloan 1991; Cheng 2004). In the worst case, managers may not only neglect but potentially even harm firm prospects. A large body of literature in accounting has attempted to identify solutions to this problem of managerial opportunism (e.g., Rogerson 1997; Reichelstein 1997, 2000; Dikolli, Kulp, and Sedatole 2013; Chen, Cheng, and Wang 2015; Ang et al. 2000; Holthausen, 1990).

Proposed solutions include the use of performance measures that improve alignment between managerial objectives and firm goals, including nonfinancial, forward-looking, and market-based performance measures (Ittner and Larcker 1998b; Dikolli 2001; Lambert and Larcker 1987; Sloan 1993). An alternative approach to encouraging managers to act in the best interest of the firm is to adjust the design of the compensation scheme. Potential procedures include multi-year approaches to evaluating performance (Li and Wang 2016), adjusting vesting periods of equity-based bonuses (Bettis et al. 2018; Laux 2012), and the use of multiple performance measures with differing weights to determine performance-based compensation (Ittner, Larcker, and Meyer 2003). Another alternative that is receiving increasing attention is delaying the payment of bonuses and imposing conditions for bonus payout (Shlomo and Nguyen, 2011; Lange and Walth, 2011). These predetermined performance targets expose bonuses awarded in one period to the risk of performance in future periods. Compensation schemes that comprise these design elements of bonus deferral and potential bonus recovery if the conditions for bonus payout are not met, are also frequently referred to as "bonus bank" schemes (e.g., Stewart 1991; Byrnes 2009; Bischof, Essex, and Furtaw 2010; Hartmann and Slapnicar 2014).

Consulting firms have been promoting bonus banks as a remedy to managerial opportunism for a long time (Stewart 1991; Young and O'Byrne 2000). Since dysfunctional incentives resulting from inappropriate remuneration schemes have been identified as one of the driving factors of the recent global financial crisis (CIMA 2010; Directive 2010/76/EU), the popularity and use of bonus bank schemes has increased in the aftermath of the crisis. A rising number of both financial and nonfinancial firms have adopted these compensation schemes (e.g., Morgan Stanley, UBS, Credit Suisse, Metro) and regulatory bodies have introduced requirements for bonus bank schemes in an attempt to address concerns related to managerial opportunism. In Europe and Australia, regulatory requirements stipulate that financial institutions delay the payment of a material share of variable compensation for a number of periods (Directive 2010/76/EU; Banking Executive Accountability Regime Division 4 Part IIAA 37E, BEAR). In several European countries, these requirements have been extended to apply to both financial and nonfinancial firms (e.g., VorstAG 2009). In addition to bonus deferral, the Australian Prudential Regulation Authority (2008) also mandates the implementation of bonus recovery provisions in financial institutions. These regulatory requirements for bonus deferral and bonus recovery as the core elements of a bonus bank scheme intend to create incentives for mangers to act in the best interest of the firm by ensuring that bonus payments are based on sustainable value creation (Stewart 1991). The regulatory requirement for listed firms to adopt clawback and holdback provisions in the U.S. (Dodd-Frank Wall Street Reform and Consumer Protection Act, Section 954, Dodd-Frank) originates from similar objectives. In contrast to bonus bank schemes, compensation schemes with clawback provisions do not defer payout of bonuses to future periods. However, managers face the risk of having to return bonuses if future performance falls short of predetermined requirements. Similarly to bonuses under bonus bank schemes, variable compensation is thus also exposed to the risk of future performance under clawback provisions. Theoretically, firms may use a multitude of performance requirements for bonus bank schemes and contracts with clawback provisions. However, clawbacks are typically triggered by accounting misstatements (e.g., DeHaan, Hodge, and Shevlin 2013).

Despite the increasing popularity of bonus bank schemes, evidence on the incentive properties of these compensation schemes remains limited. Since it is not clear whether bonus bank schemes can improve alignment of managerial behavior with firm objectives, the increasing implementation of bonus bank schemes should be considered with caution. Limited prior research has focused on developing measures of sustainable value creation that can be used to determine managers' variable compensation in bonus bank schemes (O'Hanlon and Peasnell 1998 and 2002). This literature has however failed to reconcile bonus bank schemes as suggested and implemented in practice (Ehrbar 1998; Stewart 1991) with scientific insights into the incentive structure of compensation schemes with bonus deferral and potential bonus recovery (Pfeiffer and Velthuis 2009; Edmans et al. 2012). This dissertation contributes to the academic discourse by examining the incentive properties of bonus bank schemes in a rational economics framework and identifying parameters and conditions that influence the effectiveness of bonus bank schemes. In a second step, this dissertation adopts a behavioral lens and examines whether and how bonus deferral and bonus recovery provisions individually and collectively affect individuals' behavior. This dissertation thus provides a better understanding of the behavioral incentives of bonus bank schemes and ultimately their effect on firm prospects.

The dissertation is structured as follows: Article I outlines and discusses the concepts of bonus bank schemes proposed in the practitioners' and the academic literature. It formalizes the proposed procedures and adopts an analytical approach to determine the conditions under which bonus bank schemes can provide incentives for fully rational managers to act in the best interest of the firm. Article II, article III, and article IV dismiss assumptions of decision makers' rationality and examine the behavioral incentives of bonus bank schemes. While article II focuses on the isolated effect of deferred bonus payments, article III and article IV analyze the effect of both design elements of bonus bank schemes: bonus deferral and bonus recovery. More specifically, article III examines whether bonus deferral and bonus recovery are individually and collectively effective when it comes to encouraging employees to exert effort to the benefit of the firm. Article IV focuses on the combined effect of bonus deferral and bonus recovery on risk taking behavior over time, that is, when the payout of deferred bonuses is conditional on predetermined performance targets. The dissertation concludes with a summary of the results of this dissertation, limitations and potential future research avenues.

1.2 Overview of Articles Included

Article title	Co-authors	Journal	Date
Managerial Compensation, Bonus Banks, and Long-Term Orientation	Wolfgang Schultze Andreas Weiler Mandy Cheng	Submitted to Review of Accounting Studies (A)	2019
The Effect of Bonus Deferral on Managers' Investment Decisions	Mandy Cheng Tami Dinh Wolfgang Schultze	Behavioral Research in Accounting (DOI: 10.2308/bria-52463)	2019
Encouraging Goal-Alignment in Multidimensional Tasks: An Experimental Examination of Effort under Bonus Deferral and Bonus Recovery	Mandy Cheng Tami Dinh Wolfgang Schultze	Submitted to Contemporary Accounting Research (A)	2019
Behavioral Risk Taking Incentives under Uncertain Deferred Bonus Payments	-	Submitted to EAA 43rd Annual Congress Working Paper, University of Augsburg	2019

1.2.1 Article I - Managerial Compensation, Bonus Banks, and Long-Term Orientation

The first step towards answering the question whether bonus bank schemes are an effective tool to address managerial self-interest and opportunism, is to systemize these remuneration schemes and determine their functional elements. In the first article of this dissertation, we discuss the concepts of bonus bank schemes proposed in the practitioners' and the academic literature and formalize the resulting remuneration schemes.

The formalization of bonus bank schemes enables an examination of their incentive properties in an analytical model where investment decision making is delegated to managers and compensation is based on accounting information. The model assumes information asymmetry and full rationality. More specifically, we assume that managers have private information about investment opportunities as well as their abilities and employment horizon. In this setting, delegating investment decisions to managers can lead to underinvestment. We use a procedure for annuitizing residual income developed by Rogerson (1997) as a benchmark solution to examine whether bonus bank schemes can achieve alignment between managerial interest and firm objectives. Rogerson (1997) shows that managers will make efficient investment decisions when their bonus payments are proportional to the annuity of residual income. We examine whether bonus bank schemes proposed in the practitioners' and the academic literature can replicate this stream of bonus payments when performance measures are determined according to generally accepted accounting principles.

1.2.2 Article II - The Effect of Bonus Deferral on Managers' Investment Decisions

Analytical models that assume full rationality do not capture the full breadth of factors influencing human behavior. Hence, to provide a more thorough understanding of the incentive properties of bonus bank schemes, the second article of this dissertation dismisses assumptions concerning decision makers' rationality. It adopts a behavioral lens and focuses on bonus deferral to provide empirical evidence on the effect of one element of bonus bank schemes on managers' investment behavior.

Regulatory requirements have contributed to the increasing use of bonus bank schemes (e.g., Directive 2010/76/EU; BEAR). These regulations differ in whether they mandate the implementation of bonus deferral, bonus recovery, or both. In practice, firms frequently combine bonus recovery and bonus deferral in bonus bank schemes because it is easier to recoup retained bonuses than to enforce a payback. As a result, disentangling the effects of the two functional elements of bonus bank schemes based on archival data is difficult. We conduct a 2x2 between-subjects experiment to isolate the effect of bonus deferral. The experiment allows us to establish a firm understanding of the behavioral impact of bonus deferral on managers' self-interest. More specifically, we examine whether delaying bonus payments increases managers' willingness to make an investment that provides long-term benefits to the firm but imposes immediate cost on managers' bonus.

1.2.3 Article III - Encouraging Goal-Alignment in Multidimensional Tasks: An Experimental Examination of Effort under Bonus Deferral and Bonus Recovery

The incentives provided by bonus bank schemes are based on bonus deferral and bonus recovery. The third article of this dissertation focuses on the combination of these two functional elements of bonus bank schemes and provides empirical evidence on their individual and combined behavioral effect with regard to effort provision.

Bonus bank schemes can be used for employees and managers at all hierarchical levels of a firm. Especially, but not exclusively, at lower levels of the firm, encouraging effort provision in line with firm goals is one of the core objectives of incentive schemes. Ideally, incentive schemes increase employees' willingness to exert effort and simultaneously direct their effort towards critical tasks or task dimensions. We conduct a 2x2 between-subjects experiment to analyze the individual and combined effect of bonus deferral and bonus recovery on effort provision. More specifically, we examine how bonus deferral and bonus recovery influence employees' performance on two sub-dimensions of an effort-sensitive task as well as their overall task performance.

1.2.4 Article IV - Behavioral Risk Taking Incentives under Uncertain Deferred Bonus Payments

Under bonus bank schemes, payment of bonuses is delayed and deferred bonuses are reduced or forfeited if performance targets are not met in future periods. Bonus bank schemes thus entail uncertain deferred bonuses as managers can only expect to receive deferred bonuses under predetermined conditions. The fourth article of this dissertation focuses on the combined effect of bonus deferral and bonus recovery over time and examines how uncertain deferred bonus payments affect managers' risk taking behavior.

The recent global financial crisis has partly been attributed to ineffective remuneration schemes (CIMA 2010). In particular, incentives for excessive risk taking have been claimed to have resulted in firm failure underlying the crisis (Bhagat and Bolton 2014; Ferrarini and Ungureanu 2010; Hitz and Müller-Bloch 2015). In light of these claims, regulatory bodies introduced requirements for bonus bank schemes in an attempt to curb excessive risk taking and thus stabilize firms and markets (e.g., Directive 2010/76/EU; BEAR). I conduct a 2x2x2 between-subjects experiment to analyze the combined effect of bonus deferral and bonus recovery on mangers' risk taking behavior. More specifically, I examine whether uncertain deferred bonuses effectively mitigate excessive risk taking or whether they in fact increase managers' willingness to accept excessive risk in periods when current performance jeopardizes deferred bonuses.

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2 Article I: Managerial Compensation, Bonus Banks, and Long-Term Orientation

Wolfgang Schultze, Andreas Weiler, Maria Assel, Mandy Cheng

Abstract: Bonus banks are mechanisms for deferring bonus payments and enhancing pay-for-performance by facilitating downward corrections of bonuses. These compensation schemes have become widely accepted among practitioners and regulators in recent years. However, researchers have yet to consider the incentive properties of bonus banks. Our formal analysis provides insights into how bonus banks can be used to address the problem of myopic managers. Specifically, we find that efficient investment incentives require that the net present value of newly initiated investments be credited to the bonus bank. This can be achieved by linking the bonus bank to value creation via "Economic Value Created" (O'Hanlon and Peasnell 2002), but requires managers to truthfully report about value creation. The central issue thus becomes eliciting the true value of the bonus bank. For situations in which equity market values are not applicable, like divisions or private firms, we find that an internal market for the bonus bank between the incumbent and succeeding manager can induce truthful reporting under restrictive but plausible conditions. In particular, negotiations under asymmetric information require the succeeding manager to have significantly superior capabilities to compensate for potential misreporting by the incumbent manager.

Keywords: Performance Measurement, Value Based Management, Long-Term Incentives

JEL Codes: M41, M52

2.1 Introduction

This paper formally analyzes the investment incentives of bonus banks. Bonus banks are compensation schemes in which some portion of variable remuneration is not paid out immediately but collected in internal accounts, deferred to later periods and paid out subject to pre-specified conditions. Such compensation schemes have been promoted by consulting firms to attain managerial long-term orientation for a long time, but how this objective is achieved is left unexplained (Stewart 1991; Young and O'Byrne 2001). Bonus banks have become increasingly popular in the aftermath of the global financial crisis since defective remuneration was found to be a major contributory factor.[1] An increasing number of financial and nonfinancial firms have adopted bonus bank schemes (e.g., Morgan Stanley, UBS, Credit Suisse, Metro). Europe and Australia have introduced regulatory requirements for such schemes.[2] The objective of the legislative bodies is to achieve alignment between managerial incentives and shareholder interest by ensuring that managers' compensation is based on sustainable value creation. The Sarbanes-Oxley Act of 2002 as well as the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 in the US follow a similar approach.[3] Despite their increasing prevalence, it is yet unclear whether these compensation schemes are effective in aligning managerial behavior with long-term shareholder

[1]"(1) Excessive and imprudent risk-taking in the banking sector has led to the failure of individual financial institutions and systemic problems in Member States and globally. While the causes of such risk-taking are many and complex, there is agreement by supervisors and regulatory bodies, including the G-20 and the Committee of European Banking Supervisors (CEBS), that the inappropriate remuneration structures of some financial institutions have been a contributory factor." Directive 2010/76/EU of the European Parliament and of the Council of 24 November 2010.

[2]In Europe and Australia, financial institutions are required to defer a substantial portion of variable remuneration to later periods (Directive 2010/76/EU of the European Parliament and of the Council of 24 November 2010; Banking Executive Accountability Regime Division 4 Part IIAA, BEAR). Several national bodies in Europe have extended these regulations to non-financial institutions. For example, in June 2009 Germany passed the Act on the Appropriateness of Management Board Compensation (VorstAG), requiring all publicly listed firms to implement such long-term oriented remuneration schemes.

[3]The Sarbanes-Oxley Act of 2002 as well as the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 have introduced holdback and clawback provisions, that allow firms to recoup falsely granted payments (Brink and Rankin 2013; DeHaan et al. 2013; Hodge and Winn 2012). While similar, holdback and clawback provisions differ from bonus banks in that they are typically triggered by accounting restatements rather than future performance (Iskandar-Datta and Yonghong 2013). Clawbacks require explicit involvement of the SEC or the board of directors to recoup erroneously made compensation payments while bonus banks are based on automated mechanisms. As a result, clawbacks are rarely enforced in practice (Fried and Shilon 2011; Glater 2005) since they are subject to resource limitations of the enforcing bodies. While clawback provisions allow the firm to recoup falsely granted bonuses, bonus banks are intended to prevent ineffective compensation in the first place (Edmans et al. 2012).

interest.

With few exceptions (Edmands et al. 2012; Hartmann and Slapnicar 2015; O'Hanlon and Peasnell 1998, 2002) bonus banks have received little attention in accounting research. Edmans et al. (2012) show that bonus banks can mitigate the problem of top-level managers' myopia in listed firms, where the stock price provides information on the value of the bonus bank. However, when equity market values are not applicable, e.g. for divisions or private firms, accounting performance measures are required. We therefore study the incentive properties of bonus banks based on accounting performance measures.

Edmans et al. (2012) find that when managers can engage in myopic behavior, the optimal incentive contract can be implemented by escrowing managers' pay into an internal account, equivalent to a bonus bank. In their model, myopic behavior such as underinvesting, inflates firm value in the short term but is detrimental to the long-term value of the firm. The proposed solution consists of three key components: The present value of all future managerial compensation is (i) credited to an internal account in the period when the manager is appointed, (ii) invested in the firm's stock, and (iii) paid out over an extended period of time exceeding his appointment. The value of the bonus bank depends on the value of the firm and is determined in an efficient capital market. By assumption, managements' actions and myopic behavior translate directly into firm value. Deferring payout of bonuses over time until all negative consequences of myopic behavior are realized serves to ensure that managers participate in the long-term consequences of their actions.

However, the incentive problem of managerial myopia is not limited to senior executives with oversight responsibility, but extends to lower level managers (Murphy 2003). If divisional managers' compensation is based on firm-wide performance such as the firm's stock, they bear the risk associated with the performance of others (Baker 2002) and will demand risk premia to compensate for the inherent noise (Feltham and Xie 1994; Ghosh 2005; Oxley and Pandher 2016). This increases the cost associated with equity-based compensation (Oxley and Pandher 2016). Prior research finds that the incentive problem of divisional managers requires the use of divisional measures of performance, for which stock market values are often not available.[4] The same holds for managers in private firms such as partnerships. In these settings, accounting information can be used to measure performance and address incentive problems (Aggarwal and Samwick 2003; Baker 2002; Banker and Datar 1989; Oxley and Pandher 2016). We therefore study the incentive properties of bonus banks based on accounting information as proposed in prior literature (Bischof et al. 2010; Ehrbar 1998; O'Hanlon and Peasnell 2002; Stewart 1991) and provide theoretical guidance on the conditions under which bonus banks may induce efficient investment decisions.

We examine an analytical model in which investment decision-making is delegated to the manager and compensation is determined based on accounting information. When managers are myopic, that is, are planning to leave or retire before all the benefits of the investment are realized, they may underinvest relative to the efficient level. As the benchmark solution to this problem, we use the result developed by Rogerson (1997). He shows that the problem of myopic managers can be solved by a special cost-allocation procedure to determine residual income (RI) for managerial performance evaluation. However, when managers are better informed about an investment opportunity and the firm relies on managerial reports about the investment's profitability based on generally accepted accounting principles (GAAP), accounting-based performance measures provide the opportunity for managers to misreport and inflate reported performance (Burgstahler and Dichev 1997; Gaver et al. 1995; Healy 1985). Managers may manipulate reports in an attempt to maximize their payoffs. For a situation where the firm depends on managerial reports and managers can misreport, we study whether the bonus bank can be used to induce truthful reporting and mitigate underinvestment problems.

We start by analyzing bonus banks based on RI as suggested in the practitioners' literature (Ehrbar 1998; Stewart 1991)[5] and find that efficient investment incentives require that a portion of

[4]Banker and Datar (1989) find that in the optimal contract the weight on a performance measure decreases as it becomes noisier and less sensitive to managerial behavior. That is, firms should optimally rely less on firm-wide performance measures when more precise signals of managerial performance are available. Anctil and Dutta (1999) find that optimal compensation contracts include both divisional and firm-wide performance measures to mitigate underinvestment problems. Consistently, Aggarwal and Samwick (2003) empirically find that divisional managers are more strongly rewarded based on divisional performance measures than on firm-wide performance measures.

[5]Bonus banks can generally be tied to any performance measure. We study bonus banks in conjunction with RI because (i) consulting firms have suggested bonus bank schemes to be used in combination with a version of RI, such

the net present value (NPV) of each newly initiated project be credited to the bonus bank. This can be achieved by linking the bonus bank to value creation via "Excess Value Created" (EVC) as proposed by O'Hanlon and Peasnell (2002). EVC is identical to NPV at the initiation of a project. In later periods, it measures additional value creation and managers' success in the realization of initial plans over time, based on actual performance and current knowledge.

We next analyze the EVC-based approach, and find that an optimal pay-out-scheme can be developed that reproduces the Rogerson-solution. However, this solution requires the principal to have ex ante knowledge of EVC, making delegation of the investment decision obsolete. Under asymmetric information, the main problem then becomes to induce the manager to truthfully report about value creation. One way of capturing value creation is by using stock prices determined in an efficient capital market (Edmans et al. 2012; Pfeiffer and Velthuis 2009). For lack of an external market as in Edmans et al. (2012), we follow the transfer pricing literature and use negotiations as a means for determining prices for internal exchange (Baldenius 2000; Johnson 2006). We examine an internal market where the incumbent manager is allowed to sell the bonus bank to a successor when leaving the firm before the project is completed and analyze the incentive properties of the bonus bank when the managers trade (i) under symmetric or (ii) under asymmetric information. In practice, this negotiation is similar to the process in which partners in partnerships or managers in private firms determine the value of their shares.

We find that an internal market induces truthful reporting and hence efficient investment decisions under restrictive but plausible conditions. The internal market captures the value created by the incumbent manager and balances the incentives of the parties. Trade under symmetric information provides incentives for efficient investment decisions when the incumbent manager can expect the buying manager to have equal capabilities. For efficient investment decisions given trade under asymmetric information, i.e. when the incumbent manager has better information about the project's true profitability, the succeeding manager needs to have significantly superior capabilities compared to the leaving manager. The buying manager is willing to trade only if the value

as Economic Value Added (EVA), (ii) firms combine these design element in their compensation schemes, and (iii) prior literature shows that RI has desirable properties with respect to incentive systems (e.g. Rogerson 1997).

surplus he can generate due to his superior capabilities compensates for potential overstatements of the bonus bank by the leaving manager. The internal market induces truthful reporting about value creation which is necessary for providing efficient investment incentives by means of the bonus bank scheme. While delegation of investment decision making seems obsolete when in possession of truthful information on NPV, delegation of investment decisions under the bonus bank mechanism enables the principal to elicit truthful reporting in the first place.

Our paper extends prior results by Edmans et al. (2012) to situations where firms use accounting performance measures and address incentive problems when equity-based performance measures are not available or applicable for use in incentive contracts, such as for divisional managers or managers in private firms (Aggarwal and Samwick 2003; Baker 2002; Banker and Datar 1989; Oxley and Pandher 2016). O'Hanlon and Peasnell (2002) suggest that bonus banks be linked directly to periodic changes of EVC. The resulting incentive system is equivalent to the solution by Edmans et al. (2012) except that the performance measure used to feed the bonus bank is determined in the accounting system rather than in an efficient capital market. While O'Hanlon and Peasnell (2002) develop and discuss the performance measure EVC, they provide no further analysis of the incentive properties of this mechanism for mitigating managerial short-termism. Our theoretical analysis closes this gap and determines the conditions under which bonus banks based on accounting performance measures can induce efficient investment decisions.

Our paper provides the first theoretical analysis of the incentive properties of deferred compensation schemes based on accounting performance measures. We provide an in-depth review and discussion of the existing concepts of bonus banks and formalize the procedures proposed. Our results highlight that the practitioners' claims about the usefulness of bonus banks should be considered with caution. We show that bonus banks based on accounting performance measures can provide efficient investment incentives only under restrictive conditions. In particular, the effectiveness of the practitioners' approach requires the opening balance of the bonus bank to compensate for the investment decision's negative consequences on future performance. However, for this to be effective, managers would need to truthfully report about value creation. Our findings establish that the incentive properties of bonus banks mainly depend on the settlement of the bonus bank balance at job termination. Negotiations between the incumbent manager and the successor for the purchase of the bonus bank can potentially induce truthful reports and efficient investment decisions. Such negotiations are an ongoing feature of partnerships, where partners are required to buy shares in their firm. The main difference is that the purchase price of the bonus bank derives from the *net* present value of the business rather than the present value. While our paper does not stipulate the selection process of the succeeding manager, the selectivity for the succeeding manager plays a key role in our setting. Levin and Tadelis (2005) find that the key feature of partnerships is profit sharing, leading partners to be particularly selective as to whom they accept as new partners. We find that the selectivity for new managers allows for additional value creation, compensating for managers' incentives to overstate the value of their stake and inducing truthful reporting. Combined with the bonus bank, the bargaining process for internal shares addresses the underinvestment problem.

The remainder of the paper is organized as follows. Section 2.3 describes the model framework and the benchmark solution to the incentive problem. Section 2.4 presents the related literature on bonus banks based on RI, formalizes the proposed bonus bank concept and examines its incentive properties. Section 2.5 presents the related literature on bonus banks based on periodic changes of EVC, formalizes the proposed bonus bank concept and examines its design. Section 2.6 provides a critical discussion and conclusion.

2.2 Related Literature

2.2.1 Bonus Banks based on Residual Income

The practitioners' literature claims that bonus banks (i) encourage long-term decision-making by managers, (ii) smooth bonus payments to the manager, and (iii) provide a potentially unlimited reward for success and a genuine penalty for failure (Ehrbar 1998; Stewart 1991).[6] Bonus banks are internal accounts which accumulate and transfer bonuses to later periods when they are paid

[6]The use of bonus banks as an incentive instrument is also discussed in Walter (1992) and Bischof et al. (2010). This literature does not consider goal congruence aspects.

out subject to meeting predetermined performance targets. Essentially, bonus banks have four key elements (Stewart 1991): (i) rules for out- and inflows of bonuses from and to the bonus bank, (ii) the interest rate used to compound the balance of the bonus bank, (iii) an arbitrary amount which is credited to the bonus bank at the starting point (i.e. "opening balance"), and (iv) rules concerning the final settlement of the bonus bank account.

Rules for out- and inflows of bonuses are designed to provide incentives for managers to act in the owners' best interest. The practitioners' literature generally assumes that the bonus bank is based on RI which is typically calculated based on generally accepted accounting principles (GAAP) (Ehrbar 1998; Stewart 1991). While a positive RI increases the balance of the bonus bank, a negative RI reduces its balance. This is a way of creating liability on the downside and holding the manager accountable for unfavorable outcomes in any given period. After credits (debits) have been made, payouts are based on the resulting bonus bank balance. Bonus payments from the bonus bank thus depend on both current and past performance. The remaining bonus bank balance is retained and accumulated at an interest rate r. The practitioners' literature does not explicitly discuss the interest rate r used to compute the balance of the bonus bank.

The third element of a bonus bank contract is its opening balance K_0. According to Stewart (1991), it can be the result of the following cases: (i) the opening balance constitutes a loan to the manager which is amortized, (ii) it is contributed by the manager himself, or (iii) the opening balance may come "from nowhere at all" (p. 237). A positive opening balance is intended to allow for possible negative bonuses to be deducted from the bonus bank and to avoid negative bonus payments (Bischof et al. 2010).

The fourth element of a bonus bank is its final settlement. Proposed rules for the case when the manager leaves the firm before project completion include paying out the entire positive balance or forfeiting some or even all of the leaving manager's bonus bank balance (Bischof et al. 2010; Stewart 1991). The former may create incentives for managers to leave in case of negative performance expectations, whereas managers will be more inclined to stay if job termination results in forfeiture of the bonus bank balance (Bischof et al. 2010). The resulting ex ante investment incentives of such settlement rules are not considered in the practitioners' literature.

2.2.2 Bonus Banks based on Excess Value Created

O'Hanlon and Peasnell (2002) discuss the bonus bank and find that the practitioners' arguments are solely based on the "conservation property" of RI: If managers are rewarded proportionately to RI and have the same time horizon as the firm, they will choose the investment level that maximizes NPV. If, however, their time horizon is different, the conservation property is insufficient because there is no immediate link between RI observed in one particular period and managers' success in achieving long-term value creation.

In view of this deficit, O'Hanlon and Peasnell (2002) develop a measure of long-term value creation termed "excess value created" (EVC) which captures both value creation and value realization in one period (Ohlson 2002). Value creation means that managers initiate projects that increase shareholder wealth. It is the result of an infinite series of excess returns and is equivalent to the present value of the expected future RI (Johnson and Petrone 1998). In contrast, value realization describes the success in realizing the planned figures. Realized value is identical to all RI earned and accumulated to date t, accrued at the interest rate r. EVC thus segregates the past and the future part of value creation (Ohlson 2002) and provides the "missing link" between goodwill accounting, capital budgeting and performance measurement (O'Hanlon and Peasnell 2002). O'Hanlon and Peasnell (2002) suggest to directly use EVC to feed a bonus bank (p. 235). This implies crediting the periodic change in EVC to the bonus bank and subtracting the related cost of capital. The resulting performance measure Residual Economic Value Created (REVC) captures deviations from original projections of value creation and value realization. These deviations from original value projections are added to (subtracted from) the bonus bank. While (O'Hanlon and Peasnell 2002) suggest that bonus banks be based on periodic changes of EVC rather than RI, they provide no analysis of the incentive properties of this mechanism.

2.3 The Model

To formally analyze the incentives provided by bonus banks, this section formalizes the bonus bank concepts discussed in the literature as outlined above, and presents the model as well as the benchmark solution.

2.3.1 Formalization of Bonus Banks based on Residual Income

For a bonus bank based on RI, a portion ξ $(0 \leq \xi \leq 1)$ of RI_t is credited to the bonus bank in any period t.[7] RI is calculated based on generally accepted accounting principles (GAAP) and defined as the difference between current period's net income NI^{GAAP} and the cost of capital on the capital r employed in the previous period CE_{t-1}:

$$RI_t = NI_t^{GAAP} - rCE_{t-1} \tag{1}$$

Payouts $B_t(\cdot)$ from the bonus bank to the manager reduce the balance K of the bonus bank. K_0^C denotes an opening balance K_0, which is large enough to avoid negative bonus payments. The bonus bank balance is compounded at the cost of capital r. Hence in a RI-based bonus bank, the bonus payment B_t and the balance of the bonus bank K_t at date t are formally given by:

$$B_t = \eta \xi RI_t + \eta K_{t-1}(1+r) \tag{2}$$

$$\begin{aligned} K_t &= \xi RI_t + (1+r)K_{t-1} - B_t \\ &= \xi \sum_{i=1}^{t} (1+r)^{t-i} RI_i - \sum_{i=1}^{t} (1+r)^{t-i} B_i + (1+r)^t K_0 \end{aligned} \tag{3}$$

where η is the constant periodic payout ratio in the RI-based bonus bank. In each period, RI_t is calculated according to (1) and reflects income after substracting the cost of capital.

[7] For simplicity, we assume $\xi = \xi_t$ to be constant over time.

2.3.2 Formalization of Bonus Banks based on Excess Value Created

O'Hanlon and Peasnell (2002) formally define "Excess value created" (EVC) as:

$$EVC_t = \sum_{i=1}^{t} RI_i(1+r)^{t-i} + \sum_{i=1}^{\infty} \mathrm{E}_t(RI_{t+i})(1+r)^{-i} \tag{4}$$

where RI in each period reflects excess income over the investment cost of the period, including depreciation and interest rate charges on the remaining book value of the investment; $\mathrm{E_t}(\cdot)$ denotes expected values in period t.

For a bonus bank based on EVC, a constant portion ξ of Residual Economic Value Created ($REVC_t$) is credited to the bonus bank in any period t. REVC as the periodic change in EVC less the cost of capital on the previous period's EVC is formally given by:

$$\begin{aligned} REVC_t &= \Delta EVC_t - rEVC_{t-1} \\ &= RI_t + \Delta NPV_t - rNPV_{t-1} \end{aligned} \tag{5}$$

where $NPV_t = \sum_{i=t+1}^{T} \frac{\mathrm{E_t}(RI_i)}{(1+r)^{i-t}}$ denotes value creation until the end of the planning horizon in $t = T$.

Payouts $B_t(\cdot)$ to the manager reduce the balance of the bonus bank. The opening balance K_0 of the bonus bank is given by $K_0 = \xi REVC_0 = \xi NPV_0$.[8] The bonus bank balance is compounded at the cost of capital r. Hence in an REVC-based bonus bank, the bonus payment B_t and the balance of the bonus bank K_t at date t are formally given by:

$$B_t = \upsilon_t \xi REVC_t + \upsilon_t K_{t-1}(1+r) \tag{6}$$

$$\begin{aligned} K_t &= \xi REVC_t + (1+r)K_{t-1} - B_t \\ &= \xi \sum_{i=0}^{t} (1+r)^{t-i} REVC_i - \sum_{i=1}^{t} (1+r)^{t-i} B_i \end{aligned} \tag{7}$$

where υ_t is the payout ratio in period t in the REVC-based bonus bank.

In the period of initiating a new investment project, REVC ceteris paribus equals the NPV of the project. In subsequent periods, a zero value for REVC indicates that the original projections

[8] Assuming truthful reporting, K_0 is thus proportional to project NPV: $K_0 = \xi REVC_0 = \xi NPV_0$.

were exactly met and an adequate return was earned. From the perspective of date 0, $REVC_t$, $t = 1, \ldots, T$ are expected to be zero. Hence, the expected bonus payment B_t and the balance of the bonus bank K_t at date t can be rewritten as:

$$\mathrm{E}(B_t) = \omega_t \xi REVC_0 (1+r)^t \tag{8}$$

$$\mathrm{E}(K_t) = \xi REVC_0 \, (1+r)^t - \sum_{i=1}^{t} B_i(I)(\cdot) \, (1+r)^{t-i} \; \forall \, t \in \{0, \ldots, T\} \tag{9}$$

where ω_t is the payout ratio in period t.

REVC reflects past and future performance that is not directly observable. The principal depends on managers' reports about forward-looking information at any date $t < T$ to determine REVC. The manager may misreport and REVC may be overstated. Let $l_t \geq 0$ be real-valued, where $l_t > 0$ denotes the managers' overstatement for period t in their reporting.[9] Let $REVC_t$ denote true REVC at date t and $REVC_t^l$ reported REVC with

$$REVC_t^l = REVC_t + l_t. \tag{10}$$

Within this formulation, differences between reported forecasted values and later realized values are due to (i) an untruthful report by the manager ($l_t > 0$ for any t), and (ii) deviations from the expected values. In this setting, a mechanism is needed to induce managers to truthfully report about value creation. Section 2.5.2 analyzes how truthful reporting on REVC can be attained by using a bonus bank.

2.3.3 Model assumptions

We consider a model in which the risk-neutral owner of the firm delegates an investment decision to the better informed, risk-neutral manager.[10] "Owner of the firm", "the firm" and "principal"

[9]If effort-averse managers report about their private information, the principal typically has to solve understatement problems. Effort-averse managers understate performance to reduce the cost assocciated with reaching the "benchmark level" (Lambert 2001). However, since we abstract from moral hazard issues as well as assume that bonus payments are contingent on REVC, managers' objective is to maximize their compensation and therefore to report the highest possible REVC.

[10]See Mohnen and Bareket (2007) and Rogerson (1997) for similar assumptions. Underinvestment problems are only due to managers' impatience. The case that the variances of the cash flows depend on managers' investment decision would cause additional problems. Consider the optimal contracting case in which the principal and the manager may disagree on how to trade off risk and return. A possible solution would be to adjust the capital charge when calculating RI (Christensen et al. 2002; Dutta and Reichelstein 2002). Thus, contracts including bonus payments

will be used interchangeably. Consider $T+1$ periods indexed by $t \in \{0,\ldots,T\}$. The principal hires a manager at the beginning of $t=0$ to choose the efficient investment level in period 0 and to realize cash flows in each of the periods $1,\ldots,T$. Investment decisions are delegated to the manager because she is better informed about project profitability. The principal offers the manager a contract which specifies the bonus payments B_t in every period t as a function of the manager's investment choice in period 0 and realized performance. If the manager rejects the contract, she receives her reservation utility and the relationship is over. If the manager accepts the contract, she chooses an investment level and realizes cash flows as long as she remains on the project.

A project has the cash flow structure $(-I, CF_1,\ldots,CF_T)$, where I denotes the level of investment in period 0 and CF_t represents the cash flow at date t associated with the project. The accounting system directly measures I and realized CF_t. Assume that the manager is better informed about her own time horizon $T^A \leq T$.[11] We further assume that the manager has private information on her own characteristics and knowledge, which determine the marginal productivity of the investment. Formally, we denote this private information on marginal productivity as a multidimensional variable θ, which is drawn from a set Θ. The principal's cost of capital is r. Further assume that the manager's and the principal's cost of capital are equivalent.

The period t cash flow is affected by θ and the investment level I. Therefore expected future cash flows are only known to the manager. Formally, the period t cash flow is determined by

$$CF_t = \rho_t \delta(I,\theta) + \varepsilon_t \tag{11}$$

where $\delta(I,\theta) = \theta\delta(I)$ is an increasing function of I for every θ and ε_t is a normally distributed random variable $\varepsilon_t \sim N(0,\sigma^2)$. Since the productivity parameters ρ and $\delta(I,\theta)$ are linked in a multiplicatively separable way, the relative marginal productivity of investments across periods is not affected by the level of investment. Note that the optimal level of investment cannot be computed based on the time pattern of the investment's relative productivity profile ρ, without

based on current performance measures must be convex in order to offset the concavity of the manager's utility function and therefore induce the manager to behave in a less risk averse fashion. See for instance Lambert (1986), Demski and Dye (1999) or Feltham and Wu (2001).

[11]For $T^A < T$, the manager is assumed to leave the firm after the end of period T^A.

knowledge of θ.

The efficient investment level that maximizes expected discounted cash flows is the level that maximizes:

$$\sum_{t=1}^{T} \frac{\rho_t \delta(I,\theta)}{(1+r)^t} - I \tag{12}$$

To guarantee that for every θ there is a unique value of I that maximizes the NPV of future cash flows, assume that for every θ, $\delta(I,\theta)$ is continuously differentiable, strictly increasing, and strictly concave in I. We denote the optimal investment level $\hat{I}(\theta)$.

Let $B(I) = (B_1(I), \ldots, B_T(I))$ represent the vector of wage payments the manager receives at the end of each period t from the project.[12] We abstract from additional operative effort incentives and assume the private cost of value creation to be zero. Thus the manager's objective is to maximize the present value of expected bonuses during her time horizon T^A $\sum_{t=1}^{T^A} \frac{\mathrm{E}_0(B_t(I))}{(1+r)^t}$. No additional bonus payments can be made after the manager leaves the firm in $T^A < T$.[13] Hence, the manager chooses the investment level I^m which maximizes the present value of expected bonus payments:

$$I^m \in \arg\max_I \sum_{t=1}^{T^A} \frac{\mathrm{E}_0(B_t(I))}{(1+r)^t} \tag{13}$$

A bonus contract B induces efficient investment decisions if, for every possible θ, the manager maximizes her expected utility by choosing the efficient investment level $I^m(\theta) = \hat{I}(\theta)$ which maximizes the NPV of the project. Managerial performance evaluation is based on the accounting performance measures RI or REVC as defined in (1) and (4). The managers' incentive contracts include a bonus bank structure as outlined above, based on either RI as defined in (2) and (3), or on REVC as defined in (8) and (9). Note that this assumption precludes the application of the solution to the problem of the impatient manager as proposed by Rogerson (1997), which requires to determine RI based on a special cost-allocation procedure rather than using performance

[12]For instance, let $\pi(I)$ denote the performance measure that is fixed in the compensation contract, then $B_t(I) = w_t \pi_t(I)$. This notion captures the fact that the manager's investment decisions affect her bonus payment.

[13]This assumption is significantly different compared to the model examined by Edmans et al. (2012) where the agent receives equity- and cash-based compensation until after retirement.

measures that are determined based on GAAP. Rather, we analyze how the payout structure of the bonus bank can potentially induce efficient decision making.

2.3.4 Benchmark solution

The structure of the above model is equivalent to the model in (Rogerson 1997) except for the assumptions on the incentive contract. We use the bonus structure resulting from the solution proposed by Rogerson (1997) as our benchmark solution and examine whether a bonus bank based on RI and REVC can generate a bonus structure that induces managers to make efficient investment decisions.

When the manager's and the project's time horizons are not conflicting and the gain from accepting the project, discounted at the interest rate r, is proportional to the project's NPV, the manager has incentives to choose the efficient investment level. When the principal grants the manager a share τ of the project's total NPV ($0 \leq \tau \leq 1$), the manager's investment decision will be goal congruent. Goal congruence is the general incentive compatibility constraint. It creates incentives for the manager to accept all projects with a positive NPV by ensuring that the present value of the gain from accepting a project is proportional to the project's NPV (Reichelstein 1997). Formally, a bonus contract B where bonus payments B_t fulfill the following condition:

$$\sum_{t=1}^{T} \frac{B_t}{(1+r)^t} = \tau NPV \tag{14}$$

achieves goal congruence. Goal congruence is not sufficient to induce efficient investment decisions when the manager's time horizon is shorter than the firm's (Dutta and Reichelstein 2005).

When the manager's and the project's time horizons are conflicting, strong goal congruence creates incentives for the manager to make efficient investment decisions (Rogerson 1997). It requires that the manager's gain from accepting a project in each period must have the same sign as the project's NPV and ensures that investment decisions are independent of the manager's time horizon (Reichelstein 1997; Rogerson 1997). Formally, a bonus contract B is strong goal congruent, if expected bonus payments conditional on the investment level I satisfy the following conditions:

$$\begin{aligned} &E(B_t(I)) \geq 0 \,\forall\, t \in \{1,\ldots,T\} \Leftrightarrow NPV(I) \geq 0 \\ &E(B_t(I)) < 0 \,\forall\, t \in \{1,\ldots,T\} \Leftrightarrow NPV(I) < 0. \end{aligned} \tag{15}$$

A bonus contract that satisfies (15) solves the problem of managerial myopia.

Rogerson (1997) shows that specific accounting rules solve the problem of managerial myopia in a linear contract when the manager receives a portion ξ of RI_t in each period. When RI_t is calculated according to a special cost-allocation procedure for matching revenues and costs, a positive NPV of a project leads to a positive bonus payment to the manager in each period. Let $a = (a_1, \ldots, a_T)$ be a vector of real numbers, where a_t denotes the investment cost allocated to the period t for every monetary unit invested. These allocation costs comprise depreciation and interest charges on the remaining book value of the investment. Rogerson (1997) shows that the relative marginal benefits allocation rule (MBAR), denoted by $a_t^{\rho,r}$, is the unique allocation rule that induces efficient investment decisions and creates a strong goal congruent linear bonus contract. MBAR is given by:

$$a_t^{\rho,r} = \frac{\rho_t}{\sum_{i=1}^{T} \frac{\rho_i}{(1+r)^i}} \tag{16}$$

When RI_t is calculated based on the MBAR-allocation rule, bonus payments have the following structure:

$$B_t^{\rho,r}(I) = \xi \frac{\rho_t}{\sum_{i=1}^{T} \frac{\rho_i}{(1+r)^i}} \left(\sum_{t=1}^{T} \frac{\rho_t \delta(I,\theta)}{(1+r)^t} - I \right) \tag{17}$$

The resulting bonus payments are strictly positive in any period, if and only if the initiated project has a positive NPV, and thus attain strong goal congruence. This solution can be extended to settings with adverse selection problems when the manager has precontract information about the absolute profitability of a project (Dutta and Reichelstein 2002).

In the special case of capital constraints, when the manager has to decide about a portfolio of projects, strong goal congruence is not a sufficient criterion. Mohnen and Bareket (2007) develop accounting rules leading to an annuity-RI that induces myopic managers to choose the investment levels that maximize the NPV of the investment portfolio. This concept is termed robust goal congruence and requires the contract to eliminate any intertemporal trade-offs. Only when the manager's payoffs from the efficient set of projects are not lower than the payoffs from any other possible set of projects in any period will the manager choose the investment levels that maximize the NPV of the investment portfolio. Consider S possible project portfolios indexed by $s \in \{1, \ldots, S\}$. Formally, a bonus contract B is robust goal congruent, if expected bonus payments conditional on the investment levels I during the manager's time horizon T^A satisfy the following conditions:

$$\sum_{t=1}^{T^A} \frac{\mathrm{E}_0(B_t(I_s))}{(1+r)^t} = kE(NPV_s) \; \forall \; s \in \{1, \ldots, S\} \tag{18}$$

for an arbitrary, non-negative constant k. A bonus contract that satisfies (18) solves the problem of managerial myopia under capital constraints.

Any bonus contract that replicates the stream of bonus payments $B_t^{\rho,r}$ according to (17) or satisfies the condition for robust goal congruence stated in (18) creates efficient investment incentives regardless of the manager's time horizon. We use the bonus structure as defined in (17) and (18) as the benchmark solution to the problem of managerial myopia to study the incentive properties of the bonus bank and test whether bonus bank contracts can achieve strong and robust goal congruence. Theoretically, bonus banks can be based on any performance measure. Edmans et al. (2012) examine a bonus bank based on equity performance measures. We focus on a setting where public signals on managerial behavior are not available and consider the two performance measures discussed in the literature: RI and EVC (Ehrbar 1998; O'Hanlon and Peasnell 2002; Stewart 1991).

2.4 Incentive Properties of Bonus Banks based on Residual Income

We examine whether the stream of bonus payments from a bonus bank based on RI induces efficient investment decisions according to (14) and (15). All proofs are in the appendix.

Proposition 1 *Given the RI-based bonus bank concept as defined in (2) and (3), investment incentives are goal congruent if and only if* $K_0 = 0$ *for* $\tau = \xi$ *or* $K_0 = (\tau - \xi)NPV$ *for* $\tau > \xi > 0$

where τ and ξ are arbitrary numbers $\tau > 0$ and $0 \leq \xi \leq 1$. The second condition would require the principal to have knowledge of NPV. Strong goal congruence is not attained.

Proposition 1 states that the ability of the practitioners' bonus bank concept to provide efficient investment incentives for non-conflicting time horizons between the manager and the firm depends on the opening balance. Goal congruence requires an opening balance that is either zero or a linear function of project NPV, i.e. $K_0 = 0$ and $K_0 = (\tau - \xi)NPV$. In the first case, the present value of bonus payments is proportional to the project's NPV if the manager receives a constant portion ξ of RI_t throughout the duration of the project and ξ coincides with the total share τ of NPV credited to him ($\xi = \tau$). The second case $K_0 = (\tau - \xi)NPV$ with $\tau > \xi > 0$ is equivalent to granting the manager an advance. Any advance $K_0 > 0$ needs to be amortized over the course of the project to avoid overinvestment and excess payments. $K_0 = (\tau - \xi)NPV$ with $\tau > \xi > 0$ denotes the case of a payback structure, which annuitizes amortization when the opening balance is a linear function of project NPV. Due to information asymmetry regarding θ, the firm is dependent on external sources of information to determine the opening balance $K_0 = (\tau - \xi)NPV$. When equity values obtained in an efficient capital market are not available to derive the value of project NPV, the firm requires the manager to report project NPV. Unless the manager reports her information truthfully, the firm cannot calibrate the opening balance optimally and provide the manager with goal congruent investment incentives.

Proposition 1 further states that an RI-based bonus bank cannot provide efficient investment incentives when the manager's time horizon is shorter than project duration ($T^A < T$). The intuition behind this result can be shown based on one period only. Assume a project with $NPV > 0$. The bonus B_1 in $t = 1$ will be negative if $RI_1 < 0$ for $K_0 = 0$ and $\tau = \xi$, or $RI_1 < (1+r)\left(1 - \frac{\tau}{\xi}\right)NPV$ for $K_0 = (\tau - \xi)NPV$ and $\tau > \xi > 0$. In this case a manager who plans to leave the firm in $t = 1$ will not initiate the project despite the fact that it would create value for the firm. Since she can only expect to receive one bonus payment $B_1 < 0$, (2) and (3) are not sufficient to provide efficient investment incentives. Hence, the bonus bank based on RI does not achieve strong goal congruence because negative bonuses may arise as a result of negative RI even for projects with a positive NPV.[14]

The practitioners' literature frequently sets the opening balance larger than zero to avoid negative bonus payments. While an opening balance K_0^C large enough to cover future negative RI could ensure non-negative bonus payments, it needs to be amortized to avoid excess payments and overinvestment. If bonus payments are made without amortization of K_0^C, the present value of bonus payments consists of a share τ of the project's NPV and the opening balance K_0^C. A myopic manager has incentives to inflate K_0^C to receive excess compensation before she leaves. Amortization depends on the time pattern of the investment's relative productivity profile and the marginal productivity of the investment. Therefore, the principal would need knowledge of NPV to be able to optimally calibrate and amortize the opening balance, as stated in Proposition 1. One performance measure that allows for frontloading of project NPV is EVC (Ohlson 2002). While an incentive system based on NPV is a trivial solution when the principal could make an efficient investment decision without delegation given knowledge of NPV, the real problem then becomes to induce truthful reporting about NPV, as is analyzed in the next section.

2.5 Incentive Properties of Bonus Banks based on Excess Value Created

EVC captures managers' success in value creation and value realization and is equivalent to the present value of the expected future RI. To determine EVC in each period, a report about the present value of expected future cash flows is needed. If the manager truthfully reports about NPV, delegation of the investment decision becomes obsolete. However, a mechanism is needed to induce truthful reporting about the value created by the project. Bonus banks may be useful as a device to provide incentives for managers to reveal their private information to the firm. In order to analyze the incentive properties of a bonus bank based on EVC, we proceed as follows: first, we analyze a situation in which truthful reports about NPV by the manager have already been elicited. In the next step we analyze how such truthful reports can be attained.

[14] Investment decisions typically negatively influence accounting-based performance measures in the beginning of the investment lifecycle, while positive effects of investment decisions generally eventuate towards the end of the investment lifecycle (e.g. Dechow and Sloan 1991).

2.5.1 Incentive Properties of Bonus Banks based on Excess Value Created given truthful reporting

In this section, we analyze a situation where truthful reports have been elicited by the use of bonus banks (discussed in the next section). We examine whether the stream of bonus payments resulting from a bonus bank based on REVC replicates the Rogerson-solution according to (17) and thus induces efficient investment decisions according to (15).

Lemma 1 *Suppose that the manager is compensated according to the REVC-based bonus bank concept as defined in (8) and (9). Investment incentives are strong goal congruent if bonus payments are as follows:*

$$\mathrm{E}\left(B_t(I)\right) = \omega_t \xi REVC_0(1+r)^t,\ \omega_t = \frac{\rho_t}{\sum_{i=1}^{T} \frac{\rho_i}{(1+r)^{(i-t)}}} \tag{19}$$

When the manager receives bonus payments from a bonus bank based on periodic changes of EVC, the Rogerson-solution can be reproduced by a specific pay-out-scheme ω_t. One main advantage of the Rogerson-solution is that the principal can induce efficient investment decisions regardless of the manager's time preferences or utility function since the manager receives positive bonus payments if and only if the NPV of the project is positive. This advantage is maintained here and efficient investment decision-making is attained.

While Rogerson (1997) shows that the MBAR-allocation rule is unique in inducing the efficient investment level, this result does not apply here. The manager chooses the optimal investment level for all pay-out-schemes that ensure positive bonus payments if and only if the NPV of the project is positive. We analyze the conditions for which the stream of bonus payments induces efficient investment incentives according to (15) and show that a large set of pay-out-schemes $(\omega_0, \ldots, \omega_T)$ results in positive bonus payments if and only if the project creates additional value for the firm. Under this set of pay-out-schemes, the present value of bonus payments from a specific project is linear in the project's NPV and the REVC-based bonus bank attains strong and robust goal congruence.

Lemma 2 *Suppose that the manager is compensated according to the REVC-based bonus bank concept as defined in (8) and (9). Investment decisions are strong goal congruent and robust goal congruent if bonus payments are as follows:*

$$\mathrm{E}(B_t(I)) = \omega_t \xi REVC_0 (1+r)^t,\ \omega_t \geq 0\ \forall t \in \{0, \ldots, T\} \text{ and } \sum_{t=0}^{T} \omega_t = 1 \tag{20}$$

Lemma 2 shows that if the manager is rewarded according to the REVC-based bonus bank concept as defined in (8) and (9), the bonus payment has the same sign as the project's NPV (measured by $REVC_0$) in each period for any set of nonnegative payout ratios $(\omega_0, \ldots, \omega_T)$ with a present value of 1. As a result, the present value of bonus payments from one specific project is linear in the project's NPV. The manager maximizes her bonus payments by choosing the efficient investment level regardless of her own time preferences. Under capital constraints, the manager chooses the investment levels that maximize the value of a project portfolio. No adjustments to the measurement basis and accounting rules are necessary. In particular, this solution does not require the principal to have knowledge of ρ (but requires truthful reports about REVC).

Lemma 2 shows that a large set of pay-out-schemes induces efficient investment decisions. This is due to the fact that $REVC_0$ directly reflects the economic value of a project. When a portion of the project's NPV, i.e. $REVC_0$, is credited to the bonus bank and compounded at the cost of capital, economic value is maintained. Lemma 3 examines the incentive properties of a bonus bank offering the manager a single bonus payment equal to a portion of the project's NPV.

Lemma 3 *Suppose that the manager is compensated according to the REVC-based bonus bank concept as defined in (8) and (9). Investment incentives are strong goal congruent if the manager receives a single bonus payment in $t = s$ and bonus payments are as follows:*

$$\mathrm{E}(B_t(I)) = \omega_t \xi REVC_0 (1+r)^t,\ \omega_t = 0\ \forall t \in \{0, \ldots, T\} \setminus \{s\} \text{ and } \omega_s = 1 \tag{21}$$

Lemma 3 states that the REVC-based bonus bank induces strong goal congruence when the manager can expect to receive a portion of the project's NPV. The manager is indifferent between receiving bonus payments now or later, as long as she can expect to receive her bonus compounded at the opportunity cost of capital at some point in time (Miller and Modigliani 1961).

Note that Lemma 3 is actually a specification of Lemma 2 in which the balance of the bonus bank is paid out at one specific point in time. For a payment in $t = s$, the manager receives a bonus $B_s(I) = \xi(1+r)^s REVC_0$ which represents the fair value of the manager's share in the project.

If it were possible to sell the bonus bank in an arm's-length market transaction at its fair value, the manager could expect to receive a price equal to this amount. In an efficient capital market, the market mechanism would warrant efficient pricing of the bonus bank.[15] Efficient external market prices are not available for divisions, private firms and single investment projects. In the absence of an external market, an internal market could be established for this purpose. When managers are not assumed to make truthful reports, a market solution can also be used to verify the true value of the bonus bank. This is analyzed in detail in the following section 2.5.2, where we make use of this result as well as the following.

If the manager remains with the firm until the project is completed ($T^A = T$), the bonus payment can be made in T based on the observed value realization.[16] Lemma 4 examines whether this bonus system provides incentives for managers to make truthful reports ($REVC_t^l = REVC_t, \ \forall t \in \{0,\ldots,T\}$) by examining the impact of untruthful reports on the manager's expected payoff.[17]

Lemma 4 *Suppose that the manager with $T^A = T$ is compensated based on the REVC-based bonus bank concept as defined in (8) and (9). Investment incentives will be efficient and the manager will report her information truthfully ($I^m(\theta) = \hat{I}(\theta)$ and $l_t = 0, \ \forall t \in \{0,\ldots,T\}$) when bonus payments are as follows:*

$$\mathrm{E}(B_t(I)) = \omega_t \xi REVC_0 (1+r)^t, \ \omega_t = 0 \ \forall t \in \{0,\ldots,T-1\} \text{ and } \omega_T = 1. \tag{22}$$

Lemma 4 states that the REVC-based bonus bank and the bonus structure $\omega = (0,\ldots,0,1)$ induce strong goal congruence and truthful reporting when the manager plans to stay until project com-

[15] Edmans et al. (2012) find that in an efficient capital market, linking performance measurement to equity incentives provides efficient incentives for myopic managers when performance-based pay is escrowed in a bonus bank.

[16] Similar assumptions can be found in Demski (1998). He presents a two-period model in which the manager has an option to misreport first-period performance. However, any misreport must be reversed in the second period, as total output is observed in the game's conclusion. Making a bonus payment in T based on the observed value creation requires the firm to identify cash flows from individual transactions and projects separately (Dutta and Reichelstein 2005). This may be critical if overlapping projects are considered.

[17] We assume that the manager will only make untruthful reports if she can strictly increase her utility by doing so.

pletion. For each project, she is reviewed at the end of period T on the basis of the ex post realized value as follows:

$$
\begin{aligned}
B_T &= \xi \sum_{t=1}^{T} RI_t \,(1+r)^{T-t} \\
&= \xi \sum_{t=o}^{T} REVC_t \,(1+r)^{T-t}
\end{aligned}
\tag{23}
$$

Since bonus payments to the manager are only based on realized, directly observable values, she cannot affect her bonus payment by untruthful reports about forward-looking information.

2.5.2 Internal Market for the Bonus Bank

If the manager decides to leave the firm before project completion, selling the bonus bank at its current fair value would provide efficient investment incentives as stated in Lemma 3. In the absence of an external market for the bonus bank, an internal market can be used to provide both efficient investment incentives and truthful reporting. In the following, we analyze how an internal market transaction can be used to provide incentives for myopic managers to report truthfully and invest efficiently.

2.5.2.1 The Internal Market Model

An internal market is introduced in which the leaving manager (manager 1) negotiates with a possible buyer (manager 2) in period j. A successful transaction leads to a purchase price P for the bonus bank. The time line is as follows: In period 0, manager 1 chooses investment level $I^m(\theta)$. In period $j \in \{0,\ldots,T-1\}$, trade takes place and the purchase price is determined ($B_j(\cdot) = P$). To capture the fact that managers may have different capabilities and knowledge, we assume that the absolute future profitability of the project $\delta(I,\theta_i) = \theta_i \delta(I),\ i = 1,2$, after the transaction depends on the managers' characteristics and knowledge $\theta_i,\ i = 1,2$. The random variable $\theta_i,\ i = 1,2$ is independently distributed. We further assume that the project's relative productivity profile ρ is known to both managers. Both managers are risk neutral and discount future bonus payments at the cost of capital r. We restrict attention to situations in which the successor remains with the firm until the project's completion, that is, the successor's time horizon T^S exceeds the remaining duration of the project ($T^S > T - T^A$).[18] Bonus payments are made according to the REVC-based bonus bank concept as defined in (22). We make no assumption about the hiring policies of the firm in which the succeeding manager is identified (Levin and Tadelis 2005).

When the bargaining process takes place at date $j \in \{0, \ldots, T-1\}$, each manager has two alternatives. On the one hand, manager 1 can sell the bonus bank for a price P. On the other hand, she can continue with the project. If manager 1 decides to stay with the firm, the bonus payment at date T according to (23) is based on observable value creation and therefore independent from l_t. Lemma 4 shows that the manager has no possibility to realize value based on untruthful reports and reporting will be unbiased. Based on the guaranteed bonus payment at date T according to (23), the reservation utility of manager 1 $U_j^1(\cdot)$ is given as follows:

$$U_j^1(\cdot) = \xi \left(\sum_{i=1}^{j} RI_i(\theta_1)(1+r)^{j-i} + \sum_{i=j+1}^{T} \mathrm{E}_j(RI_i(\theta_1))(1+r)^{j-i} \right) \tag{24}$$

Manager 2 can buy the bonus bank for a price P or he can invest in risk-equivalent financial assets on the capital market. The value of the bonus bank for manager 2 ($U_j^2(\cdot)$) at date j is formally given by:

$$U_j^2(\cdot) = \xi \left(\sum_{i=1}^{j} RI_i(\theta_1)(1+r)^{j-i} + \sum_{i=j+1}^{T} \mathrm{E}_j(RI_i(\theta_2))(1+r)^{j-i} \right) \tag{25}$$

Manager 2 has no incentive to lie if he decides to take over the project since his bonus payment in T according to (23) is independent from l_t. The difference between both utilities depends on the managers' differing knowledge and capabilities to generate future cash flows.

[18] This assumption could easily be weakened. If the successor's time horizon is shorter than the remaining duration of the project, the bargaining process can be repeated in each period.

2.5.2.2 The Bargaining Solution under Symmetric Information about Project Profitability

In this section, both managers are assumed to observe the other manager's characteristics θ_i symmetrically.[19] A priori, the leaving manager only has information about the expected marginal productivity of the investment based on her successor's expected capabilities and characteristics ($\mathrm{E}_0(\theta_2)$). However, in j, manager 1 and 2 symmetrically observe θ_1 and θ_2 and update their beliefs about future performances. Figure 1 depicts the sequence of events for this situation.

To attain a purchase price between symmetrically informed managers, we exploit the Nash bargaining solution (Nash 1950). The upper bound for a possible purchase price P is the value of the bonus bank for manager 2. He will not pay a price P that exceeds his expectations in the project. The lower bound for a possible purchase price P is the value of the bonus bank for manager 1. She will only trade the bonus bank for a price P exceeding her value of the bonus bank. The boundaries of the purchase price are given by:

$$U_j^1(\cdot) \leq P \leq U_j^2(\cdot) \tag{26}$$

Solving the Nash-bargaining solution yields the optimal price P for the bonus bank in $t = j$:

$$P = \xi \left(EVC_j + \frac{1}{2} \left(\sum_{i=j+1}^{T} \left(\mathrm{E}_j(RI_i(\theta_2)) - \mathrm{E}_j(RI_i(\theta_1))\right)(1+r)^{j-i} \right) \right) \tag{27}$$

Trade occurs if and only if the investment's marginal productivity under the successor is at least as high as the marginal productivity under the the leaving manager, that is, the successor has at least the same capabilities as the incumbent manager ($\theta_1 \leq \theta_2$).[20] When managers have identical capabilities ($\theta_1 = \theta_2$), both managers are indifferent about trade.

To examine the incentive properties of the Nash-bargaining solution, we calculate the expected purchase price for the leaving manager.

[19] Comparable assumptions can be found in Baldenius et al. (1999) or Edlin and Reichelstein (1995). In their models, the bargaining process takes place under symmetric information about all necessary parameters. In contrast to their results, we explicitly assume equivalent bargaining power by both managers. Technically, we therefore consider a Nash bargaining solution.

[20] Alternatively, trade would also occur in the case $\theta_1 > \theta_2$ if the selling manager would receive a sufficiently high additional payment from a third party (e.g. for entering a new project with a new firm).

Proposition 2 *Suppose that the capabilities of the leaving manager and the possible buyer are equal in expectation (*$\mathrm{E}_0(\theta_1) = \mathrm{E}_0(\theta_2) = \theta$*), that is* θ *is the best estimate of the project's profitability in* $t = 0$*. The expected purchase price* $\mathrm{E}_0(P)$ *at date* $t = 0$ *under a Nash-bargaining solution is*

$$\mathrm{E}_0(P) = \xi(1+r)^j NPV(I, \theta_1, \rho, T) \tag{28}$$

for an arbitrary $j \in \{0, \ldots, T-1\}$*. Manager 1 is rewarded based on the project's NPV. She has no incentive to lie and will choose the efficient investment level, that is,* $I^m(\theta) = \hat{I}(\theta)$ *and* $l_t^i = 0, \forall t \in \{0, \cdots, T\}$.

Proposition 2 shows that manager 1 will choose the efficient investment level regardless of her time horizon T^A. Symmetric information about project profitability in $t = j$ leads to a purchase price for the bonus bank that is equal to the overall project value as reflected by EVC and half of the additional value created by the new manager's superior characteristics and capabilities. The added value of the transaction is shared evenly between the leaving manager and her successor. Both managers benefit from higher future cash flows if $\theta_1 < \theta_2$ and have strong incentives to trade. Since her successor can directly observe the true value of the project and the bonus bank, the leaving manager has no incentives to provide untruthful reports. This solution requires the leaving manager to expect the succeeding manager to have equal capabilities ($\mathrm{E}_0(\theta_1) = \mathrm{E}_0(\theta_2)$).

Cooperation between the managers is also beneficial from the perspective of the firm. Consider REVC in the period of trade ($t = j$) under the assumption that differences in the economic performance are solely due to the sale of the bonus bank ($\mathrm{E}(RI_j) = RI_j$):

$$\begin{aligned} REVC_j &= RI_j - r\left(\sum_{i=j}^{T} \mathrm{E}(RI_i(\theta_1))(1+r)^{j-i-1}\right) \\ &\quad + \sum_{i=j+1}^{T} \mathrm{E}(RI_i(\theta_2))(1+r)^{j-i} - \sum_{i=j}^{T} \mathrm{E}(RI_i(\theta_1))(1+r)^{j-i-1} \\ &= \sum_{i=j}^{T} \mathrm{E}\left(RI_i(\theta_2) - RI_i(\theta_1)\right)(1+r)^{j-i}. \end{aligned} \tag{29}$$

This implies that $REVC_j > 0$ if $\theta_1 < \theta_2$. The preceeding section shows that the internal capital market solution may create additional value by providing incentives for managers to take over a project when they are able to outperform the former manager.

2.5.2.3 The Bargaining Solution under Asymmetric Information about Project Profitability

The use of the Nash-bargaining solution requires the managers to observe the private information of the managers' characteristics θ_i symmetrically. In the following, we relax this assumption and consider a setting where the managers bargain under incomplete information. At date j, both managers update their expectations about the characteristics of the other manager and the resulting marginal productivity of the investment. The random variables $\theta_i,\ i = 1,2$ are independently distributed with cumulative distribution functions $F_1(\theta_1)$ and $F_2(\theta_2)$. Both of these are common knowledge among the managers and have strictly positive densities $f_1(\theta_1)$ and $f_2(\theta_2)$ in the respective range $\Theta_i = [\underline{\theta_i}, \overline{\theta_i}]$. We follow Chatterjee and Samuelson (1983) in restricting attention to uniform type distributions. To avoid different case distinctions, we assume

$$\max\left\{\underline{\theta_1}, \underline{\theta_2}\right\} < \theta_1, \theta_2 < \min\left\{\overline{\theta_1}, \overline{\theta_2}\right\} \tag{30}$$

This implies that the conditional trading probability is strictly positive but less than one. The corner solutions are discussed in Baldenius (2000). Figure 2 illustrates the event sequences for this trading situation.

Following Chatterjee and Samuelson (1983), we model the bargaining process as an equal-split sealed-bid mechanism. In this process, both managers submit sealed bids, and trade occurs if and only if the buyer's bid b exceeds the seller's bid s. In this case, the surplus is split equally $P = \frac{1}{2}(b+s)$.[21]

Given these assumptions, optimal bidding strategies are the solution to the following simulta-

[21] This process implies that both managers can observe the investment volume I and the state parameter θ. However, both managers have incomplete information about the new state parameters θ_1 and θ_2.

neous optimization problems:[22]

$$s(\theta_1, I) = \arg\max_s \int_{\underline{\theta_2}}^{\overline{\theta_2}} \left(\frac{s + b(\theta_2, I)}{2} - U^1(\theta, \theta_1, I) \right) 1_{s<b(\theta_2,I)} dF_2(\theta_2) \quad (31)$$

$$b(\theta_2, I) = \arg\max_b \int_{\underline{\theta_1}}^{\overline{\theta_1}} \left(U^2(\theta, \theta_2, I) - \frac{s(\theta_1, I) + b}{2} \right) 1_{s(\theta_1,I)<b} dF_1(\theta_1) \quad (32)$$

Baldenius (2008) provides an illustrative explanation of the characteristics of the solution: From the perspective of the seller, an increase of the ask s of one dollar increases the price for the bonus bank by fifty cent. At the same time, however, the probability that the buyer's bid exceeds s decreases, i.e. a successful transaction becomes less likely. To determine the Bayesian-Nash equilibrium, we determine the optimal linear bidding strategies where both effects just balance each other out. In order to determine incentives for truthful reporting, we test for the impact of untruthful reports on the purchase price.

Lemma 5 *Suppose uniformly distributed state parameters θ_i and a trade decision at date $j \in \{0, \ldots, T-1\}$. The simultaneous optimization problem (31) and (32) yields the following optimal linear bidding strategies $\hat{s}(\theta_1, I)$ and $\hat{b}(\theta_2, I)$:*

$$\hat{s}(\theta_1, I) = \gamma(I) + \frac{1}{12}\phi(I) \left(3\overline{\theta_2} + \underline{\theta_1} + 8\theta_1\right) \quad (33)$$

$$\hat{b}(\theta_2, I) = \gamma(I) + \frac{1}{12}\phi(I) \left(\overline{\theta_2} + 3\underline{\theta_1} + 8\theta_2\right) \quad (34)$$

with

$$\gamma(I) = \xi \left(\sum_{i=1}^{j} CF_i(\theta)(1+r)^{j-i} - I(1+r)^j \right) \quad (35)$$

and

$$\phi(I) = \xi \sum_{i=j+1}^{T} \rho_i \delta(I)(1+r)^{j-i} \quad (36)$$

[22] Baldenius (2000) examines a similar situation in the context of negotiated transfer pricing.

Trade takes place if $\theta_2 - \theta_1 \geq \frac{\overline{\theta_2} - \underline{\theta_1}}{4}$. *The purchase price for the bonus bank is:*

$$\begin{aligned} P &= \gamma(I) + \frac{1}{6}\phi(I)\left(\overline{\theta_2} + \underline{\theta_1} + 2\theta_1 + 2\theta_2\right) \\ &= \xi\left(\sum_{i=1}^{j} CF_i(\theta)(1+r)^{j-i} - I(1+r)^j\right) \\ &\quad + \xi\frac{1}{6}\sum_{i=j+1}^{T} \rho_i \delta(I)(1+r)^{j-i}\left(\overline{\theta_2} + \underline{\theta_1} + 2\theta_1 + 2\theta_2\right). \end{aligned} \tag{37}$$

It holds that $l_t^i = 0$, $\forall t \in \{0, \cdots, j\}$.

Lemma 5 provides the result that truthful reporting is induced when the bonus bank can be sold to the succeeding manager. Trade only occurs if the leaving manager's and the successor's capabilities differ significantly, that is, $\theta_2 - \theta_1 \geq \frac{\overline{\theta_2} - \underline{\theta_1}}{4}$. The successor's knowledge is required to be at least in a higher quartile than the leaving manager's. This requirement derives from the risk imposed by incomplete information, which results in a lower estimated value of the bonus bank. In this bargaining solution the leaving manager has no incentive to lie about value creation in prior periods.

The purchase price for the bonus bank depends on the upper limit of the successor's capabilities ($\overline{\theta_2}$), the lower limit of the leaving manager's capabilities ($\underline{\theta_1}$) and both managers' true characteristics (θ_1 and θ_2). $\gamma(I)$ reflects the share of the value of realized cash flows in $t = j$ the manager is entitled to. $\phi(I)$ is the overall share of manager-independent future value the manager is entitled to. Given this price for the bonus bank, the following proposition analyzes the resulting investment incentives by examining the expected purchase price.

Proposition 3 *Suppose that the capabilities of the leaving manager and the possible buyer are equal in expectation (*$\mathrm{E}_0(\theta_1) = \mathrm{E}_0(\theta_2) = \theta$*) and managers bargain under incomplete information for the purchase price of the bonus bank at date* $j \in \{0, \ldots, T-1\}$. *The random variables* θ_i, $i = 1, 2$ *are independently and uniformly distributed in the respective range* $\Theta_i = [\underline{\theta_i}, \overline{\theta_i}]$. *Suppose* $\theta_2 - \theta_1 \geq \frac{\overline{\theta_2} - \underline{\theta_1}}{4}$, *then the following relation holds*

$$I^m(\theta) = \hat{I}(\theta) \Leftrightarrow \underline{\theta_1} = \underline{\theta_2} \text{ and } \overline{\theta_1} = \overline{\theta_2} \tag{38}$$

REVC-based bonus banks create incentives to choose the efficient investment level if and only if the random variables $\theta_i,\ i=1,2$ *are independently and uniformly distributed in the range* $\Theta_i = [\underline{\theta}, \overline{\theta}], i=1,2$ *and* $\theta_2 - \theta_1 \geq \frac{\overline{\theta}-\underline{\theta}}{4}$.

Proposition 3 provides the result that efficient investment decision-making is only induced if the managers' capabilities are distributed in an identical range, that is, the successor's estimation of the minimum (maximum) project value attainable by the current manager is identical to the leaving manager's estimation of the minimum (maximum) project value possible if manager 2 takes over. The reason for this result is that the leaving manager takes probability considerations of the buying manager's action into account. The implications of these conditions are discussed in the following.

2.5.2.4 Summary and Implications

In summarizing, the preceeding sections highlight the conditions under which efficient investment decisions may be attained. Within the Nash-bargaining solution analyzed in Proposition 2, both managers observe the private information of the other manager symmetrically and incentives for efficient investment decisions are provided when the leaving manager expects her successor to have equal capabilities. When the successor has at least the same capabilities as the leaving manager, trade occurs and both managers receive equivalent shares of the additional value created by the successor. The leaving manager has no incentives to provide untruthful reports since her successor can directly observe the true profitability of the project. Thus the bonus bank creates strong goal congruent investment incentives. From the perspective of the firm, the transaction between the managers is beneficial since additional value is created if the bonus bank is sold to a more knowledgeable and capable successor. Provided several managers are interested in buying the bonus bank, the leaving manager would choose the most knowledgeable and capable successor who is willing to pay the highest price. Symmetric information is not a counterintuitive assumption with the buying manager representing the best informed source of verification concerning the project's state parameters.

However, to provide a solution for the case of the succeeding manager being less informed, we relax this assumption and allow for asymmetric information in an equal-split sealed bid setting, leading to a Bayesian-Nash equilibrium analyzed in Proposition 3. When the leaving manager has private information concerning the true profitability of the project, she has higher bargaining power. Under the conditions of information asymmetry between the two managers, efficient investment decisions are induced if the capabilities of the two managers are distributed over an identical range, that is, if the estimates of the minimum (maximum) project value attainable by the respective other manager are identical. Additionally, efficient investment incentives require the successor to have significantly superior capabilities in expectation. This is due to the fact that under asymmetric information between the two managers, the optimal bidding strategies of the selling and the buying manager are interdependent. The selling manager's ask price depends on her estimation of the buying manager's bid price and vice versa. Trade occurs if the bid price exceeds the ask price. Asymmetric information imposes additional risk on the buying manager who can only estimate the justified value of the bonus bank. This results in a lower willingness to pay. As a result, trade occurs when the buying manager's superior capabilities can compensate for the difference between the bonus bank balance and its justified value assuming low capabilities of the leaving manager. The difference between the successor's bid and the leaving manager's ask price is split equally between the two parties. If the leaving manager can expect the successor to have significantly better capabilities, the possibility to sell the bonus bank to the successor provides strong goal congruent investment incentives under asymmetric information between the selling and the buying manager. In fact, both strong and robust goal congruence may be attained. Proposition 4 provides the result that the REVC-based bonus bank can induce robust goal congruence, if the conditions outlined above are met.

Proposition 4 *The criteria for strong goal congruence as defined in Lemma 4 when the manager stays for the full length of the project and in Proposition 2 and 3 when the manager decides to leave the firm are sufficient to induce robust goal congruent investment decisions by managers.*

When the manager leaves the firm before project completion, the criteria derived for strong goal congruent incentives both under symmetric and asymmetric information in Proposition 2 and 3 suffice to ensure robust goal congruence. The reason for this result is that the use of the bonus bank leads to a situation in which the manager's bonus payment is directly related to value creation. Consequently, for higher value creation she also receives a higher bonus payment.

2.6 Discussion and Conclusion

Bonus banks have become increasingly popular in the public media as a mechanism to improve alignment between managerial behavior and long-term firm objectives (Bhagat and Bolton 2014; Bhagat and Romano 2009). The intention of the bonus bank is to achieve linear participation of managers in the positive and negative effects of their investment decisions on firm value by implementing deferred performance-contingent bonus payments and thus create incentives for efficient investment decisions (Stewart 1991). Bonuses are paid out based on realized performance. To measure realized performance, different measures are proposed in the literature, such as residual income (RI) and Excess Value Created (EVC) (O'Hanlon and Peasnell 2002). Edmans et al. (2012) show that bonus banks provide a solution to the problem of managerial myopia when efficient market prices are available. We extend this research to situations where share prices are not available, such as for divisional managers or managers in private firms and study how bonus banks based on accounting information can be used to solve the problem of managerial myopia.

Our analysis shows that the bonus bank based on accounting performance measures as proposed in the practitioners' literature does not provide efficient investment incentives because in some periods, a negative bonus bank balance may arise even for a profitable project. A myopic manager who plans to leave the firm before she receives a bonus therefore has no incentives to initiate the project. Modifications needed to attain positive bonus payments in every period would require information on the expected value of the project. The practitioner's RI-based bonus bank thus converges to an EVC-based bonus bank. When the bonus bank is based on EVC, the manager is directly rewarded for the value creation of the business unit she is in charge of. However, bonuses then depend on the value of the bonus bank and thus on managers' reports about value creation. If the firm were to simply pay out the value of the bonus bank to a leaving manager before project completion, managers would have incentives to overstate the value of the bonus bank. The incentive problem is thus shifted from investment decision making to determining the value of the bonus bank. When the value of the bonus bank is determined based on observable stock prices in an efficient capital market, Edmans et al. (2012) find that bonus banks create efficient incentives for myopic managers. However, when efficient market prices are not available, firms have to rely on managerial reports to determine project value and myopic managers have incentives to misreport. The second part of our analysis therefore focuses on whether payout structures of the bonus bank can induce truthful reporting.

We analyze a situation in which leaving managers can sell the bonus bank to their successors, following the transfer pricing literature relying on negotiations as a means for determining prices for internal transfers (Baldenius 2000; Johnson 2006). For lack of an external market, we analyze internal bargaining under symmetric and asymmetric information. The bargaining situation creates an internal market that captures the value created by the leaving manager and balances the incentives of the parties. The analysis establishes that strong and robust goal congruence can be attained in such a bargaining setting under restrictive conditions. We find that under symmetric information, incentives for efficient investment decisions are provided only if the manager can expect the buying manager to have equal capabilities. Under asymmetric information, when the leaving manager has better information about the project's true profitability, attaining strong goal congruence requires the succeeding manager to have significantly superior capabilities compared to the leaving manager. This is due to the fact that the buying manager is required to estimate the justified value of the bonus bank. He is willing to trade when the value surplus he can generate due to his superior capabilities at least compensates for potential overstatements of the bonus bank balance.

A possible intuition of this internal transfer is that succeeding managers are generally considered capable of doing the job, are well informed and may be considered the first best source of verification. The buyer of the bonus bank has a strong incentive to verify the value of the bonus bank because untruthful reporting will be revealed at project completion and would reduce bonuses paid to him. The leaving manager will only sell the bonus bank if she receives at least the value she would receive if she decided to stay until project completion.[23] The additional value created by the successor is shared between the two managers. The negotiated price depends on the additional value created by the successor. The leaving manager has strong incentives to sell the bonus bank at a higher price to a successor who has strong capabilities to realize value from the existing investments. Consequently, the firm will benefit from the identification of a succeeding manager with higher capabilities. Truthful reporting and efficient investment incentives are only achieved when this is the case.

The analysis suggests that the leaving manager is incentivized to identify a successor with superior capabilities in realizing value from the existing investments. At the same time, the successor's willingness to pay for the bonus bank can reveal hidden information about his capabilities to improve firm value. Since the leaving manager is rewarded based on the additional value created in the unit during her employment regardless of her time horizon and the duration of projects, the internal market creates a situation in which a manager is treated like a partner of the business unit she is in charge of. Furthermore, it serves as a control mechanism inducing truthful reports as the buying manager constitutes an authority of third party verification.

However, there are aspects of this approach that should be considered with caution. First, no restrictions in communication between the managers or between the principal and the managers are allowed in this examination.[24] It is the strong advantage of the Rogerson-approach that the principal can induce efficient investment decisions without any communication between the manager and the principal. This is largely based on the assumption that the principal himself has forward-looking information about the project's profitability. We relax this assumption and provide an alternative approach in which the problem of asymmetric information is solved in a bargaining situation between informed parties.

Secondly, the bargaining solution between managers requires several critical assumptions. Effi-

[23]If the leaving manager is considering employment with a different firm, the expected compensation payments by the new employer decrease her minimum willingness to accept.

[24]However, in many agency models there is no need for communication to have a positive value. In other words, information delay can make both parties better off and an aggregation of information can actually improve both parties' welfare (Arya et al. 1997; Demski and Frimor 1999; Indejejikian and Nanda 1999).

cient investment decisions are achieved by annuitizing the problem so that the manager can sell the bonus bank to a well-informed successor in each period. In particular, trade only takes place if the successor expects to realize at least the same future cash flows as the leaving manager. Obviously, a firm has strong incentives to replace a manager with a skilled and well-informed successor. A successor will have the same proximity to the information of a particular project or business unit. While the higher value created by the successor may also affect the efficient investment level in the initial investment decision, we do not explicitly take this into consideration. Also, we do not consider strategic negotiations where several potential buyers compete for the purchase of the bonus bank, potentially leading to inefficient solutions. The question how the firm organizes the selection process for the succeeding manager is an opportunity for future research (Levin and Tadelis 2005).

A practical question that arises is whether the successor is willing to purchase the bonus bank as a condition of accepting his new role or whether there are institutional constraints for the internal transfer. The concept of rewarding the manager as a partner of the business unit she is in charge of can be observed quite frequently in practice. Some companies require managers in high level positions to prove ownership of a significant amount of company stock acquired with personal funds. Also, many companies offer sign-on bonuses or interest free signing loans for new employees (Van Wesep 2010; WorldatWork 2014). Firms could therefore encourage successors to use their sign-on bonuses or signing loans to purchase the bonus bank balance. This is in line with Stewart (1991) suggesting that the opening balance of a bonus bank may be contributed by a manager himself. Bonus banks based on EVC can be interpreted as partnerships, where the entering partner needs to buy shares from other partners. The main difference is that the purchase price of the bonus banks derives from the *net* present value of the business rather than the present value. This creates incentives for the manager to act like an owner of the business.

Overall, our analysis suggests that deferred bonus payments, as suggested by regulators, can induce managers to make efficient long-term decisions only under specific circumstances. We provide a framework to theoretically analyze properties of this incentive scheme. The analysis identifies three main elements affecting the investment incentives created under a bonus bank: (i) deferral of bonus payments, (ii) uncertainty about receiving a granted bonus, and (iii) settlement of the bonus bank balance upon project completion or job termination. Firstly, the bonus bank model and our analysis assumes that managers are indifferent between immediate or deferred bonus payments, as long as the economic value of the bonus bank amount is maintained. Secondly, our model is based on the ex ante incentives of the bonus bank where bonuses are based on expectations of future performance. If these expectations are not met in the future, bonuses are not paid out from the bonus bank. We do not consider managers' reactions to performance realizations and our model abstracts from the incentive properties of the bonus bank in periods after project initiation. Thirdly, settlement addresses the treatment of the bonus bank account upon project or job termination. It plays a crucial role in our analysis as it provides the main mechanism ensuring truthful reporting. This suggests that a simple requirement of deferring a portion of the bonus to later periods, as suggested in the EU regulations, may not be sufficient to overcome myopia. As firms have significant leeway in the specification of deferred bonus payments when implementing these regulations, further research will be required to determine the interaction of these three elements and identify the circumstances under which regulatory requirements mitigate the principal-agent problem.

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Appendix

Proof of Proposition 1

To analyze the incentive properties of a bonus bank as suggested by Stewart (1991) or Ehrbar (1998), we examine the conditions for which bonus payments satisfy (14) ensuring goal congruence:[25]

$$\sum_{t=1}^{T} \frac{B_t}{(1+r)^t} = \tau NPV$$

for an arbitrary chosen $\tau > 0$.

When a bonus payment based on ξRI ($0 \leq \xi \leq 1$) is not paid out immediately but a portion $(1-\eta)$ of it is credited to a bonus bank, the manager's bonus payment at date 1 is given by $B_1 = \eta\xi RI_1 + \eta K_0(1+r)$ while $(1-\eta)\xi RI_1 + (1-\eta)K_0(1+r)$ is credited to the bonus bank account where it is accumulated at the cost of capital r. [26] Hence, the bonus payment at date t, $t = 1,\ldots,T-1$ can be calculated as:

$$\begin{aligned}
B_t &= \eta\xi RI_t + \eta K_{t-1}(1+r) \\
&= \eta\xi RI_t + \eta\left(\xi\sum_{i=1}^{t-1}(1-\eta)^{t-i}(1+r)^{t-i}RI_i + (1-\eta)^{t-1}(1+r)^t K_0\right) \\
&= \eta\left(\xi\sum_{i=1}^{t}(1-\eta)^{t-i}(1+r)^{t-i}RI_i + (1-\eta)^{t-1}(1+r)^t K_0\right)
\end{aligned}$$

The balance of the bonus bank at each date is a recursive function of current and past RI, bonus payments, and the opening balance:

$$\begin{aligned}
K_t &= \xi RI_t + (1+r)K_{t-1} - B_t \\
&= \xi\sum_{i=1}^{t}(1+r)^{t-i}RI_i - \sum_{i=1}^{t}(1+r)^{t-i}B_i + (1+r)^t K_0
\end{aligned}$$

[25] This condition does not ensure strong goal congruence. We abstract from conflicting time preferences.

[26] The parameter $0 \leq \xi \leq 1$ reflects the weight on RI in the compensation contract. For simplicity, we assume $\xi = \xi_t$ to be constant over time.

It is zero ($K_T = 0$) after the project's completion. Hence, B_T must satisfy

$$\begin{aligned}
B_T &= \xi RI_T + (1+r)K_{T-1} \\
&= \xi \sum_{t=1}^{T}(1+r)^{T-t}RI_t - \sum_{t=1}^{T-1}(1+r)^{T-t}B_t + (1+r)^T K_0 \\
&= \xi \sum_{t=1}^{T}(1+r)^{T-t}RI_t + (1+r)^T K_0 \\
&\quad - \sum_{t=1}^{T-1}(1+r)^{T-t}\eta \left(\xi \sum_{i=1}^{t}(1-\eta)^{t-i}(1+r)^{t-i}RI_i + (1-\eta)^{t-1}(1+r)^t K_0 \right) \\
&= \xi \sum_{t=1}^{T}(1+r)^{T-t}RI_t + (1+r)^T K_0 \\
&\quad -\eta \sum_{t=1}^{T-1} \left(\xi \sum_{i=1}^{t}(1-\eta)^{t-i}(1+r)^{T-i}RI_i + (1-\eta)^{t-1}(1+r)^T K_0 \right).
\end{aligned}$$

Within this standard bonus bank framework, the present value of bonus payments is calculated as follows:

$$\begin{aligned}
&\sum_{t=1}^{T}\frac{B_t}{(1+r)^t} \\
= \; & \eta \sum_{t=1}^{T-1} \left(\xi \sum_{i=1}^{t}(1-\eta)^{t-i}(1+r)^{-i}RI_i + (1-\eta)^{t-1}K_0 \right) \\
& + \xi \sum_{t=1}^{T}(1+r)^{-t}RI_t + K_0 \\
& - \eta \sum_{t=1}^{T-1} \left(\xi \sum_{i=1}^{t}(1-\eta)^{t-i}(1+r)^{-i}RI_i + (1-\eta)^{t-1}K_0 \right) \\
= \; & \xi \sum_{t=1}^{T}(1+r)^{-t}RI_t + K_0
\end{aligned}$$

Using $\sum_{t=1}^{T}\frac{B_t}{(1+r)^t} = \tau NPV$ and $NPV = \sum_{s=1}^{T}(1+r)^{-s}RI_s$ the equation can be rewritten as:

$$\begin{aligned}
K_0 &= \sum_{t=1}^{T}\frac{B_t}{(1+r)^t} - \xi \sum_{s=1}^{T}(1+r)^{-s}RI_s \\
&= (\tau - \xi)NPV
\end{aligned}$$

The ability of the bonus bank based on RI to create goal congruent investment incentives depends on the opening balance. It is straightforward to see that goal congruence can only be achieved by $K_0 = 0$ if $\tau = \xi$, or an opening balance that is a linear function of project NPV: $K_0 = (\tau - \xi)NPV$ if $\tau > \xi > 0$. For any other positive opening balance $K_0 > 0$, the use of a bonus bank distorts investment decision-making by managers.

For strong goal congruence, the bonus payments B_t must satisfy (15). Assume a project with $NPV \geq 0$ and $RI_1 < 0$. The manager's bonus payment at date $t = 1$ is given by $B_1 = \eta\xi RI_1 + \eta(1+r)K_0$. For $K_0 = 0$ and $\tau = \xi$, $B_1 = \eta\xi RI_1 < 0$. For $K_0 = (\tau - \xi)NPV$ and $\tau > \xi > 0$, $B_1 = \eta ßxiRI_1 + \eta(1+r)(\tau-\xi)NPV$. $B_1 \geq 0$ if $RI_1 \geq (1+r)(1-\frac{\tau}{\xi})NPV$. Otherwise $B_1 < 0$. The bonus bank based on RI does not create strong goal congruent investment incentives. [27]

$$B_1 = \eta\left(\xi RI_1 + (1+r)(\tau - \xi)NPV\right)$$

In this context $B_1 < 0$ for a non-negative NPV project ($NPV \geq 0$) if

$$RI_1 < (1+r)\left(1 - \frac{\tau}{\xi}\right)NPV.$$

It is straightforward to see that the practitioners' bonus bank concept is goal congruent but not sufficient to ensure strong goal congruent bonus payments. ■

Proof of Lemma 1

According to (17), managers will make efficient investment decisions if

$$B_t(I) = \xi \frac{\rho_t}{\sum_{i=1}^{T} \frac{\rho_i}{(1+r)^i}} \left(\sum_{t=1}^{T} \frac{\rho_t \delta(I,\theta)}{(1+r)^t} - I \right)$$

Under a REVC-based bonus bank concept as defined in (8) and (9), the manager is compensated according to

$$K_t = \xi \sum_{i=0}^{t} REVC_i^I (1+r)^{t-i} - \sum_{i=1}^{t} B_i(I)(\cdot)(1+r)^{t-i} \;\forall\, t \in \{0,\ldots,T\}$$

[27] The analysis considers both cases for K_0 which provide goal congruent investment incentives. Other settings are not considered since strong goal congruence can not be attained if the conditions for goal congruence are violated.

where

$$\mathrm{E}(B_t(I)) = \omega_t \xi REVC_0(1+r)^t, \ \omega_t = \frac{\rho_t}{\sum_{i=1}^{T} \frac{\rho_i}{(1+r)^{(i-t)}}}$$

Substituting $REVC_0 = \sum_{t=1}^{T} \frac{\rho_t \delta(I,\theta)}{(1+r)^t} - I$ completes the proof. ■

Proof of Lemma 2

To analyze the incentive properties of a REVC-based bonus bank as defined in (8) and (9), we examine the conditions for which bonus payments satisfy (15), ensuring goal congruence. According to (8), bonus payments $B_t(I)$ are as follows

$$\mathrm{E}(B_t(I)) = \omega_t \xi REVC_0(1+r)^t$$

Note that $REVC_0 = \sum_{t=1}^{T} \frac{\rho_t \delta(I,\theta)}{(1+r)^t} - I$. $\hat{I}(\theta)$ maximizes $REVC_0$ when $\omega_t \geq 0$ is constant and non-negative:

$$\omega_t \geq 0, \forall t \in \{0, \dots, T\}$$

The condition

$$\sum_{t=0}^{T} \omega_t \leq 1$$

suffices to ensure incentive compatibility.[28] Assume, there is $\omega_0 > 1$, on the one hand the manager would still choose the efficient investment level, but on the other hand, no financial advantage remains for the principal as she has to pay the manager more than the whole NPV of the project. The last part of the proof can now be shown by complete induction.

The REVC-based bonus bank concept as defined in (8) and (9) attains robust goal congruence if and only if the present value of bonus payments is linear in the NPV of a project j. According to

[28] See for the definition of incentive compatibility Wilson (1968) and Ross (1973).

(8), the present value of bonus payments from project j $\sum_{t=0}^{T}\frac{B_t^j(\cdot)}{(1+r)^t}$ are as follows:

$$\begin{aligned}\sum_{t=0}^{T}\frac{B_t^j(\cdot)}{(1+r)^t} &= \sum_{t=0}^{T}\frac{\omega_t\xi REVC_0^j(1+r)^t}{(1+r)^t}\\ &= \xi REVC_0^j\\ &= \xi NPV(I_j,\theta^j,\rho^j,T).\end{aligned}$$

■

Proof of Lemma 3

According to Lemma 2, the REVC-based bonus bank concept as defined in (8) and (9) achieves strong goal congruence when bonus payments $B_t(I)$ are as follows

$$\mathrm{E}(B_t(I)) = \omega_t\xi REVC_0(1+r)^t,\ \omega_t \geq 0,\ \forall t \in \{0,\ldots,T\} \text{ and } \sum_{t=0}^{T}\omega_t \leq 1$$

Thus a single bonus payment in $t = i$ with bonus payments

$$\mathrm{E}(B_t(I)) = \omega_t\xi REVC_0(1+r)^t,\ \omega_t = 0\ \ \forall t \in \{0,\ldots,T\}\setminus\{i\} \text{ and } \omega_i = 1$$

suffice to induce strong goal congruence. ■

Proof of Lemma 4

According to lemma 2, the manager will choose the efficient investment level if she is rewarded according to the bonus bank concept as presented in (9) with bonus payments based on the payout ratios as given in (21). The balance of the bonus bank K_T in T (before bonus payment B_T) can be written as

$$
\begin{aligned}
K_T &= \xi REVC_T + (1+r)\,K_{T-1} \\
&= \xi REVC_T + (1+r)\left[REVC_{T-1} + (1+r)\,K_{T-2}\right] \\
&= \xi \sum_{t=1}^{T} (1+r)^{T-t}\, REVC_t + (1+r)^T K_0 \\
&= \xi \sum_{t=1}^{T} (1+r)^{T-t}\, REVC_t + \xi\,(1+r)^T REVC_0 \\
&= \xi \sum_{t=0}^{T} (1+r)^{T-t}\, REVC_t \\
&= \xi \sum_{t=0}^{T} (1+r)^{T-t} \left(RI_t + \Delta GW_t - rGW_{t-1}\right) \\
&= \xi \sum_{t=1}^{T} (1+r)^{T-t}\, RI_t \\
&= \xi \sum_{t=0}^{T} (1+r)^{T-t}\, CF_t - I\,(1+r)^T \\
&= B_T
\end{aligned}
$$

Both bonus bank balance and bonus payment at date T are independent from l_t. Consequently, the manager is not able to improve bonus payments by untruthful reports. Thus, the strategy of truthful reports is the Nash-equilibrium for the agent. ■

Proof of Proposition 2

Within the Nash-bargaining solution (NBS), the optimal price P for the bonus bank is calculated as follows

$$NBS(P) = \left(U_j^2(\cdot) - P\right)\left(P - U_j^1(\cdot)\right) \to \max_P$$

The first-order condition leads to

$$P = \frac{1}{2}\left(U_j^1(\cdot) + U_j^2(\cdot)\right)$$

Substituting conditions (24) and (25) yields

$$\begin{aligned} P &= \xi\left(\sum_{i=1}^{j} RI_i(\theta_1)(1+r)^{j-i} + \frac{1}{2}\left(\sum_{i=j+1}^{T}\left(\mathrm{E}_j(RI_i(\theta_1)) + \mathrm{E}_j(RI_i(\theta_2))\right)(1+r)^{j-i}\right)\right) \\ &= \xi\left(EVC_j + \frac{1}{2}\left(\sum_{i=j+1}^{T}\left(\mathrm{E}_j(RI_i(\theta_2)) - \mathrm{E}_j(RI_i(\theta_1))\right)(1+r)^{j-i}\right)\right) \end{aligned}$$

From the perspective of the project's initiation date $t=0$, the manager chooses the investment level $I^m(\theta_1)$ that maximizes P. Assume that the capabilities of the leaving manager and the possible buyer are equal in expectation ($\mathrm{E}_0(\theta_1) = \mathrm{E}_0(\theta_2) = \theta$). The expected purchase price P at date 0 is as follows

$$\begin{aligned} &\mathrm{E}_0(P) \\ &= \xi\left(\sum_{i=1}^{j} \mathrm{E}_0(RI_i(\theta_1))(1+r)^{j-i} + \frac{1}{2}\left(\sum_{i=j+1}^{T}\left(\mathrm{E}_0(RI_i(\theta_1)) + \mathrm{E}_0(RI_i(\theta_2))\right)(1+r)^{j-i}\right)\right) \\ &= \xi\left(\sum_{i=1}^{j} \mathrm{E}_0(RI_i(\theta_1))(1+r)^{j-i} + \frac{1}{2}\left(\sum_{i=j+1}^{T}\left(\mathrm{E}_0(RI_i(\theta_1)) + \mathrm{E}_0(RI_i(\theta_1))\right)(1+r)^{j-i}\right)\right) \\ &= \xi(1+r)^j\left(\sum_{i=1}^{T} \mathrm{E}_0(RI_i(\theta_1))(1+r)^{-i}\right) \\ &= \xi(1+r)^j NPV(I,\theta_1,\rho,T) \end{aligned}$$

The term in brackets is maximized by $\hat{I}(\theta)$ which completes the proof. The expected purchase price is based on the project's NPV, thus providing no incentive to lie. It holds that $l_t^i = 0 \; \forall \, t \in \{0,\cdots,T\}$. ■

Proof of Lemma 5

The proof follows the intuition of Baldenius (2000). The optimal bidding strategies are the solution to the following simultaneous optimization problem

$$\begin{aligned} \hat{s}(\theta_1,I) &= \arg\max_s \int_{\underline{\theta_2}}^{\overline{\theta_2}} \left(\frac{s+b(\theta_2,I)}{2} - U^1(\theta,\theta_1,I)\right) 1_{s<b(\theta_2,I)} dF_2(\theta_2) \\ \hat{b}(\theta_2,I) &= \arg\max_b \int_{\underline{\theta_1}}^{\overline{\theta_1}} \left(U^2(\theta,\theta_2,I) - \frac{s(\theta_1,I)+b}{2}\right) 1_{s(\theta_1,I)<b} dF_1(\theta_1) \end{aligned}$$

Rewrite the utility of manager i as follows

$$
\begin{aligned}
U_j^i(\theta,\theta_i,I) &= \xi\left(\sum_{k=1}^{j} RI_k(\theta)(1+r)^{j-k} + \sum_{k=j+1}^{T} \mathrm{E}_j(RI_k(\theta_i))(1+r)^{j-k}\right) \\
&= \xi(1+r)^j\left(\sum_{k=1}^{j} CF_k(\theta)(1+r)^{-k} + \sum_{k=j+1}^{T} \mathrm{E}_j(CF_k(\theta_i))(1+r)^{-k} - I\right) \\
&= \xi(1+r)^j\left(\sum_{k=1}^{j} CF_k(\theta)(1+r)^{-k} + \theta_i \sum_{k=j+1}^{T} \rho_k \delta(I)(1+r)^{-k} - I\right)
\end{aligned}
$$

The first term in brackets is directly observable in $t = j$ and therefore independent of reports by manager 1. It follows that $l_t^i = 0$, $t \in 0,\ldots,j$. The second term in brackets reflects expected value creation. In the case that manager i remains with the firm until the project's completion she expects to be rewarded according to (23), which is independent from l_t^i.

Manager i's utility can be restated as a linear function dependent on θ_i

$$
U_j^i(\theta,\theta_i,I) = \gamma + \phi\theta_i
$$

with

$$
\begin{aligned}
\gamma &= \xi\left(\sum_{i=1}^{j} CF_i(\theta)(1+r)^{j-i} - I(1+r)^j\right) \\
&= \xi\left(\sum_{i=0}^{j} CF_i(\theta)(1+r)^{j-i} - I(1+r)^j - CF_0(\theta)(1+r)^j\right)
\end{aligned}
$$

and

$$
\phi = \xi \sum_{i=j+1}^{T} \rho_i \delta(I)(1+r)^{j-i}
$$

Define the following relations $\psi_i = \gamma + \phi\theta_i$, $\underline{\psi_i} = \gamma + \phi\underline{\theta_i}$, and $\overline{\psi_i} = \gamma + \phi\overline{\theta_i}$. By taking the boundary conditions of the indicator functions into account, the optimization problem becomes

$$
\begin{aligned}
\hat{s}(\psi_1,I) &= \arg\max_{s} \int_{s}^{\hat{b}(\overline{\psi_2},I)} \left(\frac{s+b}{2} - \psi_1\right) dG_2(b,I) \\
\hat{b}(\psi_2,I) &= \arg\max_{b} \int_{\hat{s}(\underline{\psi_1},I)}^{b} \left(\psi_2 - \frac{s+b}{2}\right) dG_1(s,I)
\end{aligned}
$$

where the distribution function G_i are induced by (i) the underlying uniform distribution $\hat{F}_i(\psi_i)$ and by (ii) the bidding strategies $\hat{s}$ and $\hat{b}$, where $G_1(\xi,I) = \hat{F}_1(\hat{s}^{-1}(\xi,I))$ and $G_2(\xi,I) = \hat{F}_2(\hat{b}^{-1}(\xi,I))$.

Recall that $G_1(\hat{s}(\underline{\psi_1},I),I)=0$ and $G_2(\hat{b}(\overline{\psi_2},I),I)=1$. By integrating by parts, the seller's problem can be restated as follows

$$
\begin{aligned}
s(\psi_1,I) &= \int_s^{\hat{b}(\overline{\psi_2},I)} \left(\frac{s+b}{2}-\psi_1\right) dG_2(b,I) \\
&= \left[\left(\frac{s+b}{2}-\psi_1\right) G_2(b,I)\right]_s^{\hat{b}(\overline{\psi_2},I)} - \int_s^{\hat{b}(\overline{\psi_2},I)} \frac{1}{2} G_2(b,I)db \\
&= \left[\left(\frac{s+\hat{b}(\overline{\psi_2},I)}{2}-\psi_1\right) G_2(\hat{b}(\overline{\psi_2},I),I) - (s-\psi_1)\, G_2(s,I)\right] \\
&\quad -\frac{1}{2}\int_s^{\hat{b}(\overline{\psi_2},I)} G_2(b,I)db
\end{aligned}
$$

The first-order condition yields

$$\frac{1}{2}\left(1-G_2(\hat{s}(\cdot),I)\right) - \left(\hat{s}(\cdot)-\psi_1\right) g_2(\hat{s}(\cdot),I) = 0$$

where $g_i(\cdot)$ denotes the density function of $G_i(\cdot)$. The buyer's problem can be rewritten as follows

$$
\begin{aligned}
b(\psi_2,I) &= \int_{\hat{s}(\underline{\psi_1},I)}^{b} \left(\psi_2-\frac{s+b}{2}\right) dG_1(s,I) \\
&= \left[\left(\psi_2-\frac{s+b}{2}\right) G_1(s,I)\right]_{\hat{s}(\underline{\psi_1},I)}^{b} + \int_{\hat{s}(\underline{\psi_1},I)}^{b} \frac{1}{2} G_1(s,I)ds \\
&= \left[(\psi_2-b)\, G_1(b,I) - \left(\psi_2-\frac{\hat{s}(\underline{\psi_1},I)+b}{2}\right) G_1(\hat{s}(\underline{\psi_1},I),I)\right] \\
&\quad +\int_{\hat{s}(\underline{\psi_1},I)}^{b} \frac{1}{2} G_1(s,I)ds
\end{aligned}
$$

The first-order condition yields

$$-\frac{1}{2} G_1(\hat{b}(\cdot),I) + \left(\psi_2-\hat{b}(\cdot)\right) g_1(\hat{b}(\cdot),I) = 0$$

Defining $x=\hat{b}^{-1}(\hat{s},I)$ and $y=\hat{s}^{-1}(\hat{b},I)$, we have $g_2(\hat{s},I)=\frac{f_2(x)}{\hat{b}'(x,I)}$, $\psi_1=\hat{s}^{-1}(\hat{b}(x,I),I)$, and $F_2(x)=G_2(\hat{s},I)$. Further, $g_1(\hat{b},I)=\frac{f_1(y)}{\hat{s}'(y,I)}$, $\psi_2=\hat{b}^{-1}(\hat{s}(y,I),I)$, and $F_1(y)=G_1(\hat{b},I)$. Hence, the first-order conditions can be restated as follows

$$\begin{aligned}
\hat{s}^{-1}(\hat{b}(x,I),I) &= \hat{b}(x,I) - \frac{1}{2}\hat{b}'(x,I)\frac{1-F_2(x)}{f_2(x)} \\
\hat{b}^{-1}(\hat{s}(y,I),I) &= \hat{s}(y,I) + \frac{1}{2}\hat{s}'(y,I)\frac{F_1(y)}{f_1(y)}
\end{aligned}$$

The Bayesian-Nash equilibrium is the solution to these two linked differential equations. We restrict attention to linear bidding strategies

$$\hat{s}(\psi_1, I) = \kappa_1(I) + \eta_1(I)\psi_1$$

$$\hat{b}(\psi_2, I) = \kappa_2(I) + \eta_2(I)\psi_2$$

Recall that $F_i(\psi_1)$ is uniformly distributed on the interval $\left[\underline{\psi_i}, \overline{\psi_i}\right]$ and therefore

$$\begin{aligned}
\hat{s}^{-1}(\hat{b}(\psi_2,I),I) &= \kappa_2(I) + \eta_2(I)\psi_2 - \frac{1}{2}\eta_2(I)\left(\overline{\psi_2} - \psi_2\right) \\
\hat{b}^{-1}(\hat{s}(\psi_1,I),I) &= \kappa_1(I) + \eta_1(I)\psi_1 + \frac{1}{2}\eta_1(I)\left(\psi_1 - \underline{\psi_1}\right)
\end{aligned}$$

By differentiation with respect to ψ_i, the solutions to this equation system are given by $\eta_1(I) = \eta_2(I) = \frac{2}{3}$ and $\kappa_1(I) = \frac{1}{4}\overline{\psi_2} + \frac{1}{12}\underline{\psi_1}$ and $\kappa_2(I) = \frac{1}{12}\overline{\psi_2} + \frac{1}{4}\underline{\psi_1}$. Recall that $\psi_i = U_j^i(\theta, \theta_i, I) = \gamma(I) + \phi(I)\theta_i$. Hence, the optimal linear bidding strategy for the seller is

$$\begin{aligned}
\hat{s}(\theta_1, I) &= \frac{1}{4}\left(\gamma(I) + \phi(I)\overline{\theta_2}\right) + \frac{1}{12}\left(\gamma(I) + \phi(I)\underline{\theta_1}\right) + \frac{2}{3}\left(\gamma(I) + \phi(I)\theta_1\right) \\
&= \gamma(I) + \frac{1}{12}\phi(I)\left(3\overline{\theta_2} + \underline{\theta_1} + 8\theta_1\right)
\end{aligned}$$

The optimal bidding strategy for the buyer is

$$\begin{aligned}
\hat{b}(\theta_2, I) &= \frac{1}{12}\left(\gamma(I) + \phi(I)\overline{\theta_2}\right) + \frac{1}{4}\left(\gamma(I) + \phi(I)\underline{\theta_1}\right) + \frac{2}{3}\left(\gamma(I) + \phi(I)\theta_2\right) \\
&= \gamma(I) + \frac{1}{12}\phi(I)\left(\overline{\theta_2} + 3\underline{\theta_1} + 8\theta_2\right)
\end{aligned}$$

As a consequence, trade takes place if $4\theta_2 - \overline{\theta_2} \geq 4\theta_1 - \underline{\theta_1}$ which completes the proof. ■

Proof of Proposition 3

According to lemma 5, the purchase price at date j for the bonus bank is

$$P = \gamma(I) + \frac{1}{6}\phi(I)\left(\overline{\theta_2} + \underline{\theta_1} + 2\theta_1 + 2\theta_2\right)$$

$$\gamma = \xi\left(\sum_{i=1}^{j} CF_i(\theta)(1+r)^{j-i} - I(1+r)^j\right)$$

and

$$\phi(I) = \xi \sum_{i=j+1}^{T} \rho_i \delta(I)(1+r)^{j-i}$$

if $\theta_2 - \theta_1 \geq \frac{\overline{\theta_2} - \underline{\theta_1}}{4}$. The manager's investment criterion is

$$\begin{aligned}
& I^m(\theta) \in \arg\max_I \sum_{t=1}^{T^A} \frac{W_t(I)}{(1+r)^t} \\
\Leftrightarrow \quad & I^m(\theta) \in \arg\max_I \left\{ \frac{\mathrm{E}_0(P)}{(1+r)^j} \right\} \\
= \quad & \xi\left(\sum_{i=1}^{j} \mathrm{E}_0(CF_i(\theta))(1+r)^{-i} - I + \frac{1}{6}\mathrm{E}_0\left(\overline{\theta_2} + \underline{\theta_1} + 2\theta_1 + 2\theta_2\right) \sum_{i=j+1}^{T} \rho_i \delta(I)(1+r)^{-i}\right) \\
= \quad & \xi\left(\theta \sum_{i=1}^{j} \rho_i \delta(I)(1+r)^{-i} + \frac{1}{6}\mathrm{E}_0\left(\overline{\theta_2} + \underline{\theta_1} + 2\theta_1 + 2\theta_2\right) \sum_{i=j+1}^{T} \rho_i \delta(I)(1+r)^{-i} - I\right)
\end{aligned}$$

Hence, $\hat{I}(\theta) = I^m(\theta)$ if $\theta = \frac{1}{6}\mathrm{E}_0\left(\overline{\theta_2} + \underline{\theta_1} + 2\theta_1 + 2\theta_2\right)$. In $t = 0$, the leaving manager assumes that $\theta = \mathrm{E}_0(\theta_1) = \mathrm{E}_0(\theta_2)$. Consequently, the condition reduces to $\mathrm{E}_0(\overline{\theta_2} + \underline{\theta_1}) = 2\theta$. Since θ_i is uniformly distributed, we have $\overline{\theta_1} = \overline{\theta_2}$ and $\underline{\theta_1} = \underline{\theta_2}$ which implies that investment decisions are efficient if and only if the managers' capabilities are distributed in the identical range $\Theta_i = [\underline{\theta_i}, \overline{\theta_i}], i = 1,2$. This yields the condition $\theta_2 - \theta_1 \geq \frac{\overline{\theta} - \underline{\theta}}{4}$. ■

Proof of Proposition 4

The situation $T = T^A$ is straightforward. Consider the case $T^A < T$ and a bargaining process under complete information (condition (27)), the present value of bonus payments is given as

$$\sum_{t=1}^{T^A} \frac{B_t^i(\cdot)}{(1+r)^t}$$
$$= \xi \left(\sum_{s=1}^{j} \mathrm{E}_0(RI_s^i(\theta^i))(1+r)^{-s} + \frac{1}{2} \left(\sum_{s=j+1}^{T} \left(\mathrm{E}_0(RI_s^i(\theta_1^i)) + \mathrm{E}_0(RI_s^i(\theta_2^i)) \right) (1+r)^{-s} \right) \right)$$

The assumption $\theta_2 \geq \theta_1$ ensures that trade takes place and the assumption $\theta = \mathrm{E}_0(\theta_1^i) = \mathrm{E}_0(\theta_2^i)$ implies that

$$\begin{aligned} \sum_{t=1}^{T^A} \frac{B_t^i(\cdot)}{(1+r)^t} &= \xi \left(\sum_{s=1}^{T} \mathrm{E}_0(RI_s^i(\theta^i))(1+r)^{-s} \right) \\ &= \xi NPV(I_i, \theta^i, \rho^i, T) \end{aligned}$$

which provides the relation between bonus payment and ranking of the projects. Turn to the case $T^A < T$ and a bargaining process under incomplete information (condition (37)), the present value of bonus payments is given as

$$\sum_{t=1}^{T^A} \frac{B_t^i(\cdot)}{(1+r)^t}$$
$$= \xi \left(\theta^i \sum_{s=1}^{j} \rho_s^i \delta(I_i)(1+r)^{-s} + \frac{1}{6} \mathrm{E}_0 \left(\overline{\theta_2^i} + \underline{\theta_1^i} + 2\theta_1^i + 2\theta_2^i \right) \sum_{s=j+1}^{T} \rho_s^i \delta(I_i)(1+r)^{-s} - I_i \right)$$

Trade takes place if $\theta_2^i - \theta_1^i = \frac{\overline{\theta_2^i} - \underline{\theta_1^i}}{4}$ and the conditions $\underline{\theta_1^i} = \underline{\theta_2^i}$ and $\overline{\theta_1^i} = \overline{\theta_2^i}$ ensure that

$$\begin{aligned} \sum_{t=1}^{T^A} \frac{B_t^i(\cdot)}{(1+r)^t} &= \xi \left(\theta \left(\sum_{s=1}^{j} \rho_s^i \delta(I_i)(1+r)^{-s} + \sum_{s=j+1}^{T} \rho_s^i \delta(I_i)(1+r)^{-s} \right) - I_i \right) \\ &= \xi NPV(I_i, \theta^i, \rho^i, T) \end{aligned}$$

which completes the proof. ■

List of Symbols

a	allocation rule
B	bonus payment
b	buyer's bid
CE	capital employed
CF	cash flows
EVA	Economic Value Added
EVC	Excess value created
I	investment level
K	balance of the bonus bank
K_0	opening balance
K_0^c	opening balance large enough to avoid negative bonus payments
l	managerial overstatement
NI	net income
NPV	net present value
P	purchase price
r	interest rate
$REVC$	Residual economic value created
RI	residual income
s	seller's bid
S	project portfolio
t	time period
U	reservation utility
w	wage payment
bw	fixed compensation
δ	productivity parameter
ε	error term
υ	payout ratio (EVC-based bonus bank)
η	payout ratio (RI-based bonus bank)

θ manager specific productivity parameter

ξ periodic participation rate

ρ investment's relative productivity profile

τ share of project's total NPV granted to the manager

ω payout ratio in expectation (EVC-based bonus bank)

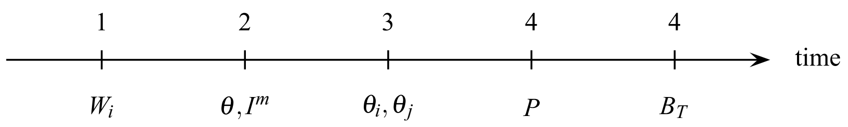

Figure 1: Sequence of events - Bargaining under complete information

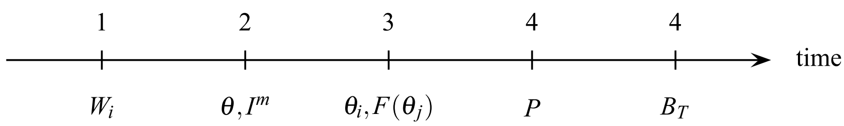

Figure 2: Sequence of events - Bargaining under incomplete information

3 Article II: The Effect of Bonus Deferral on Managers' Investment Decisions

Cheng, M., T. Dinh, W. Schultze, and M. Assel. 2019. The Effect of Bonus Deferral on Managers' Investment Decisions. *Behavioral Research in Accounting* 31 (2): 31-49 (https://doi.org/10.2308/bria-52463).

4 Article III: Encouraging Goal-Alignment in Multidimensional Tasks: An Experimental Examination of Effort under Bonus Deferral and Bonus Recovery

Mandy Cheng, Tami Dinh, Wolfgang Schultze, and Maria Assel

Abstract. We examine how bonus deferral and bonus recovery affect employees' performance in a multi-dimensional effort-sensitive task, where improving overall task performance requires employees to focus on both output quantity and output quality. Deferred bonuses and bonus recovery provisions are important elements in contemporary incentives schemes designed to motivate employees to act in the best interest of the firm. We propose that bonus deferral improves performance by encouraging employees to exert effort towards advancing their company's interests, while bonus recovery serves an effort-directing role by indicating undesirable behavior that should be avoided. Our experimental results show that bonus deferral increases performance quantity but does not change performance quality; in contrast, bonus recovery increases performance quality, the performance dimension related to bonus recovery, but at the expense of performance quantity. Furthermore, we find that overall task performance is negatively affected by bonus recovery because individuals become overly concerned with output quality. Our study contributes to the debate on effective compensation by showing that bonus deferral and bonus recovery can help align employees' interests with firm goals.

Keywords: Compensation, self-interest, deferred bonus payments, bonus recovery

Data availability: Data is available from the authors upon request.

JEL Codes: M40, M41

4.1 Introduction

Multidimensional task environments are common in contemporary firms (Hannan, McPhee, Newman, and Tafkov 2019; Staats and Gino 2012). In such environments, firms need to design incentive systems that motivate employees' effort level and direction in ways that benefit the firm (Bonner and Sprinkle 2002). Traditional bonus schemes, however, have been met with criticisms for creating incentives for employees to improve their rewarded performance at the expense of the firm's interest (Lambert 2001; Morse, Nanda, and Seru 2011; Bennett, Bettis, Gopalan, and Milbourn 2017). Such criticisms have led to the continuous search for better compensation scheme designs that are able to mitigate dysfunctional behaviors. One proposed remedy is the use of bonus deferral and bonus recovery (Chen, Greene, and Owers 2015; DeHaan, Hodge, and Shevlin 2013; Gillan and Nguyen 2016). Prior results on the effects of bonus deferral and bonus recovery are limited and suggest that while bonus deferral by itself may be a tool to improve incentive alignment (Cheng, Dinh, Schultze, and Assel 2019), a combination of bonus deferral and bonus recovery may have unintended effects especially on risk taking behaviors (Hodge and Winn 2012; Hartmann and Slapničar 2014). This study investigates how the deferral of bonus payment and the looming threat of not receiving an already earned bonus under bonus recovery provisions, affect the effectiveness of compensation schemes in motivating employees to perform a multidimensional task.

Bonus deferral refers to the delayed payment of bonuses to managers over a pre-specified period of time, while bonus recovery refers to debits against previously awarded bonuses in case of substandard performance (Brink and Rankin 2013; Hartmann and Slapničar 2014). Because it is difficult to recoup excess compensation when it has already been paid out, these two compensation elements are commonly implemented together, often as part of a "bonus bank" scheme (e.g., Byrnes 2009; Bischof, Essex, and Furtaw 2010; O'Hanlon and Peasnell 1998, 2002; Stewart 1991). In an attempt to discourage managers from maximizing their current pay by undesirable means or at the expense of shareholders' interest, many financial and nonfinancial firms have implemented compensation schemes with bonus deferral and bonus recovery provisions (e.g., Morgan Stanley, UBS, Credit Suisse, Metro). Regulatory bodies, especially in Europe and Australia, require companies to implement deferred bonus schemes and bonus recovery provisions[29]. Despite these developments, empirical evidence on how these attributes of incentive schemes affect the behaviors of managers and employees remains limited, and tend to focus on employees' risk taking behaviors and reporting choices (Hartmann and Slapničar 2014; Hodge and Winn 2012). Examining the effects of bonus deferral and recovery on employees' effort provision and task performance is important since these compensation attributes are not necessarily restricted to top executives, but can apply to employees at all levels of an organization.

The current study examines potential consequences of bonus deferral and recovery on employee effort in a multidimensional setting, where employees are required to focus on both output quality and output quantity to improve overall task performance[30]. This setting allows us to investigate how bonus deferral and bonus recovery have differential and combined effects on different performance dimensions, as well as their overall effect on task performance.

Specifically, and drawing on the construal level theory, we argue that bonus deferral increases the perceived psychological distance between effort exertion and bonus payment, which increases employees' willingness to exert effort on behalf of their firm (Cheng et al. 2019; Trope and Liberman 2003, 2010). As bonus deferral only changes the timing of bonus payments but does not refer to any specific task dimension that may cause effort distortion by

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[29] In Europe and Australia, financial institutions are required to defer a substantial portion of variable remuneration (Directive 2010/76/EU; Banking Executive Accountability Regime Division 4 Part IIAA, BEAR). Additionally, recovery policies are mandatory for financial institutions in Australia (Australian Prudential Regulation Authority 2018, 9) and listed companies in the US (Dodd-Frank Wall Street Reform and Consumer Protection Act, Section 954, Dodd-Frank). Although firms may recoup excess compensation due to a multitude of events, clawbacks are triggered by accounting misstatements in the U.S.

[30] Consistent with prior research such as Christ, Emett, Tayler, and Wood (2016), we focus on the most basic two-dimension task setting in our experiment, even though our theorization also applies to other multidimensional and multiple task settings.

employees, it is expected to improve employee performance on both the quality and quantity dimensions.

In contrast, bonus recovery instructs employees about what the firm considers as inappropriate behaviors when seeking to improve its performance, and is tied to a specific aspect of their task. For example, bonus recovery may be based on noncompliance with company policies, accounting misrepresentation, selling unsuitable products to customers, or in our experimental setting, performing poor quality work. Unlike penalty contracts where the loss of performance incentive occurs in the same performance period, bonus recovery causes a loss of a bonus already earned. We posit that the looming threat of losing previously earned pay will make the performance dimension related to bonus recovery (e.g., quality) more salient than other task dimensions (e.g., quantity), causing employees to redirect their effort towards quality at the expense of quantity. On the other hand, bonus recovery provisions may counteract the effects of bonus deferral by causing employees to more strongly focus on the monetary implications of their behavior. We thus also predict that, since bonus recovery directly translates into lower compensation, combining bonus deferral and bonus recovery provisions will reduce the positive effect of bonus deferral.

Next, we consider the effect of bonus deferral and recovery on employees' overall task performance. We argue that bonus deferral increases overall task performance by increasing employees' willingness to exert effort on behalf of their firm. However, while bonus recovery may improve overall performance by simplifying self-regulatory processes (Andrejkow, Berger, and Guo 2018) and helping employees identify relevant task dimensions, it may also result in effort distortions that have been found to negatively affect firm performance (e.g., Hannan et al. 2019). Which of the two effects prevails in a particular setting is largely an empirical question; we thus propose a nondirectional hypothesis for the effect of bonus recovery on overall task performance. We further propose that the effect of bonus deferral on overall performance will be weaker when combined with bonus recovery provisions since bonus recovery provisions direct employees attention to monetary effects of their behavior rather than their responsibility.

We conduct a 2x2 between-subjects experiment to test our hypotheses, where we hold constant the expected economic payoffs, and manipulate the timing of bonus payments (now vs. deferred) and bonus recovery (no recovery vs. recovery). An incentive-compatible piece-rate-compensation scheme creates incentives to exert effort to complete a series of sub-tasks that require attention to both quantity and quality. Overall task performance (measured by the number of correctly completed outputs) can be enhanced by either working on more sub-tasks (output quantity), and/or by working more accurately (output quality). We find that bonus deferral significantly increases employees' performance on output quantity, but does not change output quality. In contrast, the presence of bonus recovery results in significantly improved performance on output quality, but at the expense of lower output quantity. Furthermore, we find evidence that overall task performance decreases as a result of a combination of bonus deferral and bonus recovery.

Our findings contribute to prior literature in three ways. First, our results provide insights into the effects of bonus deferral and bonus recovery in a multidimensional task environment. There has been limited prior research on the incentive properties of combining bonus deferral and bonus recovery, and these studies tend to be based on unidimensional tasks (e.g., Hartmann and Slapničar 2014). By examining a multidimensional task, we are able to investigate both the individual and combined effects of bonus deferral and bonus recovery on effort allocation across different task dimensions. Our research is thus closely related to the literature on partial incentives (Holmstrom and Milgrom 1991; Bonner and Sprinkle 2002). We find that bonus deferral and bonus recovery have different behavioral implications; bonus deferral improves employees' performance on output quantity, while bonus recovery tied to output quality enhances quality performance but reduces quantity performance. The implication is that the multidimensional nature of a work task, and the relationship between these dimensions, should be considered when designing a compensation scheme that involves both elements. For example, bonus recovery may be a relevant design choice in situations where a focus on one performance dimension needs to be reinforced.

Second, our study speaks to the widely claimed need for improving alignment between employees' and firms' interests via the use of bonus recovery provisions. Previous research on voluntary bonus recovery provisions document positive investor reactions to their adoption (Iskandar-Datta and Jia 2013) and suggest that these incentive schemes provide benefits including higher perceived and actual reporting quality (e.g., DeHaan et al. 2013; Chan, Chen, Chen, and Yu 2012; Erkens, Gan, and Yurtoglu 2018; Chen et al. 2015). These positive effects may be due to a deterrent effect on dysfunctional behavior or a selection effect of firms choosing to implement voluntary bonus recovery provisions (Chen et al. 2015). We focus on the deterrent effect and complement firm-level research by examining the causal link between bonus recovery and the mitigation of agency problems at an individual's level. Although our study examines the effect of bonus recovery in an effort-sensitive task, our findings imply that, consistent with the intention of standard setters, bonus recovery triggered by undesirable outcomes such as accounting misstatements is likely an appropriate tool for deterring misreporting (e.g., Chan et al. 2012; Chen et al. 2015). However, because bonus recovery provides effort-directing indication, our results also suggest that bonus recovery provisions may have a negative impact when employees become overly concerned about potentially losing their earned bonus. In our study, this strong focus on bonus recovery has led to a reduction in overall task performance, whereas in a different setting, such as financial reporting, this negative impact may manifest as overly conservative accounting choices.

Third, in practice, firms implement a range of different variants of bonus recovery provisions because regulation on the design of deferred compensation schemes, including the basis for bonus recovery, is not clear (Australian Prudential Regulation Authority 2018, 9; Dodd-Frank Section 954). In the U.S., Section 304 of the Sarbanes-Oxley Act (SOX 2002) first introduced bonus recovery for financial restatements due to misconduct. The subsequent Dodd-Frank Wall Street Reform and Consumer Protection Act extended SOX by eliminating misconduct as a prerequisite for bonus recovery (Dodd-Frank Section 954). Prior literature suggests that bonus recovery provisions that are triggered by factors beyond the individual's control may have unintended effects, including managers demanding higher pay (e.g., DeHaan et al. 2013; Chen et al. 2015; Brink and Rankin 2013; Erkens et al. 2018), making riskier reporting choices (Hodge and Winn 2012), and engaging in procyclical risk taking behavior (Hartmann and Slapničar 2014). However, previous literature has not yet analyzed the effect of bonus recovery provisions triggered by employees' own behavior on effort provision and performance.[31] We find that bonus recovery provisions increase the salience of the performance dimension that triggers bonus recovery, causing employees to over-prioritize their effort on one task dimension at the expense of overall task performance. These findings add to our understanding of the behavioral implications of bonus recovery when it is triggered by individuals' discretionary effort provision.

The paper is structured as follows. First, we develop hypotheses on the effects of bonus deferral and bonus recovery on employees' effort provision on different task dimensions, followed by their impact on overall task performance. Next, we present the research method, our result analysis, and finally, conclusion and discussion.

[31] Chen et al. (2015) predict lower employee effort under bonus recovery provisions in an analytical model. In their model, bonus recovery provisions add noise to the performance measure used to determine performance-based compensation.

4.2 Prior Literature and Hypotheses Development

4.2.1 The Behavioral Effect of Bonus Deferral

Bonus deferral and bonus recovery are both designed to mitigate dysfunctional behavior arising from the divergence of interests between employees and the firm (Chan et al. 2012; Chen et al. 2015). Together they form the central elements of the so-called bonus bank (e.g., Stewart 1991; Byrnes 2009; Koch and Pertl 2009). Over time, bonuses based on positive (negative) performance are credited to (debited against) an internal account, and the bonus payment is distributed to the manager at a future date. In doing so, employees' decisions are said to be matched with the firm's longer term interests (e.g., Edmans, Gabaix, Sadzik, and Sannikov 2012).

We first consider the effect of bonus deferral on employees' effort provision. In purely rational economic frameworks, bonus deferral should not alter individuals' behavior as long as time value of money and nonpayment risks are addressed, such as where appropriate interest is paid. However, Cheng et al. (2019) find that when their bonus is deferred, subjects display a greater willingness to make an investment that provides long-term benefits to the firm but has negative immediate consequences for the mangers' bonus. While this research suggests that bonus deferral has a positive impact on addressing managerial short-termism, it is unclear whether bonus deferral also motivates employees to exert more personal effort to perform work for their firm.

Construal level theory (CLT, Trope and Liberman 2003, 2010) proposes that individuals' representations of an action or event depend on its psychological distance from the present self, including whether the action/event pertains to the near or distant future[32]. Greater psychological distance (i.e., higher level construal representation) causes individuals to think

[32] Psychological distance can be temporal (e.g., whether an event/information pertains to the present or future), spatial (the physical location of the information/event), and social (e.g., whether an event/information relates to the self or a stranger). In our study the temporal aspect of psychological distance is more relevant.

more abstractly and pay more attention to the superordinate goal associated with an action. For example, a higher construal, abstract representation of "helping others" may be contrasted with a lower construal, more concrete representation of "giving a dollar to a homeless person on the street late at night" (Trope and Liberman 2003). Cheng et al. (2019) argue that bonus deferral causes managers to consider the consequences of their behavior in a more distant future. Drawing on CLT, they predict and find that bonus deferral increases managers' concern for their responsibility to improve the company's prospects, and therefore their willingness to make investments that align with their company's interests even at their personal expenses.

In this study, we examine a setting where employees are deciding whether and how much effort to exert for performing a task that benefits their company. Variable compensation encourages a certain effort level. Consistent with Cheng et al. (2019), we propose that delaying bonus payments will cause employees to consider the consequences of their behavior in a more distant future and to adopt a more abstract mindset. Thus, employees will place greater importance on what they should do rather than what they want to do (Rogers and Bazerman 2007), and become more willing to exert effort that is congruent with their responsibility. Furthermore, CLT predicts that psychological distance reduces individuals' feasibility concerns – that is, the personal sacrifices required to achieve an outcome (Bornemann and Homburg 2011; Roehm and Roehm Jr. 2011). For example, Liberman and Trope (1998) find that higher temporal psychological distance reduces students' considerations of time constraints and the potential trade-offs required between academic and leisure activities. As such, we expect that bonus deferral will cause employees to reduce their concern about the personal costs associated with exerting effort to help the firm attain its goal. Consequently, employees are more willing to exert effort to advance the firm's interests under deferred bonus payments than immediate bonus payments.

In an effort-sensitive task, where higher effort results in higher performance, we expect to find a positive effect of bonus deferral on employees' performance. Further, as bonus deferral involves merely the delaying of bonus payment and does not emphasize any specific task dimension, in our two-dimensional task setting we expect bonus deferral to positively affect employees' performance on both quality and quantity:

H1: Employees under a deferred bonus scheme will have: ***(a)*** higher quantity performance and ***(b)*** higher quality performance than those under an immediate bonus payment scheme.

4.2.2 Effort Allocation and Bonus Recovery Provisions

Bonus recovery provisions enable firms to recoup previous periods' compensation in a period of low performance, such that employees participate in both profits and losses associated with their actions (Bischof et al. 2010; Shlomo and Nguyen 2011). Bonus recovery thus puts previous payments at stake by implementing punishments for undesirable behaviors while managers receive "extra credit" as a reward for good performance (Lazear 1991). Because it is difficult to recoup excess compensation when it has already been paid out, bonus recovery provisions are commonly used in combination with bonus deferral (e.g., Byrnes 2009; Bischof et al. 2010; O'Hanlon and Peasnell 1998, 2002; Stewart 1991). This approach allows firms to make debits against previously accumulated compensation and does not require legal actions to reclaim payments[33].

When overall performance comprises multiple dimensions, the design of compensation schemes influences how employees approach a task by directing employees' attention to relevant task or job dimensions (Holmstrom and Milgrom 1991). Previous literature has found that firms' choices of performance measures serve as an indication of appropriate behaviors in

[33] Specific types of bonus recovery that are not combined with bonus deferral are the so-called clawbacks (e.g., Erkens et al. 2018; Lublin 2010). Clawback provisions allow firms to reclaim bonuses that have already been paid out to managers if performance outcomes trigger conditions outlined in their compensation contract.

multidimensional environments (e.g., Farrell, Kadous, and Towry 2008; Ittner and Larcker 2003). We posit that bonus recovery provisions play a similar role. By penalizing undesirable outcomes associated with a particular task dimension, bonus recovery provisions instruct employees about what the firm considers as an appropriate effort allocation strategy. For example, an equipment service manager may receive a bonus based on overall profit generated from maintaining and upgrading customers' equipment, but with a recovery provision tied to the costs associated with revisits due to poor quality prior services. In this example, the recovery provision indicates to the manager that servicing customers' equipment correctly the first time, rather than processing a larger number of customer requests but with poor quality, is the effort allocation strategy preferred by the firm.

In addition, previous literature provides evidence for individual loss aversion, that is, the fact that a loss of a certain amount relative to the decision maker's reference point causes greater emotional affect than an equivalent gain (Kahneman and Tversky 1979). Individuals anticipate aversive future losses (Imas, Sadoff, and Samek 2016; Jevons 1905; Loewenstein 1987; Frederickson and Waller 2005) and adapt their behavior in order to avoid incurring a loss (Hannan, Hoffman, and Moser 2005; Church, Libby, and Zhang 2008; Hong, Hossain, and List 2015; Hossain and List 2012). We expect that individuals will anticipate and experience a sense of loss when a bonus recovery occurs since they consider deferred bonuses as their possessions even if the bonus payout is subject to predetermined conditions tied to bonus recovery provisions (Ariely and Simonson, 2003; Reb and Connolly, 2007).

Based on these arguments, we hypothesize that employees adapt their behavior to avoid bonus recovery occurrence. In particular, we expect employees to put stronger emphasis on the performance dimension that might trigger bonus recovery. In line with this prediction, previous literature finds that compensation feedback that is related to losses or the avoidance thereof encourages an increased concern with vigilance and safety (Förster, Higgins, and Bianco 2003).

We thus expect that, holding constant the expected economic returns, bonus recovery has a positive effect on employee effort provisions towards the task dimension that triggers bonus recovery. In our setting, bonus recovery is tied to output quality. This leads to the following hypothesis:

H2: Employees whose compensation scheme has a bonus recovery provision tied to output quality will have higher quality performance than those who do not have a bonus recovery provision.

Employees typically have limited resources. As a result, effort exerted towards one performance dimension cannot simultaneously be allocated towards another performance dimension. In a multidimensional task, this means that increases in effort allocated to one performance dimension may come at the cost of decreased effort allocated towards other performance dimensions (Farrell et al. 2008; Hannan et al. 2005). This is particularly the case where the approaches for improving different task dimensions are different (Christ, Emett, Tayler, and Wood 2016). For example, increasing effort allocated to improve output quality requires greater care and focus when completing the assigned task, which will likely result in lower output quantity. This prediction is further supported by individual loss aversion. When bonus recovery is only triggered by unsatisfactory performance in one dimension, avoiding loss associated with low performance in this dimension will likely lead to employees prioritizing this performance dimension. We thus expect bonus recovery provision to reduce effort provision directed towards output dimensions that do not trigger bonus recovery.

H2b: Employees whose compensation scheme has a bonus recovery provision tied to output quality will have lower quantity performance than those who do not have a bonus recovery provision.

4.2.3 Combining Bonus Deferral and Bonus Recovery

Earlier we argue that delaying bonus payments encourages employees to place greater importance on their responsibility and improving their company's prospects, since their behavior is less driven by short-term monetary considerations but rather by abstract considerations about the general good for the firm. Employees hence focus more on what they should do and put more emphasis on complying with firm goals when bonus payments are deferred (Cheng et al. 2019). On the other hand, bonus recovery causes employees to more strongly focus on the implications of their actions on their monetary reward. Under bonus recovery, mistakes translate directly into lower compensation (even though it is paid out later) and thus the negative effects of potential failures (low quality) are immediate even in the deferred setting. This leads employees to pay more attention to monetary aspects, which counteracts the effect of deferral. The combination of deferral and recovery will hence reduce the positive effects of deferral on quantity and quality hypothesized in H1.

H3: When bonus deferral is combined with bonus recovery, the positive effects of deferral on ***(a)*** quantity performance and ***(b)*** quality performance will be reduced.

While deferral in isolation has positive effects on quality and quantity, recovery highlights the importance of quality, causing a trade-off between quantity and quality. Subjects will have different approaches on how to combine quantity and quality in order to achieve optimal performance. We next consider the effect of bonus deferral and bonus recovery on overall task performance.

4.2.4 Effects of Bonus Deferral and Recovery on Overall Performance

Since bonus deferral is expected to improve both output quantity and quality under H1, we propose that bonus deferral will improve overall performance by encouraging employees to exert effort in the interest of the firm:

H4a: Overall task performance is higher when bonus payments are deferred than when bonus payments are not deferred.

However, the prediction relating to the effect of bonus recovery on overall task performance is less clear. On the one hand, bonus recovery may improve overall task performance by providing an indication of desirable behavior. In the absence of indications of desirable effort allocation, employees typically face a goal conflict in multidimensional environments, as the relative importance of each performance dimension is ambiguous (Locke, Smith, Erez, Chah, and Schaffer 1994). To attend to these conflicting goals, employees engage in self-regulatory processes, which shift limited cognitive resources away from engaging in the task itself (Christ et al. 2016; Masicampo and Baumeister 2011). Bonus recovery provides an indication of the desirable weighting of performance dimensions and frees up cognitive resources by simplifying self-regulatory processes (Andrejkow et al. 2018).

On the other hand, bonus recovery may distort effort allocation away from an individual's initial distribution between performance dimensions. This is commonly considered to come at a cost to overall performance, unless marginal returns to effort differ between tasks or task dimensions (e.g., Hannan et al. 2019)[34]. Also, employees' individual abilities may differ, resulting in differences between marginal returns to effort between tasks or task dimensions. If an employee has specialized and strong skills in one job dimension, but mediocre abilities in other job dimensions, the firm may benefit from the employee focusing on the former (e.g., Kachelmeier 2019). Hence, optimal effort allocation depends on employee- and firm-specific characteristics when marginal returns to effort differ between different job dimensions. As a result, providing incentives for optimal effort allocation hinges on *ex ante* knowledge of ability-dependent marginal returns to effort. If employees' abilities are unknown, not restricting

[34] For example, a firm producing imaging devices for medical purposes may require a particular focus on the quality of the product over the number of devices produced, as defective images may have costly consequences. Conversely, a larger margin of error may be acceptable for a firm in the clothing industry where profits are generated by selling large quantities of products.

employees' freedom to weigh different performance dimensions according to their individual returns to effort is likely to achieve superior results. Because it is not clear which of the two effects will prevail in our setting, we do not predict a directional effect of bonus recovery on overall task performance:

H4b: Bonus recovery provisions affect overall task performance.

When deferral and recovery are combined, recovery counteracts the positive effect of deferral. We thus further posit that the positive effects of bonus deferral on overall performance will be reduced when combining bonus deferral and bonus recovery. We hypothesize:

H4c: The effect of bonus deferral on overall task performance is lower under bonus recovery provisions.

4.3 Research Method

4.3.1 Research Design

We test our hypotheses using a 2x2 between-subjects experiment programmed in z-Tree (Fischbacher 2007). The two independent variables are bonus timing (bonus now vs. bonus deferred) and bonus recovery (no bonus recovery vs. bonus recovery). The primary dependent variable is employees' performance on a real-effort task to help the firm win a new client contract. The experiment was conducted at two large universities in Germany and Switzerland. Recruitment of participants and execution of the experiment was organized by the local experimental laboratories, and the experiment was approved by the universities' ethics committees.

4.3.2 Participants

148 undergraduate business students voluntarily participated in the computerized experiment. Of these, 65 were enrolled in the Business School of a large German university and

83 participants were business students at a large university in German-speaking Switzerland.[35] The experimental task does not require specific accounting knowledge; hence, undergraduate business students are suitable participants for this study.[36] 54.6% of our participants were male (53.3% in Germany and 55.4% in Switzerland). To encourage participation, each participant was guaranteed 5 Euro (CHF 5) for participating in the experiment. Additional performance-based compensation ensures incentive compatibility. On average participants in Germany (Switzerland) earned a total of 23.73 Euro (CHF 48.68) for participating in the experiment.

4.3.3 Experimental Task

Upon arrival at the experimental lab, participants are randomly assigned to one of the computer desks. Participants receive information about the experimental set-up on the computer screen and learn that they can earn additional compensation during the experiment. The experimental currency is experimental Dollar ($).[37] The experiment consists of two parts. The first part of the experiment mimics a typical consultant assignment and captures participants' willingness to contribute to firm prospects. The second part of the experiment derives individual preferences concerning risk, time and losses as control variables.

In the first part of the experiment, participants assume the role of a consultant at a consulting firm. They are informed that the appointed time for an important Executive Board presentation at a high-profile client has been moved earlier such that the presentation will take place in 45 minutes. The presentation is based on the results of a performance analysis on the

[35] The experiment was administered in the participants' native language, German. To ensure language proficiency of Swiss participants, the pool of potential participants was filtered based on self-reported command of German and invitations to participate in the experiment explicitly indicated the language of administration.

[36] Business students have sufficient general knowledge to understand the experimental setting. We are confident that undergraduate participants do not impair the quality and generalizability of our study. Undergraduate business students can be considered a reasonable proxy for employees in our setting, as we are not aware of any theoretical reasons why loss aversion and the construal level effect will differ systematically between students and practising employees. Results in prior literature further support the use of student participants in behavioral accounting research (Peecher and Solomon 2001; Libby, Bloomfield, and Nelson 2002).

[37] The exchange rate for the experimental currency is $1=1/30 EUR for participants in Germany and $1=CHF 0.07 for participants in Switzerland. The difference in the exchange rate between the German and the Swiss experiment is used to achieve equivalent purchasing power parity.

client's product portfolio[38]. To visualize these results, participants are asked to prepare as many high-quality presentation slides as possible. Following prior literature, we thus model the multidimensional environment using a task that comprises two subdimensions, namely output quantity and output quality (e.g., Andrejkow et al. 2018; Christ et al. 2016; Förster et al. 2003; Kachelmeier, Reichert, and Williamson 2008).[39] Participants are informed that the presentation slides, which each contain a diagram, are important to ensure acquisition of a new high-profile client and hence to promote the consulting firm's prospects. They will receive additional performance-based compensation; the compensation structure varies across treatment groups. Participants then answer a set of comprehension check questions to ensure that they have fully understood the scenario and are aware of their respective compensation scheme.

Bonus recovery occurs when performance targets are not met. We focus on bonus recovery based on employees' performance, although in practice external reasons also result in underperformance. The experimental task is an adaptation of the effort-sensitive slider task developed by Gill and Prowse (2012). Choi, Clark, and Presslee (2018) find that the slider task is well suited for testing the effect of incentive compensation on performance. The slider task involves participants using the computer mouse to move sliders on scales to pre-specified values in order to prepare the required slides for their firm. To position a slider correctly, participants need to work with care and precision. The position of each slider can only be changed once; as soon as participants release hold of a slider by removing their finger from the mouse, they will not be able to move the slider to a different position. This slider task incorporates the possibility of failure, is effort-sensitive, and does not require specialized skill

[38] As we expect that in the deferred treatment, participants exert effort to support the firm's objective, it is important that the experimental task explicitly states how performing their tasks can benefit their firm. Hence, we design the experimental setting to provide participants with a sense of purpose by linking the slider task to the perspective of winning a new business for their consulting firm. Working as a consultant is among the most frequently stated aims of business students at German-speaking Universities. Hence, the consultancy setting is suitable for inducing a sense of purpose for the majority of participants.
[39] Similarly, multitask environments are typically operationalized using an experimental set-up comprising two tasks (e.g., Hannan et al. 2019).

or knowledge.[40] The values indicated by the position of the slider will then be displayed in diagrams on presentation slides.

Prior to preparing the required slides for their firm, participants practice the slider task on 10 sliders. This practicing period controls for widely documented learning effects in specialized, repetitive tasks (Staats and Gino 2012; Bohn 2005; Bohn and Lapré 2011).[41] After this practice round, participants have 45 minutes to complete as many high-quality presentation slides as possible to help their consulting firm win a new important business opportunity. Each presentation slide contains a diagram displaying information on 10 performance indicators. That is, for each presentation slide, a screen with 10 sliders appears. After this set of sliders, the subsequent screen shows the completed bar diagram, information on the time remaining, the number of correctly positioned sliders in the current presentation slide and the resulting effect on the participant's bonus payment. Throughout the experiment, participants are consistently provided with information on their accumulated bonus as well as the effect of their current performance on their total bonus. After 45 minutes, participants respond to the post-experimental questionnaire and two manipulation check questions that assess participants' understanding of their compensation scheme with respect to payment timing and bonus recovery provisions.

4.3.4 Independent Variables

While the compensation structure varies across treatments, participants in all conditions are informed that the minimum bonus for the first part of the experiment is $0, and that compensation earned during the experiment will be transferred to participants' bank accounts.

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[40] Participants are unlikely to possess highly varied skill levels for this task, compared to alternative real effort tasks frequently used in experimental research such as games of Sudoku (Williams, 2004). As a result, individual abilities and knowledge should not be significant determinants of performance. To further ensure that our results are not driven by differences in skills, we use participants' performance in the practice round as a control variable in our analyses.

[41] To ensure that the practice period is sufficiently long to control for learning effects, we rerun all our analyses after excluding the data from the first 30 and 40 sliders respectively. The results remain qualitatively the same.

The first independent variable is bonus timing. In the "bonus deferred" treatment, the payment of the reward is delayed by six months.[42] Participants in the bonus deferred treatment thus receive their compensation earned in the experimental task six months after the experiment. In the "bonus now" treatment, the bonus is transferred to participants' bank account immediately.[43]

The second independent variable is bonus recovery triggered by unsatisfactory output quality. In the "no bonus recovery" treatment, participants are rewarded based on correct slider solutions. Participants receive a variable payment of $2 for each successfully completed slider. Based on an average expected success rate of 83.23%, the expected payoff per screen is $16.65 (10 * $2 * 83.23%). Bonus recovery provisions in the "bonus recovery" treatment are tied to output quality. That is, incorrectly positioned sliders result in a deduction from the overall bonus earned such that participants can lose already earned bonuses. While it is not possible to hold the economic incentives per slider constant across the two bonus recovery manipulations[44], we designed the compensation scheme based on pretest results to ensure that the economic incentives are equivalent under both the no bonus recovery treatment and the bonus recovery treatment for a set quantity of sliders. This approach is similar to the experimental treatment in Oblak, Ličen, and Slapničar (2018) where payments per period differ but the overall payoff for a series of decisions is equal across treatment groups.[45] The payment per slider thus effectively

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[42] The reward does not earn interest during the deferral period. The literature on time discounting suggests that this may create economically different incentives to exert effort between the bonus deferred and the bonus now treatment (Stevenson 1986; Benzion, Rapoport, and Yagil 1989). Because individuals are present-biased and discount future payments, time discounting predicts lower effort when bonus payments are deferred. The effect of time discounting hence strengthens our results since deferred bonuses do not earn interest in our experiment which may impair the economic incentives to exert effort. However, we propose that the interest rate for a 6-month deferral is negligible given the current environment of low interest rates (European Central Bank 2019).

[43] As a result of regular banking processes, participants receive their bonus within two working days after the money is transferred to their account. The bonus now treatment thus incorporates a front-end delay, that reduces the impact of perceived differences between the bonus now and the bonus deferred treatment concerning transaction costs related to the delay (Denant-Boèmont, Diecidue, and l'Haridon 2017).

[44] In the no bonus recovery treatment, participants earn a bonus of $0 when they fail to set a slider correctly. Holding the economic incentives per slider constant across the two bonus recovery manipulations implies a bonus recovery of $0 in case of an incorrectly positioned slider. It would not allow us to implement losses of previously earned bonuses.

[45] In a pretest, seven students completed a total number of 1,300 slider tasks. Of the 1,300 slider tasks, 1,082 were completed successfully, resulting an average success rate of 83.23%. We further tested the robustness of this result

incorporates a risk premium in the recovery treatment. Our bonus recovery manipulation allows us to implement losses of previously earned bonuses and differs from previous research where performance-contingent bonus recoveries apply to noncontingent bonuses (e.g., Brink and Rankin 2013). Participants in the bonus recovery treatment receive \$2.40 for each correctly positioned slider. For each incorrectly positioned slider, participants' variable compensation is reduced by \$2.00. Based on an average expected success rate of 83.23%, the expected payoff per presentation slide is \$16.65 (10 * \$2.4 * 83.23% - 10 * \$2 * (100% - 83.23%)).

4.3.5 Dependent Variables

The dependent variable is participants' performance on the two-dimensional task. We examine output quantity (measured by the number of sliders attempted) and output quality (measured by the percentage of correctly positioned sliders) to determine the effects of bonus deferral and bonus recovery on two subdimensions of the task. Similar to the computerized ball-dragging task in Heyman and Ariely (2004), the slider task itself represents an uninteresting task.[46] The experimental instructions ask participants to complete *"as many high-quality presentation slides as possible"*, thus equally highlighting the importance of both the quantity and the quality of completed presentation slides.[47] During the 45-minute period allowed for preparing the presentation slides, participants face a trade-off between leisure and performing an uninteresting task that advances their firm's prospects and generates a variable bonus. Given a certain effort level, participants' focus on the two performance dimensions output quantity

with a modification of the slider task that facilitated correct slider positioning. 16 participants correctly positioned 4,425 sliders of a total number of 5,069 slider tasks (average success rate=87.30%). For the main experiment, we implemented the first version of the slider task and optimized the variable compensation of treatment groups based on the success rate of 83.23%. None of the participants in the pretest study participated in the main experiment.

[46] Several participants' statements confirm that the experimental task is tedious and cumbersome. Effort provision hence incurs a personal cost to participants because engaging in the slider task is not rewarding. This suggests that participants' effort provision is driven by the incentive structure.

[47] We are confident that the instructions did not imply that either output quantity or output quality were more important. Our procedure is similar to the experimental instructions for a task in Förster et al. (2003) that requires participants to connect numbered dots and examines participants' performance quantity and quality. Their instructions were "not to miss a dot […] and to get as much of the drawing done as possible within a period of 30s" (Förster et al. 2003, 152).

and output quality may differ. The number of attempted sliders (*QUANTITY*) captures participants' focus on output quantity, i.e. whether participants attempt to complete a larger number of presentation slides. Participants' success rate in the slider task (*QUALITY*) captures whether participants focus on creating high-quality presentation slides (i.e., output quality). On average, participants attempted 331.01 slider tasks, with an average success rate of 80.33% (see Table 1).

We also measure participants' overall task performance, based on the total number of sliders solved correctly (*PERFORMANCE*). Participants may achieve a certain number of sliders solved correctly by working on a large number of slider tasks with a low success rate or by working on a smaller number of slider tasks with a high success rate.

4.3.6 Other Measured Variables

We use the percentage of correctly solved sliders in the practice round as a proxy of participants' ability level in the slider task. This measure of participants' innate ability in the experimental task (*ABILITY*), which is then used as a control variable in our subsequent analyses. We also measure participants' loss aversion, as bonus recovery introduces the possibility of losing previously earned bonuses. Prospect theory suggests that loss aversion can cause managers to direct more effort towards quality and less effort towards quantity in an attempt of avoiding bonus recovery (Kahneman and Tversky 1979). We follow Abdellaoui, Bleichrodt, l'Haridon, and Paraschiv (2013) and use an incentive compatible procedure to derive measures of individual loss aversion. Based on participants' present equivalent for positive, negative and mixed delayed outcomes we calculate a measure of loss aversion *(LOSS*).

4.3.7 Regression Estimation

We use regression analyses to control for participants' *ABILITY*, *LOSS* as well as demographic characteristics in the analysis of the effect of bonus timing and bonus recovery on participants' performance on the slider task (see Table 4).[48] We also test each model without these control variables. We test the effects of the timing of bonus payments, bonus recovery and their interaction based on the dummy variables *TIMING* (0=bonus now; 1=bonus deferred) and *RECOVERY* (0=no bonus recovery; 1=bonus recovery). We use ordinary least squares regressions for the dependent variables *QUANTITY* and *PERFORMANCE*. To accommodate the fact that *QUALITY* is naturally limited to values between 0 and 1, we use TOBIT regressions for this dependent variable.

4.4 Results

4.4.1 Quality and Quantity Performance

We examine H1 to H3 based on two dependent variables: the number of sliders attempted (output quantity), and participants' success rate in the slider task (output quality). Table 1 shows descriptive statistics for these variables.

The first set of hypotheses predicts that deferring bonus payments motivates employees to perform their assigned tasks, resulting in higher quantity performance (H1a) and higher quality performance (H1b). Consistent with H1a, the regression analysis finds that the timing of bonus payments has a significant positive effect on output quantity (p=0.008; Table 2 panel A), with participants achieving higher output quantity in the bonus deferred treatment compared to the bonus now treatment (346.2 vs. 315.3; Table 1 panel B). Regarding H1b, regression results do not find a significant effect of the timing of bonus payments on output quality (p=0.175; Table 2 panel B). These results indicate that although bonus deferral does not refer to any specific task dimension, participants appear to distribute their higher efforts unevenly on

[48] The demographic control variables for each of the three dependent variables *QUANTITY*, *QUALITY*, and *PERFORMANCE*, were selected based on stepwise optimization. The demographic control variables are participants' gender (*GENDER*) in the analysis of *QUANTITY*, gender (*GENDER*) and age (*AGE*) in the analysis of *QUALITY*, and gender (*GENDER*), current employment status (*JOB*) and participants' interest in consultancy (*CONSULTING*) in the analysis of *PERFORMANCE*.

the two task dimensions when aiming to improve their performance. When employees can focus on improving output quantity or output quality, bonus deferral primarily encourages higher quantity performance. Evidence from participants' self-reported focus on working with precision indicates that participants' enhanced focus on output quantity might even occur at the expense of output quality: participants in the deferred bonus treatment self-reported significantly lower concern about output quality than participants in the bonus now treatment (bonus now vs. bonus deferred: 6.07 vs. 5.64, χ^2=6.983, p=0.008).

Our findings are consistent with cognitive research suggesting that individuals typically focus on one objective in settings where several objectives are present (Payne, Bettman, and Johnson 1993). Increasing effort towards output quantity may appear to be a superior strategy in the experimental task, thus explaining the unidimensional effect of bonus deferral. Participants can only attempt to solve each slider once; as such, they may perceive that higher efforts will increase output quantity but not necessarily output quality, leading to a greater focus on output quantity.[49]

H2a proposes that participants direct more effort towards the output dimension that triggers bonus recovery. Consistent with our expectation, the average output quality is significantly higher in the bonus recovery treatment compared to the no bonus recovery treatment (0.83 vs. 0.77; Table 1 panel C). More specifically, regression results show a significant positive effect of bonus recovery on output quality (p=0.029; Table 2 panel B), where output quality is significantly higher when participants' compensation is subject to a bonus recovery provision. These results provide support for H2a.[50]

[49] Open-ended responses in the post-experimental questionnaire suggest that participants perceived differences in the link between effort provision and quality compared to the link between effort provision and quantity. A number of participants commented on the fact that some sliders were easier to solve than others and one participant noted that during the experiment, his strategy shifted from attempting to solve each slider correctly to attempting many sliders.

[50] Two items from the post-experimental questionnaire provide further support for the effort-directing effect of bonus recovery provisions. Compared to participants in the no bonus recovery treatment, participants in the bonus recovery treatment self-reported significantly higher concern of failing in the slider task (no bonus recovery vs.

H2b posits that the effort-directing effect of bonus recovery provisions towards output dimensions that trigger bonus recovery comes at the cost of performance in the other task dimensions (i.e., output quantity). Our results show that output quantity is lower in the presence of a bonus recovery provision (296,89-335,53=-38,65; Table 1 panel B). The regression results indicate that this negative main effect of bonus recovery on output quantity is significant (-38,65; p=0.091; Table 2 panel A).[51] H2b is supported. H3a and H3b posit that the positive effects of bonus deferral on quantity performance and quality performance are lower when bonus deferral is combined with bonus recovery provisions. Consistent with H3a, we find that quantity is significantly higher in the no recovery group compared to the recovery group (385.2–306.12=79,08; t=3,38 (p=0.001)). The difference in output quantity between the bonus deferred and the bonus now treatment is larger in the no bonus recovery treatment (385.20–335.53=49.67) than in the bonus recovery treatment (306.12–296.89=9.23; Table 1 panel B). Based on a t-test, this difference (49.67-9.23=40.44) is significant at p=0.0164 (one-tailed). A regression analysis with controls finds a significantly negative interaction effect of bonus recovery and bonus deferral on output quantity (p=0.049 (one-tailed); Table 2 panel A). These results indicate that the positive effect of bonus deferral on output quantity is weaker when bonus deferral is combined with bonus recovery. H3a is supported.

With respect to H3b, we find that the difference between immediate and deferred bonus payments is similar between the no bonus recovery (0.79–0.76=0.03) and the bonus recovery treatment (0.85–0.81=0.04; Table 1 panel C). The regression analyses of output quality do not

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bonus recovery: 4.4 vs. 5.01, χ^2=8.940, p=0.003) and significantly higher focus on working with precision (no bonus recovery vs. bonus recovery: 5.57 vs. 6.17, χ^2=5.489, p=0.019).

[51] The remuneration scheme in the bonus recovery treatment was designed to ensure equal expected payoffs across treatment groups based on pretest results. Previous literature documents that individuals tend to overestimate their own abilities (e.g., Shelley 1994; Heath and Tversky 1991). If participants overestimate their success rate in the slider task, the perceived economic incentives to exert effort will be higher in the bonus recovery treatment compared to the no recovery treatment. While this alternative explanation would also predict a positive effect of bonus recovery on effort provision, it does not explain the directional effect of bonus recovery towards output quality. Instead, we would expect to find a positive effect of bonus recovery on output quantity. Hence we reject this alternative explanation.

show a significant interaction effect between bonus recovery and bonus deferral (*p*=0.893; Table 2 panel B). These findings extend the results to H1b and indicate that output quality remains the same under bonus deferral and combinations of bonus deferral and bonus recovery provisions.

4.4.2 Task Performance

H4a to H4c concern participants' overall task performance, measured by the total number of correctly solved sliders (see Table 1 for descriptive statistics). Table 3 panel A shows that overall task performance is higher when bonuses are deferred (265.2 vs. 255.5). The regression analysis using control variables finds a significant positive effect of bonus timing (*p*=0.053; Table 3 panel B), providing support for H4a. H4b examines the effect of bonus recovery on overall task performance. Table 3 panel A shows that task performance is lower in the bonus recovery treatment than in the no bonus recovery treatment (250.0 vs. 271.1). Regression results do not find a significant effect of bonus recovery on task performance (*p*=0.893; Table 3 Panel B). Consistent with H4c, the interaction between bonus recovery and bonus timing is weakly significant and negative in a regression analysis using control variables (*p*=0.092; Table 3 panel B). When we split the sample and test the effect of bonus recovery for the deferred and the nondeferred treatment group separately, we find further partial support for a negative interaction effect between bonus deferral and bonus recovery. More specifically, we find that bonus recovery has a significantly negative effect on performance when bonuses are deferred (*p*=0.027, Table 3 panel C), but not when they are paid immediately (*p*=0.841, Table 3 panel C). H4c is supported.

Overall performance is highest in the deferred no recovery treatment (283.9, Table 3 panel A). Participants achieved the lowest number of correctly solved sliders when bonus deferral is combined with bonus recovery (246.0, Table 3 panel A). Untabulated *t*-test results suggest that overall performance in the deferred/no recovery treatment is significantly different from overall performance in the other three treatment groups (*p*=0.027). Pairwise *t*-tests for the deferred/recovery treatment, the bonus now/no recovery treatment and the bonus now/recovery treatment do not find significant differences for overall performance (*p*=0.841, *p*=0.559, and *p*=0.669 respectively). These findings suggest that bonus deferral in the absence of bonus recovery provisions results in the highest overall performance by increasing participants' willingness to perform without restricting employees' freedom to allocate effort based on differences in returns to effort between task dimensions. These results suggest that combining bonus deferral and bonus recovery reduces overall task performance. The interaction effects of bonus deferral and bonus recovery on output quantity and output quality provide an explanation for this finding. We find that combining bonus deferral and bonus recovery provisions reduces quantity performance (H3a; see Table 2 panel A), while quality performance does not change (H3b; see Table 2 panel B). This results in lower overall task performance.

Overall, our results are largely consistent with diminishing returns to effort (Bailey and Fessler 2011). Combining bonus deferral and bonus recovery may further increase employees' willingness to provide effort in the output quality dimension. However, because bonus recovery provisions result in employees becoming overly concerned with output quality, the combination of the two reduces overall task performance.

4.4.3 Additional Analyses – The Role of Ability

We use the measure of participants' performance in the practice round to examine whether bonus recovery and bonus deferral affect participants' behavior differently, depending on their level of ability. We split our sample by the mean value of the percentage of correctly solved sliders in the practice round and rerun the analyses for two subsamples separately.

Low-ability participants have higher quantity performance in the bonus deferred treatment compared to the bonus now treatment (343.2 vs. 303.7) and higher quality performance in the bonus recovery treatment compared to the no recovery treatment (79.5% vs.

72.0%). For low-ability participants, we continue to find support for H1a (F(1, 57)=3.45, *p*=0.037), H2a (F(1, 57)=3.58, *p*=0.064), and H2b (F(1, 57)=9.35, *p*=0.003) based on untabulated ANOVA results, but not for H3a, H3b, and H4b. We also find marginal support for H4c, where bonus recovery has a marginally significant negative effect on overall task performance when bonuses are deferred (F(1, 31)=3.25, *p*=0.081), but not when they are paid immediately (F(1, 26)=0.00, *p*=0.996). Overall, our results for the low-ability subsample is generally consistent with our full sample.

In the high-ability subsample, output quantity is higher in the bonus deferred treatment compared to the bonus now treatment (349.1 vs. 323.7), and output quality is higher in the bonus recovery treatment compared to the no recovery treatment (86.2% vs. 81.6%). Untabulated ANOVA results support H2a (F(1, 71)=4.48, *p*=0.038), and 3a (F(1, 71)=4.58, *p*=0.036). There are no other significant results.

In summary, our additional analyses suggest that low-ability employees are more sensitive to the bonus deferral and recovery attributes of their incentive schemes.[52]

4.5 Conclusion and Discussion

In this study, we examine how compensation schemes that include bonus deferral and bonus recovery provisions impact on incentive problems concerning effort provision. We propose that bonus deferral encourages employees to act according to their responsibilities while bonus recovery provisions serve as an indication of (un)desirable behavior. That is, employees are more willing to provide costly effort to promote firm prospects when bonus payments are deferred, while bonus recovery provisions cause employees to direct effort towards performance dimensions that are linked to bonus recovery to avoid undesirable

[52] Our measure of participants' skill level in the slider task is based on the percentage of correctly solved sliders in the practice round. The practice round has no time constraints or incentives to do well. The proxy for participants' ability may thus capture an innate desire to excel and participants' concern over mistakes. A high concern over making mistakes is generally considered a subdimension of perfectionism (e.g., Frost, Marten, Lahart, and Rosenblate 1990), which may also explain the varied levels of performance in the practice round. Thus, our split sample results need to be interpreted with caution.

outcomes in these performance dimensions. Our results are largely consistent with these expectations. We find that bonus deferral results in a significant increase of quantity performance, while output quality remains unchanged. In contrast, bonus recovery significantly improves performance on output quality, but at the expense of significantly lower output quantity. Further, bonus recovery provisions encourage a stronger focus on monetary consequences of employees' behavior and counteract the positive effects of bonus deferral on employees' willingness to promote firm prospects. More specifically, employees appear to become overly concerned with output quality, the performance dimension that is linked to bonus recovery, such that bonus recovery results in inefficient effort allocation and ultimately causes a decline of overall task performance.

The management accounting literature has long acknowledged that bonus schemes can affect managers' and employees' willingness to work effectively towards maximizing the company's interests. In the aftermath of the global financial crisis, the catalyzing role of compensation schemes has been under even greater scrutiny and debate (e.g., Bhagat and Bolton 2014; Hitz and Müller-Bloch 2015; Kothari and Lester 2012). Designing a compensation scheme that reduces the impact of self-interested behavior is crucial to sustaining companies' performance. Our results indicate that individually, bonus deferral and bonus recovery are effective in aligning behavior with firm goals in settings where employees' behavior – in particular their effort – influence the probability of bonus recovery. Our study also extends prior research on the behavioral effects of bonus deferral primarily in investment decision-making (e.g., Cheng et al. 2019), by showing that bonus deferral encourages compliance with firm goals when role-congruent behavior requires the manager to exert effort. This finding is important because in practice, bonus deferral and recovery are tied not only to managerial misconduct, investment and accounting decisions, but can also be tied to performance driven by employees' effort exertion. However, our results further indicate that combining bonus deferral with bonus recovery provisions counteracts these positive behavioral effects of deferred bonus payments and may result in lower overall performance.

Our results also potentially speak to other multidimensional environments where employees need to weigh and consider several performance aspects, such as where employees are balancing short-term and long-term initiatives. In these settings, our findings suggest that bonus deferral enhances employees' willingness to act in the best interest of the firm while bonus recovery provisions highlight which aspects of a task are particularly relevant to the firm. To the extent that bonus recovery could be linked to long-term performance measures, our results indicate that bonus deferral and recovery may be effective in mitigating the problem of managerial myopia (e.g., Edmans et al. 2012).

We acknowledge a number of limitations in our study, which also provide future research avenues. We find that bonus deferral encourages managers to exert effort to increase output quantity and bonus recovery encourages managers to direct effort to output quality. However, the combined effect of bonus deferral and bonus recovery on overall performance depends on the task-specific relationship between output quality and output quantity to determine total performance. Hence, our results with respect to total performance should be interpreted with caution. In the specific task used in our experiment, a stronger emphasis on output quality naturally impedes the ability to achieve high output quantity. While this is commonly the case in single-unit tasks that require individual attention (e.g., recruiting processes, manual quality control), it is not necessarily the case when bulk production is possible. Alternatively, managers may develop strategies to improve output quality that do not negatively affect output quantity (e.g., computerized pre-screening of applicants, automated quality control). Prior literature further indicates that the trade-off between output quantity and output quality depends on task difficulty (Förster et al. 2003). Achieving high output quantity and high output quality simultaneously is possible for easy tasks when individuals focus on accomplishments (Förster et al. 2003). However, when individuals are concerned with potential losses, as is likely the case under bonus recovery provisions, individuals maximize output quality at the expense of output quantity as they focus on avoiding both easy and difficult mistakes. Future research may examine the influence of task difficulty on the effects of bonus recovery and bonus deferral to enable a better understanding of how bonus deferral and bonus recovery interact in multidimensional environments that allow for alternative approaches to solving the task.

In conclusion, our results show that individually, bonus deferral and bonus recovery are a potentially useful way to align employees' behavior with firm interests. However, combining bonus recovery with bonus deferral reduces the positive behavioral effects of bonus deferral and may result in lower performance. Our results thus represent one step towards a better understanding of the behavioral effects of a bonus bank approach to compensation.

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Table 1

Descriptive statistics of dependent variables[1]

Panel A: Descriptive statistics of dependent variables

Variable	N	Mean (standard deviation)	Median	Minimum	Maximum
QUANTITY[2]	136	331.01 (98.24)	315.0	156.0	600.0
QUALITY[3]	136	0.80 (0.13)	0.84	0.15	0.97
PERFORMANCE[4]	136	260.40 (70.11)	271.0	35.0	490.0

Panel B: Means (standard deviation) of the number of sliders attempted (*QUANTITY*)

		TIMING		TOTAL
		Bonus Now	**Bonus Deferred**	
RECOVERY	**No Bonus Recovery**	335.53 (104.72) N=32	385.20 (101.00) N=35	361.48 (105.03) N=67
	Bonus Recovery	296.89 (69.40) N=35	306.12 (93.28) N=34	301.43 (81.56) N=69
TOTAL		315.34 (89.50) N=67	346.23 (104.45) N=69	331.01 (98.24) N=136

Panel C: Means (standard deviation) of the percentage of correctly solved slider tasks (*QUALITY*)

		TIMING		TOTAL
		Bonus Now	**Bonus Deferred**	
RECOVERY	**No Bonus Recovery**	0.79 (0.14) N=32	0.76 (0.13) N=35	0.77 (0.14) N=67
	Bonus Recovery	0.85 (0.07) N=35	0.81 (0.16) N=34	0.83 (0.13) N=69
TOTAL		0.82 (0.12) N=67	0.79 (0.15) N=69	0.80 (0.13) N=136

[1] Results reported for participants who correctly answered the manipulation check questions (failure rate: 8.1%).
[2] Quantity reflects the number of sliders attempted.
[3] Quality reflects participants' success rate in the slider task.
[4] Performance reflects the number of sliders solved correctly.

Panel A shows the number of observations (N), means (standard deviations), median, minimum and maximum values of the dependent variables *QUANTITY*, *QUALITY*, and *PERFORMANCE*.

Panel B shows means (standard deviations) and the number of observations (N) of the dependent variable *QUANTITY* across the four treatment groups.

Panel C shows means (standard deviations) and the number of observations (N) of the dependent variable *QUALITY* across the four treatment groups.

Table 2

Regression Analysis for direct and indirect effects of TIMING and RECOVERY

Panel A: Linear regression results for dependent variable *QUANTITY*[1]

	Model 1: OLS for *QUANTITY* N = 136		**Model 2: OLS for *QUANTITY*** N = 132	
Variable	**Coefficient**	**p-value[2]**	**Coefficient**	**p-value[2]**
Constant	335.53***	0.000	292.95***	0.000
TIMING	49.67**	0.030	60.56***	0.008
RECOVERY	-38.65*	0.091	-29.09	0.196
TIMING * RECOVERY	-40.44	0.207	-51.62*	0.098
ABILITY[3]			-12.18	0.712
LOSS[4]			3.10***	0.003
GENDER[5]			57.98***	0.000
	Adj. R^2 10.70%	**VIF** 2.36	**Adj. R^2** 20.93%	**VIF** 1.75

Panel B: Tobit regression results for dependent variable *QUALITY*[1]

	Model 1: Tobit regression for *QUALITY* N = 136		Model 2: Tobit regression for *QUALITY* N = 132	
Variable	**Coefficient**	**p-value**[2]	**Coefficient**	**p-value**[2]
Constant	0.79***	0.000	0.52***	0.000
TIMING	-0.03	0.399	-0.04	0.175
RECOVERY	0.06**	0.050	0.07*	0.029
TIMING * RECOVERY	-0.01	0.747	0.01	0.893
ABILITY[3]			0.24***	0.000
GENDER[5]			-0.02	0.329
AGE[6]			0.01	0.145
	Pseudo R^2	**VIF**	**Pseudo R^2**	**VIF**
	-5.39%	2.36	-23.99%	1.78

TIMING – dummy variable (0=Bonus Now; 1=Bonus Deferred).
RECOVERY – dummy variable (0= No Recovery; 1=Bonus Recovery).

[1] Results reported for participants who correctly answered the manipulation check questions (failure rate: 8.1%).

[2] *p*-values for all paths are reported two-tailed.

[3] Measure of participants' performance in the practice round
[4] Measure of loss aversion over time for large immediate losses following Abdellaoui et al. (2013).
[5] Dummy variable measuring participants' gender, where 0 = female, 1 = male.
[6] Measure of participants' age.

* significance at 10%-level
** significance at 5%-level
*** significance at 1%-level

TABLE 3

Analyses of overall task performance[1]

Panel A: Means (standard deviation) of performance (the number of correctly solved slider tasks)

		TIMING		TOTAL
		Bonus Now	**Bonus Deferred**	
RECOVERY	**No Bonus Recovery**	257.25 (71.25) N=32	283.86 (51.49) N=35	271.15 (62.69) N=67
	Bonus Recovery	253.83 (67.64) N=35	245.97 (83.89) N=34	249.96 (75.62) N=69
TOTAL		255.46 (68.88) N=67	265.19 (71.45) N=69	260.40 (70.11) N=136

Panel B: Linear regression results for the number of correctly solved slider tasks (*PERFORMANCE*)

	Model 1: OLS for *PERFORMANCE* N = 136		**Model 2: OLS for *PERFORMANCE*** N = 132	
Variable	**Coefficient**	**p-value**[2]	**Coefficient**	**p-value**[2]
Constant	257.25***	0.000	194.46***	0.000
TIMING	26.61	0.119	31.19*	0.053
RECOVERY	-3.42	0.841	2.15	0.893
TIMING * RECOVERY	-34.47	0.15	-37.76*	0.092
ABILITY[3]			82.67***	0.001
LOSS[4]			1.28*	0.082
GENDER[5]			39.27***	0.001
JOB[6]			24.66**	0.030
CONSULTING[7]			-33.59	0.130
	Adj. R^2 2.07%	**VIF** 2.36	**Adj. R^2** 21.20%	**VIF** 1.59

Panel C: ANOVA model of the number of correctly solved slider tasks (*PERFORMANCE*) when splitting the sample by the timing of bonus payments[8]

TIMING		DF	MS	*F*	*p*-value
Bonus Now	**Recovery**	1	195.685	0.04	0.841
	Error	65	4814.600		
Bonus Deferred	**Recovery**	1	24755.294	5.14	0.027
	Error	67	4811.661		

TIMING – dummy variable (0=Bonus Now; 1=Bonus Deferred).
RECOVERY – dummy variable (0= No Recovery; 1=Bonus Recovery).

[1] Results reported for participants who correctly answered the manipulation check questions (failure rate: 8.1%).

[2] *p*-values for all paths are reported two-tailed.

[3] Measure of participants' performance in the practice round
[4] Measure of loss aversion over time for large immediate losses following Abdellaoui et al. (2013).
[5] Dummy variable measuring participants' gender, where 0 = female, 1 = male.
[6] Dummy variable capturing whether participants currently have a job, where 0 = no, 1 = yes.
[7] Item measuring participants' interest in consultancy, where lower values indicate higher interest.
[8] Untabulated results including a dummy variable for the location of the experimental session indicate that there is no statistically significant influence of the country the experiment was conducted in (Germany vs. Switzerland). The results remain qualitatively the same.

Panel A shows means (standard deviations) and the number of observations (N) of the dependent variable *PERFORMANCE* across the four treatment groups.

* significance at 10%-level
** significance at 5%-level
*** significance at 1%-level

5 Article IV: Behavioral Risk Taking Incentives under Uncertain Deferred Bonus Payments

Maria Assel

Abstract. I examine the impact of uncertain deferred bonus payments on managers' risk taking behavior. Bonus deferral and bonus recovery, that impose conditions for the payment of deferred bonuses, are important elements in modern incentive schemes designed to motivate managers to act in the best interest of the firm. Drawing on loss aversion, I propose that uncertain deferred bonus payments increase managers' willingness to expose their firm to excessive risk when previously awarded bonuses are at stake. I conduct a paper-and-pencil study to examine these propositions and find that risk taking increases in periods of substandard performance as managers attempt to achieve performance targets and receive a bonus. Uncertain deferred bonus payments encourage higher additional risk taking when a firm slogan increases awareness of moral values, while moral priming on average results in lower (additional) risk taking. Excessive risk taking depends on the interaction between the compensation scheme and individual loss aversion. My study contributes to the understanding of the incentive properties of uncertain deferred bonus payments by showing that bonus deferral and bonus recovery reverse the effect of moral priming.

Keywords: Managerial compensation, behavioral risk taking, deferred bonus payments, bonus recovery

Data availability: Data is available from the authors upon request.

JEL Codes: M40, M41

5.1 Introduction

While performance-contingent compensation is intended to align managers' objectives with long-term firm goals, inappropriate bonus schemes may encourage dysfunctional behavior at the expense of long-term firm stability (Lambert 2001 p. 5). Inappropriate remuneration schemes have been claimed to be one of the key drivers of the global financial crisis (CIMA 2010). Uncertain deferred bonus payments have been proposed as a remedy to mitigate dysfunctional behaviors and discourage managers from maximizing their current pay at the expense of shareholders' long-term interests (Chen, Greene, and Owers 2015; DeHaan, Hodge, and Shevlin 2013; Gillan and Nguyen 2016). Prior results on the effects of uncertain deferred bonus payments suggest that while these bonus schemes may be a tool to improve alignment between managerial behavior and firm interest *ex ante* (Cheng et al. 2019; Edmans et al. 2012; DeHaan, Hodge, and Shevlin 2013), unintended consequences may occur when managers have been awarded a bonus but ownership is still pending (e.g., Pyzoha 2015; Chan et al. 2012; Hartmann and Slapničar 2014). This study investigates whether managers' concern over losing previously awarded bonuses under uncertain deferred bonus payments increases their willingness to accept excessive risk at the cost of firm stability. I also examine whether the effect of uncertain deferred bonus payments on managers' risk taking behavior is moderated by managers' moral awareness.

Uncertain deferred bonus schemes defer bonuses to later periods and impose performance requirements for bonus payout (Brink and Rankin 2013; Hartmann and Slapničar 2014).[53] In case of substandard performance, a bonus recovery is debited against previously

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[53] Compensation schemes that combine bonus deferral with performance requirements for bonus payout are also frequently referred to as "bonus bank" schemes (e.g., Byrnes 2009; Bischof, Essex, and Furtaw 2010; O'Hanlon and Peasnell, 1998, 2002; Stewart 1991). In the U.S., uncertain deferred bonus payments are typically implemented as holdback or clawback provisions. Bonus banks and contracts with clawback provisions differ with respect to the timing of bonus payout. While bonus banks defer bonus payments and simultaneously transfer possession and ownership of bonuses to managers in a future period, managers receive their bonuses earlier under a contract with clawback provisions, but the firm retains the right to reclaim bonuses in case the manager fails to meet predetermined performance targets in the future. Bonuses are thus exposed to the risk of future performance under both bonus bank and contracts with clawback provisions. Although firms may use a multitude of performance

awarded bonuses. Since payout is conditional on meeting predetermined targets, bonuses awarded in one period are exposed to the risk of performance in future periods. In the aftermath of the global financial crisis, uncertain deferred bonus payments have received increasing attention in both public media and academic discussions as a mechanism to discourage managers from self-interested behavior (Bhagat and Bolton 2014; Bhagat and Romano 2009) and many financial and nonfinancial firms have implemented uncertain deferred bonus payments (e.g., Morgan Stanley, UBS, Credit Suisse, Metro). Especially in Europe and Australia, regulatory requirements for bonus deferral and bonus recovery contribute to the increasing use of uncertain deferred bonus payments.[54] Despite these developments, evidence on how these bonus schemes affect behavior remains limited, and tends to focus on the *ex ante* incentive properties of uncertain deferred bonuses (Edmans et al. 2012, Cheng et al. 2019). To date, it is not clear whether uncertain deferred bonus payments can mitigate managers' dysfunctional behavior over time, that is, when managers have been awarded a bonus but are still awaiting its payout. Examining the effects of uncertain deferred bonuses on risk taking behavior is important because excessive risk taking can contribute to firm failure and potentially cause market disruptions (Ferrarini and Ungureanu 2010; Lieder and Fischer 2011; Hitz and Müller-Bloch 2015; Bhagat and Bolton 2014; Bebchuk, Cohen, and Spamann 2010).

The current study examines the consequences of uncertain deferred bonus payments in a multi-period setting, where performance developments may jeopardize the payout of bonuses awarded in previous periods and managers can retain their bonus by accepting excessively risky investment projects. This setting allows me to examine the effect of uncertain deferred bonus payments on risk taking depending on performance outcomes. I draw on Prospect Theory (PT;

requirements, clawbacks are typically triggered by accounting misstatements (e.g. DeHaan, Hodge, and Shevlin 2013).

[54] In Europe and Australia, financial institutions are required to defer a substantial portion of variable remuneration to later periods (Directive 2010/76/EU; Banking Executive Accountability Regime Division 4 Part IIAA, BEAR). Additionally, recovery policies are mandatory for financial institutions in Australia (Australian Prudential Regulation Authority, 2018, p. 9) and listed companies in the US (Dodd-Frank Wall Street Reform and Consumer Protection Act, Section 954, Dodd-Frank).

Kahneman and Tversky 1979) to posit that uncertain deferred bonus payments influence managers' willingness to accept excessive risk. When managers feel entitled to a deferred bonus even if bonus payout is subject to meeting predetermined performance targets in future periods, they experience a loss in periods of substandard performance when they do not receive their bonus. Individuals are more willing to take risk in order to avoid incurring a loss (Kaustia 2010; Thaler and Johnson 1990). The prospect of losing a deferred bonus causes managers to focus on the performance target required to avert the loss. These cognitive distractions decrease the probability that managers recognize the moral implications of making an investment that threatens firm stability but provides the opportunity to receive a deferred bonus. Since the lack of ethical recognition facilitates immoral behavior (Mazar, Amir, and Ariely 2008; Murphy and Dacin 2011; Tsang 2002; Schweitzer, Ordóñez, and Douma 2004), I hypothesize that excessive risk taking will be higher under uncertain deferred bonus payments in periods of substandard performance. External cues can improve moral judgment by increasing decisions-makers' awareness of their moral standards (Aquino and Reed II 2002; Aquino et al. 2009; Bandura 2001; Welsh and Ordóñez 2014). I thus propose that priming moral standards causes managers to consider the moral conflict related to bonus maximization at the cost of accepting excessive risk. Moral priming will increase moral recognition and decrease excessive risk taking under uncertain deferred bonus payments.

I conduct a 2x2x2 between-subjects paper-and-pencil study to test my hypotheses. I manipulate performance (substandard vs. standard), compensation type (traditional vs. uncertain deferred), and priming (no priming vs. moral priming) and analyze managers' risk taking behavior in two periods. In the substandard performance condition, managers' risk taking behavior in the second period influences the probability of receiving their deferred bonus under uncertain deferred bonus payments. My results show that uncertain deferred bonuses increase managers' willingness to accept risk under particular conditions. More specifically, uncertain deferred bonus payments encourage managers to accept more additional risk in ongoing investment decisions when a firm slogan increases awareness of moral values. Conversely, in initial investment decisions, a firm slogan with moral content reduces extreme risk taking under uncertain deferred bonus payments. Excessive risk taking that threatens firm stability depends on the interaction between decision makers' individual degree of loss aversion and the design of the compensation scheme.

My findings contribute to prior literature in two main ways. First, my study speaks to the widely claimed need for discouraging dysfunctional behavior via the use of uncertain deferred bonus payments. However, extant literature has largely neglected the effect of these bonus schemes on managers' willingness to take risk. Managerial risk taking may pose a serious threat to the financial stability of the firm. I am aware of only two empirical analyses of the risk taking incentives of uncertain deferred bonus payments. Hodge and Winn (2012) examine managers' risk taking behavior in the context of financial reporting decisions and provide evidence suggesting that a bonus recovery can promote riskier reporting choices when managers do not feel responsible for the event that triggered the recovery. Hartmann and Slapničar (2014) find that uncertain deferred bonus payments induce pro-cyclical risk taking behavior by increasing the effect of prior investment outcomes in subsequent risk taking decisions. Prior literature has not examined dysfunctional behavior such as excessive risk taking. Hence, it is still unclear whether uncertain deferred bonus payments are an effective mechanism for improving firms' long-term prospects, or whether they in fact promote undesirable risk taking behavior.

Secondly, prior literature on the effect of uncertain deferred bonus payments has focused on the *ex ante* incentives provided by these bonus schemes and finds that uncertain deferred bonuses may be an effective tool for improving alignment between managers' and firms' interests (Edmans et al. 2012). More specifically, experimental evidence suggests that uncertain deferred bonus payments can mitigate underinvestment problems resulting from managerial myopia (Cheng et al. 2019) and direct employees' effort towards relevant performance dimensions (Assel et al. 2019). Consistent with these results, bonus recoveries that are triggered by accounting restatements have been found to improve reporting quality as intended by standard setters (e.g., DeHaan et al., 2013; Chan et al. 2012; Erkens, Gan, and Yurtoglu 2018; Chen et al. 2015). However, bonus payments under uncertain deferred bonus payments depend on current and past performance. Previous literature suggests that the effect of uncertain deferred bonus payments over time may deviate from the *ex ante* incentive properties of these bonus schemes because managers' concern over losing previously awarded bonuses affects their behavior. More specifically, managers have been found to oppose a proposed restatement (Pyzoha 2015) and to shift from accruals-based earnings management to real transaction management (Cohen, Dey, and Lys 2008) to avoid losing previously awarded bonuses. Additionally, managers demand higher pay levels to compensate for the risk inherent in these bonus schemes (Chen et al. 2015; DeHaan et al. 2013; Gillan and Nguyen 2016). Hodge and Winn (2012) examine *ex post* reactions to uncertain deferred bonus payments and find that losing previously awarded bonuses promotes riskier reporting choices when managers do not feel responsible for the event that triggered the bonus recovery. While these results suggest that managers may respond unfavorably to uncertain deferred bonus payments, it is to date not clear whether they will stop short of unethical behavior to prevent losing previously awarded bonuses. I complement this research by examining managers' willingness to accept excessive risk that provides the opportunity to achieve a performance target required for bonus payout but puts the financial stability of the firm at risk.

The paper is structured as follows. First, I outline the concept of uncertain deferred bonus payments in the context of diverging interests between managers and the firm and develop the hypotheses. This is followed by a discussion of the research method, the result analysis, and finally, conclusion and discussion.

5.2 Prior Literature and Hypotheses Development

5.2.1 Uncertain Deferred Bonus Payments and the Principal-Agent Problem

Uncertain deferred bonus schemes are special reward plans designed to reduce agency problems and align managerial behavior with shareholder interests (Chan et al. 2012; Chen et al. 2015). They comprise the design elements bonus deferral and bonus recovery provisions and are also often referred to as “bonus bank” schemes (e.g., Stewart 1991; Byrnes 2009; Bischof, Essex, and Furtaw 2010). Under uncertain deferred bonus schemes, bonuses based on positive (negative) performance are not paid out immediately but credited to an internal account. The manager receives the uncertain deferred bonus at a future date conditional on meeting predetermined targets. Actual bonus payments therefore depend on past and current performance and awarded bonuses are exposed to the risk of future performance. This mechanism aims to ensure that bonus payments are based on sustainable value creation (Bergstresser and Philippon 2006; Stewart 1991).

Previous literature suggests that uncertain deferred bonus payments align managerial incentives with firm objectives in purely rational economic frameworks (Edmans et al. 2012; Pfeiffer and Velthuis 2009; Schultze et al. 2019). Prior empirical evidence finds positive investor reactions to the voluntary adoption of uncertain deferred bonus payments (Iskandar-Datta and Jia 2013) and suggests that these incentive schemes provide benefits including higher perceived and actual reporting quality (e.g., DeHaan et al. 2011; Chan et al. 2012; Erkens et al. 2018; Chen et al. 2015) and increased long-term orientation (Cheng et al. 2019). However, these benefits may come at a cost due to the risk inherent in uncertain deferred bonus payments: executive may shift from accrual-based earnings management to real transactions management (Chan et al. 2015), demand a higher level of compensation and make riskier reporting choices (e.g., DeHaan, Hodge, and Shevlin 2013; Hodge and Winn 2012). Hartmann and Slapničar (2014) provide additional experimental evidence on the effect of uncertain deferred bonus payments on managerial risk taking. While they do not find an effect of uncertain deferred bonuses on risk taking *ex ante*, they find that these compensation schemes promote pro-cyclical risk taking in multi-period investment decisions by increasing the effect of prior investment outcomes in subsequent investment decisions.

These results provide first insights into the effect of uncertain deferred bonus payments on managers' willingness to accept risk and suggest that these compensation schemes may have unintended effects especially on risk taking behaviors (Hodge and Winn 2012; Hartmann and Slapničar 2014). However, it is to date unclear whether uncertain deferred bonus payments can effectively mitigate excessive risk taking. Drawing on Prospect Theory (PT; Kahneman and Tversky 1979), I propose that having "earned" but not yet received a bonus may encourage excessive risk taking.

5.2.2 Uncertain Deferred Bonus Payments and Risk Taking Incentives

Uncertain deferred bonus schemes provide rewards for good performance and result in a loss of performance-based bonuses awarded in previous periods when performance is below the target level (substandard performance). Thus, uncertain deferred bonuses are exposed to the risk of future performance and managers participate in both firm profit and firm losses (Bischof, Essex, and Furtaw 2010; Shlomo and Nguyen 2011).

Prospect Theory (PT; Kahneman and Tversky 1979) proposes that gains and losses trigger different reactions in individuals. More specifically, PT posits that individuals are loss averse, that is, that a loss of a certain amount relative to the decision maker's reference point causes greater emotional affect than an equivalent gain. Risk taking behavior depends on the individual's cognitive frame, that is, whether a situation is evaluated as a loss or a gain setting relative to the reference point (e.g., Xue, et al. 2011; Gneezy and Potters 1997). Perceptions of a loss domain have a stronger effect on behavior than perceptions of a gain domain (Cacioppo and Berntson 1994) and the former increases individuals' propensity to take risk (e.g., Oblak, Ličen, and Slapničar 2018; Thaler and Johnson 1990). When current performance is above the required target level, managers can expect to receive their deferred bonus. They will evaluate the situation as a gain domain. Conversely, performance below the target level creates a loss domain since managers cannot expect to receive a bonus. I hope to replicate prior findings and propose that performance below the target level will result in higher willingness to take risk compared to performance above the target level:

H1: In periods of substandard performance, managers' take more risk than in periods of standard performance.

Under uncertain deferred bonus payments, managers are likely to consider deferred bonuses as their possessions even if bonus payout is subject to predetermined conditions. Managers will thus perceive not receiving a deferred bonus as a loss of a previously "earned" bonus. Empirical evidence indicates that individuals anticipate aversive future losses (Imas et al. 2016; Jevons 1905; Loewenstein 1987; Frederickson and Waller 2005) and adapt their behavior in order to avoid incurring a loss (Hannan, Hoffman, and Moser 2005; Church, Libby, and Zhang 2008; Hong, Hossain, and List 2015; Hossain and List 2012). More specifically, individuals are risk seeking after experiencing a loss if accepting more risk provides the opportunity to set off the loss or turn it into a gain (Kaustia 2010; Thaler and Johnson 1990; Heath, Larrick, and Wu 1999).

When performance is below the target level, managers cannot expect to receive the deferred bonus under uncertain deferred bonus payments. I expect that managers will anticipate and experience a sense of loss in periods of substandard performance. Loss aversion implies that individuals are willing to accept more risk in order to avoid a loss than to receive a bonus. In line with these results, I expect to find higher risk taking under uncertain deferred bonus payments when current performance is below the target level but new, risky projects provide the opportunity to meet the performance benchmark.

H2: In periods of substandard performance, managers' take more risk under uncertain deferred bonus payments than under a traditional, economically equivalent bonus scheme.

5.2.3 Uncertain Deferred Bonus Payments and Excessive Risk Taking

Excessive risk taking that constitutes a fundamental danger to the financial stability of a firm is socially not desirable. Jones (1991) defines unethical behavior as any action "either illegal or morally unacceptable to the larger community" (p. 367). Individuals have an inherent need to see themselves as moral and ethical (Batson et al. 1999). When individuals face a choice between (i) unethical behavior to achieve superior payoffs and (ii) ethical behavior according to their internal moral standards, economic objectives and the human desire to see the self as moral create conflicting internal incentives. Individuals typically balance these desires to maintain a positive self-image (Mazar, Amir, and Ariely 2008). However, when a decision-maker does not realize the ethical implications of a choice set, the probability of unintentional breaches of moral standards increases (Tenbrunsel and Smith-Crowe 2008).

When a deferred bonus is at risk due to substandard performance and new investment projects provide the opportunity to receive the bonus at the cost of risking financial firm stability, managers face a trade-off between unethical behavior and forfeiting their bonus. Managers' would compromise their positive concept of self by accepting an excessively risky investment in order to ensure bonus payout. However, when managers do not recognize the ethical implications of excessive risk taking, an excessively risky investment does not compromise managers' positive self-image.

In periods of substandard performance, the looming loss of previously awarded bonuses is likely to cause managers to focus on the regret related to losing the bonus and the performance target required for averting this regret. Loss frames result in more unethical behavior than gain frames (Schweitzer, Ordoñez, and Douma 2004; Heath, Larrick, and Wu 1999). For example, individuals are more likely to lie and gather insider information when a setting is presented as a loss frame than a gain frame (Kern and Chugh 2009). Similar effects have been documented for professional tax preparers (Newberry, Reckers, and Wyndelts 1993) and sales agents (Kellaris, Boyle, and Dahlstrom 1994). Additionally, performance goals direct attention to goal achievement (Locke et al. 1981; Ariely et al. 2009) and create a distraction from moral issues (Ferrell and Gresham 1985; Jones 1991; Beilock et al. 2004; Beilock and Carr 2005). These distractions limit ethical recognition and impede the influence of moral values on individual behavior (Humphrey et al. 2004; Bersoff 1999), such that the probability of unethical behavior increases (Mazar, Amir, and Ariely 2008; Murphy and Dacin 2011; Tsang 2002; Schweitzer, Ordóñez, and Douma 2004). I propose that in periods of substandard performance, managers focus on the prospect of losing deferred bonuses and the performance target required for averting this loss. These considerations will occupy cognitive resources otherwise used to evaluate the ethical implications of their decisions. The resulting cognitive distractions thus reduce managers' awareness of the moral conflict between advancing self-interest and engaging in immoral behavior (Barsky 2008; O'Fallon and Butterfield 2005; Street et al. 2001; Welsh and Ordóñez 2014). As managers do not recognize the ethical implication of excessive risk taking, making an investment that ensures bonus payments at the risk of firm stability does not compromise their positive self-image.

I propose that the prospect of losing deferred bonuses causes managers to focus on the regret related to losing the bonus and the performance target required to avert the loss. As a result, managers are less likely to recognize the moral implications of making an investment that threatens firm stability but provides the opportunity to meet the performance target. Lacking ethical recognition facilitates excessive risk taking. Under uncertain deferred bonus payments, manager are thus more willing to take excessive risk in periods of substandard performance even if this behavior jeopardizes the financial stability of the firm. All else equal, I expect to find more excessive risk taking under uncertain deferred bonus payments in periods of substandard performance:

H3: In periods of substandard performance, excessive risk taking is greater under uncertain deferred bonus payments than under a traditional, economically equivalent bonus scheme.

5.2.4 Moral Priming and Excessive Risk Taking

Increased unethical behavior in settings were individuals fall short of achieving their goal has been attributed to automatic processes in ethical decision making (Chugh, Bazerman, and Banaji 2005; Greene and Haidt 2002; Haidt 2001; Greene et al. 2008). Consistent with this research, I propose that uncertain deferred bonus payments increase excessive risk taking in periods of substandard performance due to automatic processing of information relating to an investment decision that may provide personal benefits at the cost of threatening firm stability. As a result, managers are not aware of the moral implications of accepting this investment. Prior literature finds that explicit cues can increase cognitive engagement with a problem and prompt individuals to process all relevant information, such that ethical errors associated with automatic processing are less likely to occur (e.g., Stanovich and West 2002; Kern and Chugh 2009). Additionally, situational factors have been shown to influence the accessibility of one's moral identity (Aquino and Reed II 2002; Aquino et al. 2009; Bandura 2001). When external cues activate moral standards and draw decision-makers' attention to the ethical dimensions of their behavior, moral judgment improves and the likelihood of unethical behavior decreases (Welsh and Ordóñez 2014).

Firms can use language (e.g., slogans) to communicate goals and focus employee attention on different organizational values such as innovation (Honda – "Let's Gamble"), quality (Ford – "Quality is Job One"), and measurement (Dell – "If You Can't Measure it, You Can't Manage it"; Datar and Rajan 2018, Nonaka 1991, Thornberry 1997). Priming of ethical content has been shown to activate moral standards (Welsh and Ordóñez 2014). Prior literature finds that a firm slogan can act as a prime and alter individuals' behavior by drawing attention to the values communicated in the slogan (Thomas 2016; Stajkovic, Locke, and Blair 2006).

I propose that a firm slogan with ethical content will draw employees' attention to their moral standards. In the context of uncertain deferred bonus payments, priming moral standards via an ethical firm slogan will thus increase managers' awareness of the moral conflict related to bonus maximization at the cost of excessive risk and reduce unethical behavior due to automatic processing. Since managers desire to see themselves as moral and maintain a positive self-image, they are less likely to engage in excessive risk taking.

H4: In periods of substandard performance, priming moral standards reduces excessive risk taking.

5.3 Research Method

5.3.1 Research Design

I test my hypotheses using a 2x2x2 between-subjects experiment. The three independent variables are performance (substandard vs. standard), compensation type (traditional vs. uncertain deferred), and priming (no priming vs. moral priming). The primary dependent variable is managers' investment choice among a set of investment opportunities with different risk profiles.

5.3.2 Participants

212 graduate business students voluntarily participated in the paper-and-pencil experiment. Of these, 99 were enrolled in the business school of a large German university and 113 participants were business students at a large university in German-speaking Switzerland.[55]

[55] In Germany, the experiment was administered in the participants' native language, German. In Switzerland, the experiment was offered in German and English. Of the 113 participants at the Swiss university, 48 participants participated in the English sessions. Of these, three participants indicated English as their mother tongue, eleven participants specified German and 34 participants were native speakers in other languages. To ensure language proficiency of Swiss participants, the pool of potential participants for the German (English) sessions was filtered based on self-reported command of German (English) and invitations to participate in the experiment explicitly

On average, participants had attended 2.74 accounting classes (Germany: 2.36; Switzerland: 3.07) and 3.44 finance classes (Germany: 3.55; Switzerland: 3.35). Participants had worked in the industry for 3.01 years on average (Germany: 3.37; Switzerland: 2.68). Because of their business education, participants have sufficient general accounting knowledge to understand the experimental task. Hence, they are well suited for this study.[56] 60.85% of participants were male (Germany: 52.53%; Switzerland: 68.14%). The mean age was 24.40 years (Germany: 23.96; Switzerland: 24.78). To encourage participation, each participant was guaranteed 12 Euro (CHF 20) for participating in the experiment. Participants could earn additional compensation depending on their investment decision in the experiment. On average participant in Germany (Switzerland) earned a total of 19.65 Euro (CHF 27.79).

5.3.3 Experimental Task and Procedures

The experiment is conducted in an experimental lab using a paper-based questionnaire. Upon arrival, participants are randomly assigned to one of the work stations. They receive information about the experimental set-up and learn that they can earn performance-based compensation during the experiment. The compensation structure varies across treatment groups. The experimental currency is experimental dollar (EX$).[57]

The experimental task mimics a typical investment decision scenario, where a manager is considering several investment alternatives that may improve or reduce firm profit in the current year. Participants assume the role of a manager of PrimeInvest Firm who is responsible

indicated the language of administration. To ensure that the English instructions were equivalent to the German instructions, independent researchers translated the English instrument back to German. A comparison of the back translations with the German instrument did not reveal differences concerning the meaning of the instructions. The results remain inferentially the same if I include the language of the experimental instructions as an additional control variable. I am confident that the language of administration did not interfere with the hypothesized effects.

[56] I am not aware of any theoretical reasons why loss aversion and the effect of moral priming will differ systematically between graduate students and managers. Results in prior literature further support the use of student participants in behavioral accounting research (Peecher and Solomon 2001; Libby, Bloomfield and Nelson 2002). In particular, Liyanarachchi and Milne (2005) find that students are suitable surrogates for practitioners in the context of investment decisions.

[57] The exchange rate for the experimental currency is EX$ 10.000=1.00 Euro for participants in Germany and EX$ 10.000=CHF 1 for participants in Switzerland.

for the M&A activities of the firm. The experimental task comprises three business years. In the first business year, participants are provided with information on four investment opportunities A, B, C, and D, and asked to evaluate the investment alternatives B, C, and D.[58] The investment alternatives are displayed in Table 1 panel A. A number of questions test participants' understanding of the scenario.[59] Participants then make an investment decision and payments are made according to participants' compensation treatment.

In the second business year, participants learn about four new investment opportunities (Table 1 panel B) and expected firm earnings of PrimeInvest Firm. After these instructions, participants answer a number of questions that test their understanding of the scenario[60] and make an investment decision. This is followed by a manipulation check. The first manipulation check question refers to the requirement for being awarded a bonus and the second one to the timing of bonus payments. Participants in the substandard performance treatment receive two additional manipulation check question: the first refers to the implications of negative firm earnings, and the second to the effect of an unsuccessful M&A transaction on financial firm stability. 15 participants failed the manipulation check and their responses are excluded from

[58] For investment alternative A, the contribution to firm earnings in case of successful and unsuccessful completion of the M&A transaction, the resulting firm profit, expected firm profit, the return of the investment alternative in case of successful and unsuccessful completion of the M&A transaction, and the expected return values are provided. Participants can use these values as an example for calculating the respective measures for investment alternatives B, C, and D.
More specifically, participants are asked to calculate n.

[59] Participants are asked to complete a number of multiple choice questions relating to the impact of the M&A transaction on firm profit, the performance requirements for a bonus, whether their bonus is paid out at the end of the current fiscal year or at the end of the following fiscal year, whether the bonus payment depends on an increase of firm profit over the previous years' firm earnings or on a positive firm profit at the time of the bonus payout. In the moral priming treatment, an open ended question further requires participants to write down the firm's slogan. Participants can self-assess their answers on the following page. These questions are designed to ensure that participants have read the case material carefully before making their investment decisions.

[60] Participants are asked to complete a number of multiple choice questions relating to current firm equity, expected firm earnings, the impact of the M&A transaction on firm earnings, whether the bonus awarded in the current business year is paid out at the end of the current fiscal year or at the end of the following fiscal year, the performance requirements for earning a bonus in the current business year, and the performance requirement for a bonus payout in the current business year. Participants can self-assess their answers on the following page. These questions are designed to ensure that participants have read the case material carefully before making their investment decisions.

the analyses.[61] After completion of the manipulation checks, each participant throws a dice to determine the outcome of the selected M&A investment.

In the third business year, participants learn that they have been rotated to a different position in the firm, resulting in a change of the compensation structure. They answer a set of hypothetical questions to determine their attitude concerning losses. The experiment ends with a demographic questionnaire.

The four investment alternatives in the first business year are increasing in risk measured as the variance of returns, while the expected return on investment (ROI) is identical across all four investment alternatives. Expected returns and the variance of returns of the four investment alternatives in the second business year are identical to the investment alternatives in the first business year, while absolute cash flows differ.

5.3.4 Independent Variables

The first independent variable performance (substandard vs. standard) manipulates whether expected firm earnings of PrimeInvest Firm are above or below the zero line target level in the second business year. In the substandard performance treatment, PrimeInvest Firm is expecting to report a loss of EX$ 2m; in the standard performance treatment, expected firm earnings for the second business year are EX$ 15m.

[61] Of these, five participants are in the substandard performance/traditional bonus/no priming treatment and in the standard performance/uncertain deferred bonus/moral priming treatment respectively. The remaining 5 participants are distributed across the other six treatments. We use a multiple-sample multivariate test on means to examine whether the percentage of failures differs significantly between treatments. Wilks' lambda, Pillai's trace, Lawley-Hotelling trace and Roy's largest root all reject the null hypothesis of equal means between groups (p=0.0167 respectively). There are more manipulation check failures relating to the questions on the timing of bonus payments (6) compared to the requirement for earning a bonus (2). More participants responded incorrectly to the question on the effect of an unsuccessful M&A transaction on financial firm stability (5) compared to the question relating to the implications of negative firm earnings (1). The results remain inferentially the same if I include the responses of participants who failed the manipulation check in the analyses except for the compensation * lossaversion interaction effect on excessive risk taking in an ANOVA analysis. While the interaction effect is significant when I exclude manipulation check failures (p=0.027; Table 4 panel B), this effect is not significant anymore in an ANOVA analysis of all participants' responses (p=0.226). Similarly, the effect of the compensation treatment on extreme risk taking in the first business year becomes insignificant when responses by participants who failed to answer the manipulation check questions are included in the analysis (p=0.105; see Table 5 panel B).

The second independent variable is compensation type (traditional vs. uncertain deferred). In the traditional bonus treatment, participants immediately receive awarded bonuses. In the uncertain deferred bonus treatment, bonuses awarded in one business year are deferred for one year and payment is contingent upon performance in the following business year.

In the first business year, a bonus of EX$ 100,000 is awarded if participants choose an investment alternative with expected returns of at least 5%.[62] In the traditional bonus treatment, participants receive this bonus as a cash payment at the end of the first business year. In the uncertain deferred bonus treatment, participants' bonus is transferred to their bonus bank account and participants receive an account statement for the current value of their bonus bank.

In the second business year, participants are awarded a bonus of EX$ 100,000 if they choose an investment alternative with expected returns of at least 5%.[63] In the traditional bonus treatment, PrimeInvest Firm is additionally required to report nonnegative earnings at the end of the business year for participants to be awarded a bonus. Participants receive this bonus as a cash payment at the end of the second business year. In the uncertain deferred bonus treatment, the bonus is transferred to participants' bonus bank account to be disbursed to participants at the end of the third business year. Participants receive an account statement which states the current value of their bonus bank. Additionally, participants in the uncertain deferred bonus treatment receive the bonus awarded in the first business year as a cash payment, if PrimeInvest Firm reports nonnegative earnings. Otherwise, the bonus awarded in the first business year is forfeited.

In the third business year, participants in both compensation treatments earn a fixed compensation. The fixed compensation is EX$ 20,000 for participants in Germany and EX$

[62] Due to the design of the investment alternatives, participants meet this performance hurdle regardless of their investment choice.

[63] The design of the investment choices ensures that participants choose an investment alternative with expected returns of at least 5% regardless of their investment choice.

100,000 for participants in Switzerland.[64] In addition to the fixed payment, participants in the uncertain deferred bonus treatment receive their bonus on the bonus bank account.

Compensation in the second business year depends on PrimeInvest Firm's reported earnings at the end of the business year. In the standard performance condition, firm earnings are always nonnegative.[65] Hence, a bonus of EX$ 100,000 is distributed to each participant in the traditional bonus treatment, while in the uncertain deferred bonus treatment, participants receive the bonus awarded in the first business year. Additionally, they are awarded a new bonus of EX$ 100,000 that is deferred to the third business year. As a result, participants in Germany (Switzerland) earn a total amount of EX$ 220,000 (300,000) regardless of their investment decision in the standard performance condition.

In the substandard performance condition, total compensation depends on participants' investment decision in the second business year and the outcome of the M&A transaction. If participants choose M&A alternative G or H and the M&A transaction is successful, PrimeInvest Firm reports nonnegative earnings in the second business year. As a result, participants in the traditional bonus treatment receive a bonus payment of EX$ 100,000. Participants in the uncertain deferred bonus treatment receive the deferred bonus awarded in the first business year. Additionally, they are awarded a new bonus that is deferred to the third business year. Hence, total compensation is EX$ 220,000 (300,000) in Germany (Switzerland) in both the traditional and the uncertain deferred bonus treatment if participants choose M&A alternative G or H and the M&A transaction is successful. If participants choose M&A alternative E or F, or if they choose M&A alternative G or H and the transaction is not successful, PrimeInvest Firm reports negative earnings in the second business year. This results in a total compensation of EX$ 120,000 (200,000) in Germany (Switzerland) in both the

[64] The difference in the fixed amount between the German and the Swiss subsample is due to a significantly higher purchasing power parity in Switzerland.

[65] The lowest possible firm earnings in the standard performance condition are EX$ 3,270,000 when a participant selects M&A alternative H, and the M&A transaction fails (EX$ 15,000,000 – EX$ 4,600,000 – EX$ 7,130,000).

traditional and the uncertain deferred bonus treatment: In the traditional bonus treatment, participants' bonus for the second business year is EX$ 0. In the uncertain deferred bonus treatment, the first year's bonus is forfeited; participants receive a bonus payment of EX$ 0 and earn a new bonus that is deferred for payout in the third business year. Hence, in the substandard performance condition, EX$ 100,000 are at stake in the second business year in both compensation treatments and economic incentives to turn the expected loss for the second business year into a profit are the same between the traditional bonus treatment and the uncertain deferred bonus treatment.

The third independent variable is priming (moral priming vs. no priming). Following prior literature I use a firm slogan to morally prime participants (Thomas 2016). In the moral priming condition, a firm slogan is presented at the top right corner of each page of the experimental instructions. The slogan "The responsible company – Responsibility | Security | Future" (translated from German: "Verantwortung | Sicherheit | Zukunft") conveys firm values that are linked to moral concepts of integrity and responsibility. The slogan is used to increase participants' moral awareness and draw their attention to moral values. An open-ended question included in the comprehension check questions requires participants in the moral priming condition to write down the slogan. In the no priming condition, the firm slogan and the additional open-ended question in the comprehension check are absent.

5.3.5 Dependent Variables

I examine participants' investment decision to determine the effects of performance, compensation type and priming on risk taking. In the substandard performance condition, PrimeInvest Firm is expecting an overall loss of EX$ 2,000,000 and EX$ 100,000 are at stake in both compensation type treatments. Hence, participants in both the traditional bonus scheme and the uncertain deferred bonus scheme treatment have incentives to choose investment alternatives G or H. While both investment alternatives provide a chance of turning the expected loss for the second business year into a profit and receive an additional payment of EX$100,000, these two investment alternatives differ with respect to their risk profile. Alternative G provides a 50% chance of meeting the performance target, and a 50% chance of an additional loss of EX$ 1,610,000 (EX$ 4,600,000 – EX$ 2,990,000). Alternative H provides an 80% chance of meeting the performance target, and a 20% chance of an additional loss of EX$ 11,730,000 (EX$ 4,600,000 + EX$ 7,130,000). Firm equity is EX$ 10m. Thus alternative H puts the financial stability of PrimeInvest Firm at risk.[66] Participants investing in alternative G accept a risk of 16% measured as the variance of ROI, and participants investing in alternative H accept a risk of 169% (Table 1 panel B). Participants' investment decision in the first business year does not affect their compensation. The difference in variance of ROI between the investment alternatives selected in the first and second business year captures participants' willingness to accept additional risk in order to receive an additional payment of EX$100,000 (RISK). On average, the accepted risk in the second business year increased by 19.9% (Table 3 panel A) from 22.5% in the first business year (Table 2 panel C) to 42.4% in the second business year (Table 2 panel D).

I also measure the share of participants who choose investment alternative H (EXCESSRISK) to capture excessive risk taking. 44 participants (22.3%) chose investment alternative H in the second business year (see Table 2 panel A and panel B for a summary of participants' investment decisions).[67]

5.3.6 Other Measured Variables

I also measure the share of participants who chose investment alternative D (EXTREMERISK) because investment alternative D in the first business year is identical to

[66] In the substandard performance condition, one manipulation check question verifies that participants are aware of the effect of an unsuccessful M&A transaction with a loss of more than EX$ 10m on financial firm stability.

[67] Table 2 panel A and Table 2 panel C do not differentiate between the two performance manipulations, since participants receive information related to the performance manipulation after making the first investment decision. Hence, investment decisions in the first business year are not affected by participants' respective performance treatment.

investment alternative H in the second business year with respect to expected returns and the variance of returns. While investing in D does not threaten the financial stability of the firm, participants' investment decision in the first business year may influence their investment behavior in the second business year. Participants may for instance desire to maintain a persistent investment strategy, prompting a participant who chose investment alternative D in the first business year to invest in H in the second business year. Additionally, participants' decision to invest in D in the first business year may capture individual risk preferences that also impact on the investment decision in the second business year. In the first business year, a total of 24 participants (12.2%) chose investment alternative D (Table 5 panel A).

To assess the effect of the firm slogan on participants' awareness of their moral standards, I assess moral sensitivity related to the investment decision following Welsh and Ordoñez (2014). The measure of moral sensitivity is based on two items that focus on the role of moral values in participants' decision ("My decision was driven by business principles more than moral standards" and "I felt morally responsible to choose the option that I selected"). Participants responded to each of these two items on 7-point scales (anchored on -3 = "strongly disagree" and 3 = "strongly agree"). Since both of these items make explicit reference to ethical behavior, I measure moral sensitivity after the investment decision in the second business year, but not after the investment decision in the first business year. These two items are highly significantly correlated with a correlation coefficient of -0.45 (p=0.0000). ANOVA results indicate that across treatment groups, economic objectives were similarly important to participants' investment decisions as moral standards.

In periods of substandard performance, participants' deferred bonus is at risk under uncertain deferred bonus payments. Loss aversion implies that individuals are willing to accept more risk in order to meet the performance target and avoid losing previously awarded bonuses (Kaustia 2010; Thaler and Johnson 1990; Heath, Larrick, and Wu 1999). Participants' individual degree of loss aversion affects the strength of the incentives related to the compensation manipulation in periods of substandard performance (Kahneman and Tversky 1979). I follow prior literature to measure participants' attitude concerning losses based on six hypothetical lotteries. Each lottery provides a 50% chance of winning EX$ 6,000 and a 50% chance of losing an amount that increases from EX$ 1,000 to EX$ 6,000 in increments of EX$ 1,000 (Gächter, Johnson, and Hermann 2007; Carr and Steele 2010). For each of these lotteries, participants indicate whether they are willing to play. I use the number of rejected lotteries as the measure of loss aversion. Loss aversion does not differ significantly between treatment groups, language of the experimental instrument, and location of the experiment (Germany vs. Switzerland), except that participants in the traditional bonus manipulation are significantly more sensitive to losses that participants in the uncertain deferred bonus manipulation (3.13 vs. 2.92; p=0.0551) according to a Mann-Whitney-U-Test.

Participants responded to a demographic questionnaire at the end of the experiment.

5.4 Results

5.4.1 Risk Taking

I test the effect of performance, compensation type, and priming on risk taking based on the dummy variables PERFORMANCE (0=substandard performance; 1=standard performance), COMPENSATION (0=traditional bonus payments; 1=uncertain deferred bonus payments), and PRIMING (0=no priming; 1=moral priming). I use additional risk taking in the second business year compared to participants' risk taking in the first business year (RISK) to examine hypotheses H1 and H2. Table 3 panel A shows means (standard deviations) of this variable across the eight treatment groups. Mean values are graphically depicted in Figure 2. The analyses of hypotheses H3 and H4 is based on the dummy variable EXCESSRISK that captures whether participants accept excessive risk that poses a threat to the financial stability of the firm (0=investment in investment alternative E, F, or G; 1= investment in investment alternative H). Table 4 panel A shows means (standard deviations) of this variable across the eight treatment groups. Mean values are graphically depicted in Figure 4.

H1 proposes that risk taking is higher when performance is below the target level. Consistent with this proposition, an ANOVA analysis finds that firm performance has a significant impact on the change in participants' risk taking (p=0.000; Table 3 panel B). Figure 2 shows that across compensation and priming manipulations, additional risk taking in the substandard performance treatment is higher than in the standard performance treatment (40.4% vs. -1.2%; Table 3 panel A). Participants are willing to accept significantly more risk when performance is below the target level. The average variance of ROI is 42.4%. In the substandard treatment, the average variance is 64.3% compared to 19.9% in the standard performance treatment (Table 2 panel D). H1 is supported.

H2 proposes that uncertain deferred bonus payments induce higher risk taking in periods of substandard performance. While I do not find a statistically significant impact of compensation on the change in risk taking in an ANOVA analysis (p=0.440; Table 3 panel B), the combined effect of compensation and priming is significant (p=0.044; Table 3 panel B). When moral priming is absent, the change in accepted risk levels is smaller in the uncertain deferred bonus treatment compared to the traditional bonus treatment when performance is below the target level (19.9% vs. 58.1%; Table 3 panel A), and participants choose less risky investment alternatives (63.7% vs. 84.4%; Table 2 panel D). When performance is above the target level and moral priming is absent, risk taking decreases in the uncertain deferred bonus treatment, while risk taking increases marginally in the traditional bonus treatment (-8.5% vs. 1.4%; Table 3 panel A). Given moral priming, risk taking increases more strongly in the uncertain deferred bonus treatment than in the traditional bonus treatment both when performance is below (46.9% vs. 37.8%; Table 3 panel A) and above the performance target (5.7% vs. -4.3%; Table 3 panel A) and participants make riskier investments in the uncertain deferred bonus treatment compared to the traditional bonus treatment in the substandard (61.3% vs. 52.2%; Table 2 panel D) and the standard performance condition (29.9% vs. 16.6%; Table 2 panel D). This pattern provides partial support to H2.

Under uncertain deferred bonus payments, participants' deferred bonus is at risk in periods of substandard performance. I propose that loss aversion induces higher risk taking in order to meet the performance benchmark and avoid losing previously awarded bonuses. The decision maker's degree of loss aversion affects the strength of this effect. ANOVA results show that loss aversion has a significant impact on the change in accepted variance (p=0.034; Table 3 panel B). To control for the effect of loss aversion as well as a performance * loss aversion interaction I use ordinary least squares regressions in addition to ANOVA analyses (see Table 3 panel C).[68]

Consistent with H1, the regression analyses of the change in accepted variance of ROI finds a significant negative effect of performance on the change in accepted risk. Consistent with the ANOVA analyses, this finding indicates significantly lower (higher) additional risk taking when performance is above (below) the target level (p=0.002; Table 3 panel C).

The effect of uncertain deferred bonuses is significant and negative in the regression model (p=0.066; Table 3 panel C). I further find a significant positive compensation * priming interaction effect (p= 0.062; Table 3 panel C). Overall, this implies a negative effect of uncertain deferred bonus payments when priming is absent (-0.28; Table 3 panel C) and a positive effect of uncertain deferred bonus payments when priming is present (-0.28+0.38=0.10; Table 3 panel C). The combined effect of traditional bonus payments and priming is zero (Table 3 panel C). Figure 3 graphically displays the regression results for the effect of performance, compensation, and priming on additional risk taking. The diagram shows that uncertain deferred bonus

[68] To control for the effectiveness of the priming manipulation, I also test a second regression model including the self-reported relevance of business objectives and perceived moral responsibility. The results remain inferentially the same, except that the effect of uncertain deferred bonuses becomes marginally insignificant (p=0.102).

payments can induce higher risk taking in settings when moral priming increases awareness of moral values. This provides partial support to H2.

5.4.2 Excessive Risk Taking

H3 proposes that uncertain deferred bonus payments induce more excessive risk taking in periods of substandard performance than traditional bonus payments. Consistent with H1, ANOVA analyses find that excessive risk taking is significantly higher when performance is below the target level compared to the standard performance manipulation (34.0% vs. 10.3%; *p*=0.000; Table 4 panel A, panel B and panel C). Excessive risk taking is higher under uncertain deferred than under traditional bonus payments (25.8% vs. 19%, Table 4 panel A). This effect is not statistically significant in an ANOVA analysis (Table 4 panel B and panel C). Figure 4 shows that participants with uncertain deferred bonus payments more frequently accept excessive risk compared to participants with traditional bonus payments when performance is above the target level (17.8% vs. 3.9%; Table 4 panel A). When performance is below the target level, the effect of uncertain deferred bonus payments on excessive risk taking depends on moral priming, but the compensation * priming interaction effect is not significant in an ANOVA analysis (*p*=0.238; Table 4 panel B). Consistent with the mediating effect of loss aversion on the incentives for higher risk taking, I find a significant compensation * loss aversion interaction (*p*=0.027; Table 4 panel C). These results provide partial support for H3.

Figure 4 shows that when performance is below the target level, the difference between excessive risk taking after moral priming compared to the no priming condition is larger for traditional bonus payments (47.6%-25.9%=21.7%; Table 4 panel A) compared to uncertain deferred bonus payments (33.3%-32.1%=1.2%; Table 4 panel A). Similarly, excessive risk taking is lower in the moral priming/uncertain deferred bonus treatment compared to the no priming/uncertain deferred bonus treatment when performance is above the target level (19.1% vs. 16.7%; Table 4 panel A). In contrast, when incentives are based on traditional bonus payments and performance is above the target level, excessive risk taking is higher when moral priming is present compared to a setting without moral priming (7.7% vs. 0.0%; Table 4 panel A). An ANOVA analysis does not find a significant compensation * priming interaction effect (p=0.24; Table 4 panel B). This suggests that moral priming does not reduce the incentives of uncertain deferred bonus payments to accept excessive risk. H4 is not supported.

ANOVA results indicate that the effect of uncertain deferred bonus payments is moderated by individual loss aversion. I use a probit model in addition to ANOVA analyses to examine how loss aversion influences the propensity to accept excessive risk under uncertain deferred bonus payments (see Table 4 panel D). I distinguish between low, medium, and high loss aversion. The regression analysis further includes a control variable that captures whether participants chose investment alternative D in the first business year (EXTREMERISK). EXTREMERISK reflects individual risk preferences when participants' compensation is not contingent on investment outcomes.

Consistent with ANOVA results, the regression analysis of individuals' propensity to accept excessive risk finds a significant negative effect of performance. The findings support H1 and indicate that individuals are significantly less (more) likely to accept excessively risky investment projects when performance is above (below) the target level (p=0.000; Table 4 panel D). I further find a significant negative effect of medium loss aversion (p=0.009; Table 4 panel D) and a significant positive compensation * loss aversion interaction effect when loss aversion is at the medium level (p=0.012; Table 4 panel D). Overall, this implies a negative effect of medium loss aversion on individuals' propensity to accept excessive risk under traditional bonus payments (-1.13; Table 4 panel D) and a positive effect of medium loss aversion under uncertain deferred bonus payments (-1.13+1.41=0.28; Table 4 panel D). These results indicate that uncertain deferred bonus payments can increase the probability of excessive risk taking when decision makers are characterized by a medium degree of loss aversion. This provides partial support to H3. The regression results do not find a significant effect of priming. H4 is not supported.

5.4.3 Additional Analysis: Extreme Risk Taking in Initial Investment Decisions

Previous research suggests that uncertain deferred bonus payments influence risk taking in multi-period settings. More specifically, Hartmann and Slapnicar (2014) find that initial risk taking behavior is not affected by uncertain deferred bonus payments while these compensation schemes induce managers to take on more risk after a gain while a loss in the previous period induces lower risk taking in subsequent investment decisions (Hartmann and Slapnicar 2014). To analyze the effect of uncertain deferred bonus payments on initial risk taking behavior, I also measure the share of participants who chose investment alternative D in the first business year (EXTREMERISK). EXTREMERISK captures whether participants invest in an investment alternative with extreme variance of returns compared to other available investment options that have identical expected returns and lower variance of returns in initial investment decisions when participants' compensation is not contingent on investment outcomes.

An ANOVA analysis finds that the percentage of high-risk investments is significantly higher under uncertain deferred than under traditional bonus payments (16.5% vs. 8.0%; p=0.090; Table 5 panel A and panel B). These results are broadly consistent with H2 and suggest that uncertain deferred bonus payments may affect risk taking behavior even in settings when the risk associated with an investment alternative does not affect compensation. I further find that fewer participants accept extreme risk under moral priming compared to the treatment when moral priming was absent (15.2% vs. 9.5%; Table 5 panel A). ANOVA results find that the priming effect is statistically significant (p=0.040; Table 5 panel B) and suggest that moral priming may be an effective tool for reducing high-risk investments. More specifically, the difference between extreme risk taking in the absence of moral priming compared to extreme risk taking in the presence of moral priming is positive when participants' incentives derive from uncertain deferred bonus payments (9.6%-24.4%=-14.8%; Table 5 panel A), while it is negative under traditional bonuses (9.4%-6.4%=3.0%; Table 5 panel A). The effect of moral priming on risk taking thus depends on the compensation scheme: moral priming reduces extreme risk taking under uncertain deferred bonus payments and increases extreme risk taking under traditional bonus payments. An ANOVA analysis finds a significant compensation * priming interaction effect (p=0.025; Table 5 panel B) and indicates that this pattern is statistically significant. These results provide general support for H4.

In addition to ANOVA analyses, I also use a probit model to examine individuals' investment decision in the first business year (see Table 5 panel C). Consistent with ANOVA results, the regression analysis finds a significant positive effect of compensation type (p=0.031; Table 5 panel C). This provides support to H2 and suggests that extreme risk taking in the first business year is more likely under uncertain deferred than under traditional bonus payments. There are no other significant main or interaction effects.

5.5 Conclusion and Discussion

Compensation schemes that align managerial risk taking with the risk appetite of the firm are an effective tool for promoting firm prospects. In particular, preventing excessive risk taking is crucial to sustaining companies' long-term financial stability and preventing future crises. In this study, I examine managerial risk taking under uncertain deferred bonus payments and find that under certain conditions these compensation schemes result in higher risk taking. Increasing moral awareness is not an effective tool to curb risk taking in ongoing investments under uncertain deferred bonus payments.

Most prior research on the effect of uncertain deferred bonus payments focuses on *ex ante* incentives (Edmans et al. 2012; Cheng et al. 2019). The literature finds that these compensation schemes improve alignment between managers' and firms' objectives (Edmans et al. 2012) and increase managers' willingness to make a long-term investment despite potential negative effects on current bonuses (Cheng et al. 2019). However, managers typically make a series of investment decisions in a sequence of multiple periods and investment outcomes of previous investments may influence an investment decision in the current period. My study thus complements prior research by examining the effect of uncertain deferred bonus payments on risk taking in a multi-period setting. Under uncertain deferred bonus payments, payout of bonuses awarded in one period is deferred to future periods and conditional on meeting certain performance targets in the future. I draw on loss aversion and hypothesize that uncertain deferred bonus payments induce excessive risk taking when previously awarded bonuses are at stake and accepting excessive risk provides the possibility to retain these bonuses. I further examine whether moral priming can mitigate the proposed effect of uncertain deferred bonus payments on managers' willingness to accept excessive risk that imposes a threat to the financial stability of the firm in order to salvage bonuses awarded in previous periods.

While the findings show that (excessive) risk taking as well as the change in risk taking is higher when performance is below a target level, I do not find more (excessive) risk taking under uncertain deferred bonus payments in general. This suggests that the prospect of losing previously awarded bonuses under uncertain deferred bonus payments is akin to the prospect of not receiving an annual bonus under traditional compensation schemes, causing a similar increase in managers' willingness to accept (excessive) risk in order to achieve a performance target. Two explanations may potentially explain this result. Firstly, if a traditional compensation scheme has led to a consistent stream of bonus payments over the previous periods, managers may form an expectation of receiving a bonus payment in the next period. Prior literature suggests that individuals evaluate outcomes as gains or losses based on their expectations (Kahneman and Tversky 1979; Tetlock and Mellders 2002). Hence, the prospect of not receiving a bonus may cause managers under traditional bonus payments to experience a similar sense of loss as a manager under uncertain deferred bonus payments who cannot expect to receive previously awarded bonuses. Secondly, managers may not consider uncertain deferred bonuses as their possessions when bonus payout is subject to predetermined conditions. Previous research suggests that in contrast to consumption goods, evaluations of exchange goods such as money do not depend on ownership (Svirsky 2014; Kahneman et al. 1990; Novemsky and Kahneman 2005; Bateman et al. 2005). As a result, managers' risk taking in periods of underperformance may be driven by the economic desire to increase wealth regardless of the compensation scheme design.

The findings further show that uncertain deferred bonus payments have a positive effect on the propensity to accept excessive risk when individuals are characterized by a medium level of loss aversion. Additionally, risk taking is higher under uncertain deferred bonus payments relative to traditional bonus payments in initial investment decisions. While I find that performance below the target level induces higher risk taking regardless of the design of the compensation scheme when managers' bonuses are tied to firm performance, this result indicates that uncertain deferred bonus payments may have adverse effects and increase extreme risk taking in periods when compensation is not contingent on investment outcomes. The effect of uncertain deferred bonus payments on risk taking in initial investment decisions is moderated by moral priming: moral priming reduces extreme risk taking under uncertain deferred bonus payments and increases extreme risk taking under traditional bonus payments. In subsequent periods when previously awarded bonuses are due for payout, moral priming leads to higher additional risk taking under uncertain deferred bonus payments compared to traditional bonus payments. I propose that the positive effect of uncertain deferred compensation schemes on risk taking in initial investment decisions is driven by managers' stronger focus on firm objectives. Although excessive risk taking poses a threat to firm stability, long-term firm success crucially depends on the effectiveness of incentive schemes in addressing managers' risk aversion and promoting (moderately) risky investments (Gray and Cannella 1997; Beatty and Zajac 1994; Amihud and Lev 1981; Mishra et al. 2000; Young

1985). In the operationalization of uncertain deferred bonus payments, participants are awarded a bonus in the first business year that is deferred for payout in the second business year. Hence, investment incentives in the first business year derive from deferred bonuses and potential losses of previously awarded bonuses become relevant but in the second business year. Previous research finds that bonus deferral encourages managers to focus on their responsibilities (Cheng et al. 2019). Uncertain deferred bonus payments may thus initially increase risk taking by encouraging a stronger emphasis on firm objectives rather than personal interests, such that the influence of managers' risk aversion and the lack of (short-term) personal benefits from risk taking diminishes. In this setting, the firm slogan may have led to lower risk taking by communicating security as an organizational value. Managers, who are concerned with adhering to firm expectations due to deferred bonus payments, thus likely adjusted their investment behavior and accepted lower risk. In subsequent investment decisions, I find that moral priming in turn leads to higher additional risk taking under uncertain deferred bonus payments. I propose that moral priming reminds managers of their responsibility towards the firm, more specifically, their responsibility to foster long-term firm prospects through accepting moderately risky (albeit not excessively risky) investments. As managers under uncertain deferred bonus payments thus consider both firm objectives and self-interested motives related to their incentive pay when making the investment decision, risk taking increases.

This project contributes to the debate on effective managerial compensation and provides a nuanced understanding of the effect of uncertain deferred bonus payments on managers' risk taking behavior in ongoing investment decisions. In view of regulatory requirements for uncertain deferred remuneration schemes, I draw on theories from psychology and examine whether uncertain deferred bonus payments promote excessive risk taking or whether they are indeed effective in preventing future crises as envisaged by regulators. I provide evidence that such compensation schemes do not trigger excessive risk taking even in periods when unsatisfactory performance jeopardizes previously awarded bonuses.

I acknowledge a number of limitations in my study, which also provide several future research avenues. First, the experimental test of the effects of uncertain deferred bonus payments does not account for the influence of individual degrees of impatience and differing consumption preferences. Under traditional bonus payments, managers receive their bonuses earlier than under uncertain deferred bonus payments. In my experiment, the first bonus payment occurs at the end of the first (second) business year in the traditional (uncertain deferred) bonus treatment. Since the experiment was administered in one multi-period experimental session and participants did not have the opportunity to spend money between periods, managers' liquidity needs and refinancing possibilities did not affect managers' investment decisions. Future research could examine how individual time and consumption preferences impact the incentive properties of uncertain deferred bonus payments compared with traditional incentive schemes.

Second, I find that the occurrence of excessive risk taking is similar under uncertain deferred bonus payments compared to traditional bonus payments and propose two alternative explanations for this result: Under traditional bonus payments, managers may also have behavioral incentives to accept additional risk since they experience a similar sense of loss as managers under uncertain deferred bonus payments when they cannot expect to receive a bonus. On the other hand, under both traditional and uncertain deferred bonus payments risk taking may be driven by purely economic considerations if managers do not consider previously awarded bonuses as their possessions. My study does not allow me to conclude which of the two explanations is driving the results. Future research can examine whether risk taking behavior under uncertain deferred as well as traditional bonus payments is based on similar economic or alternatively similar behavioral motives.

Third, my study examines the effect of uncertain deferred bonus payments when external events impact on performance levels. That is, the performance level in the second business year is unrelated to managers' initial investment decision. In contrast, when performance outcomes depend on managers' investments in previous periods, additional information on effective behavior is available. The design of the compensation scheme may influence how managers process this information and adjust their investment behavior. Further research can examine whether uncertain deferred bonus payments facilitate learning and strategy development by linking bonus payments to past and current performance.

In conclusion, my results indicate that uncertain deferred bonus payments generally do not promote excessive risk taking behavior in periods of substandard performance, but increase risk taking in initial investment decisions. Priming moral values decreases initial risk taking under uncertain deferred bonus payments and increases additional risk taking in subsequent investment decisions. I thus contribute to a better understanding of risk taking incentives of a bonus bank and show that it is important for firms to consider the set of incentives under which a manager is managing when introducing uncertain deferred bonus payments since these compensation schemes may reverse the effect of other elements of the incentive set.

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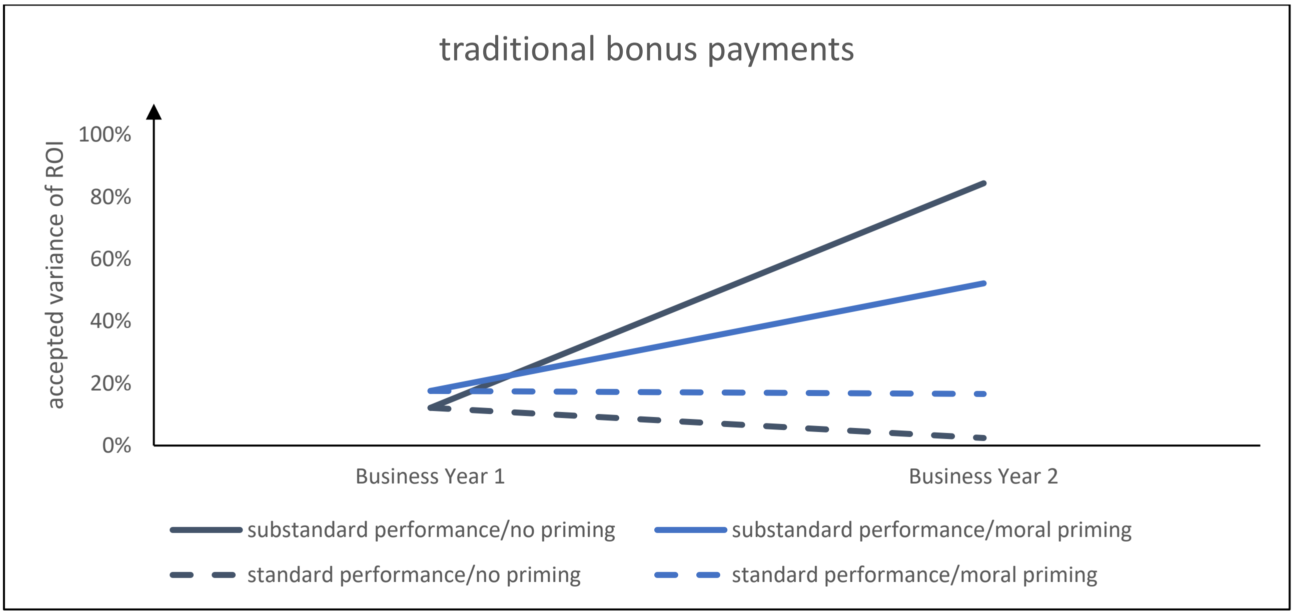
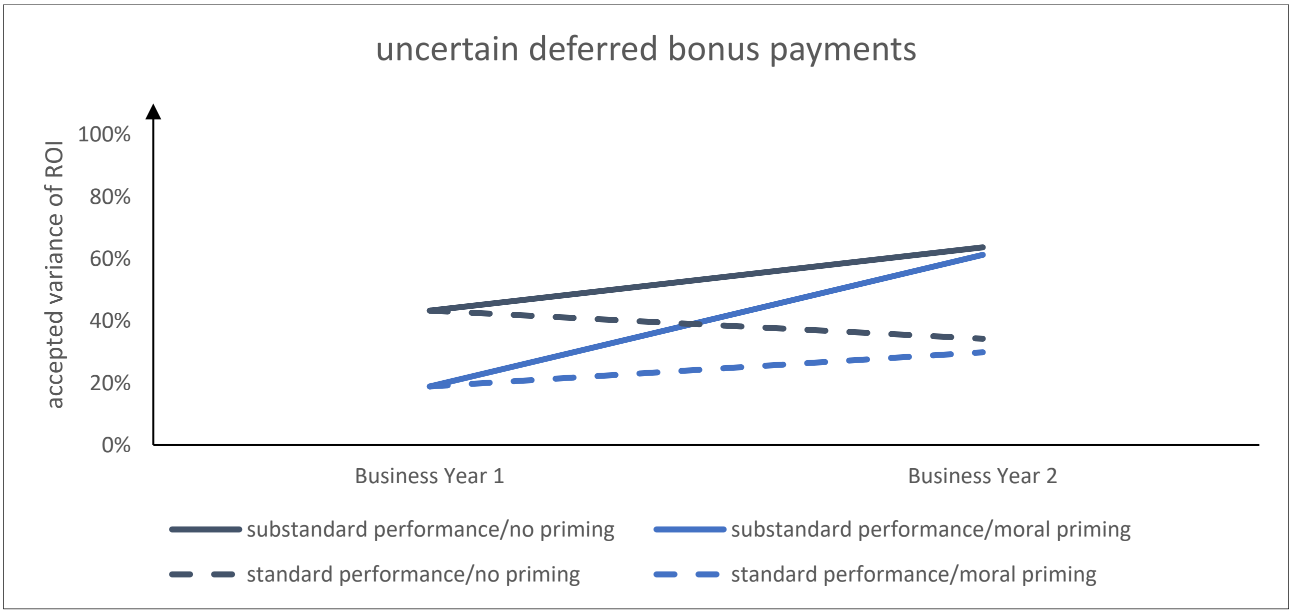
Figure 1

Means of the accepted variance of ROI in the first and second business year[1]



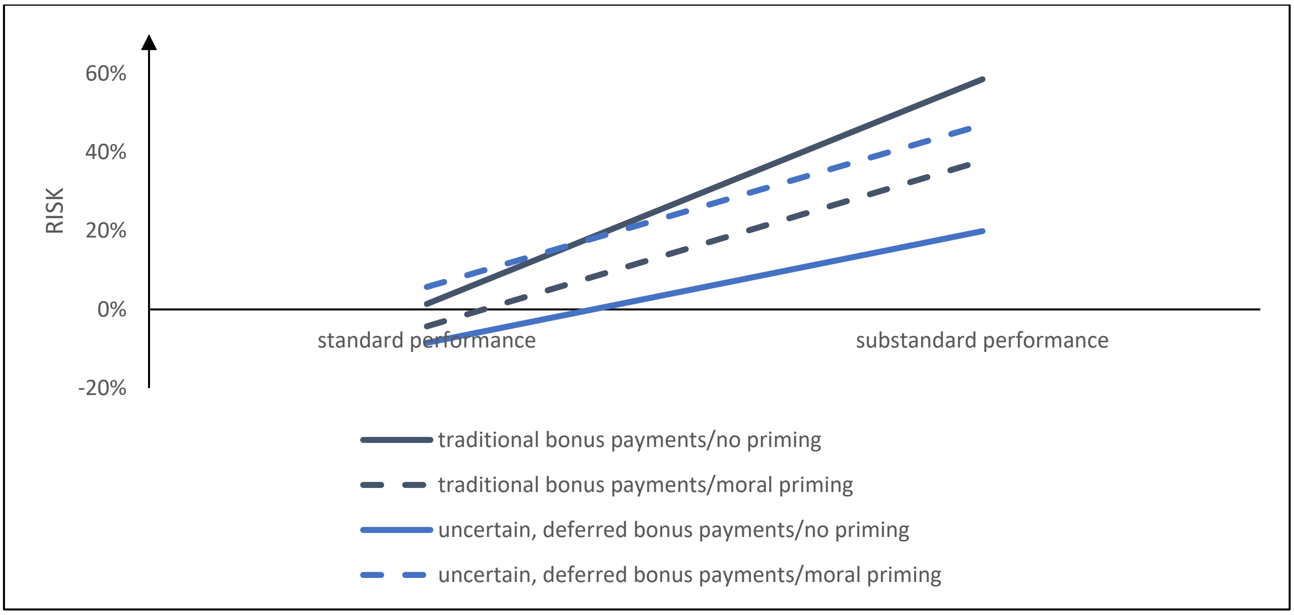


The two diagrams show the mean values of the accepted variance of ROI in the first and second business year under traditional bonus payments (diagram 1) and uncertain deferred bonus payments (diagram 2).

[1] Results reported for participants who correctly answered the manipulation check questions (failure rate: 6.7%).

Figure 2

Means of the change in accepted variance of ROI (RISK)[1]

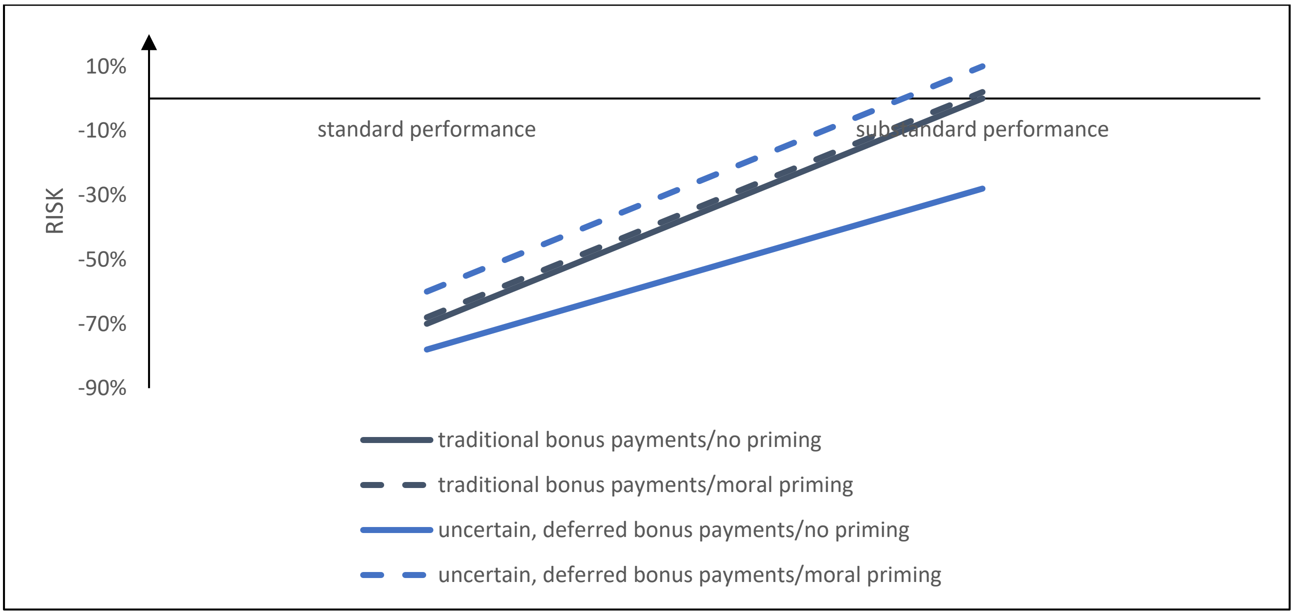


The diagram shows the mean values of the change in accepted variance of ROI (RISK) between the first and the second business year for each of the eight treatment groups.

[1] Results reported for participants who correctly answered the manipulation check questions (failure rate: 6.7%).

Figure 3

Effect of performance, compensation type and priming on the change in accepted variance of ROI (RISK)[1]

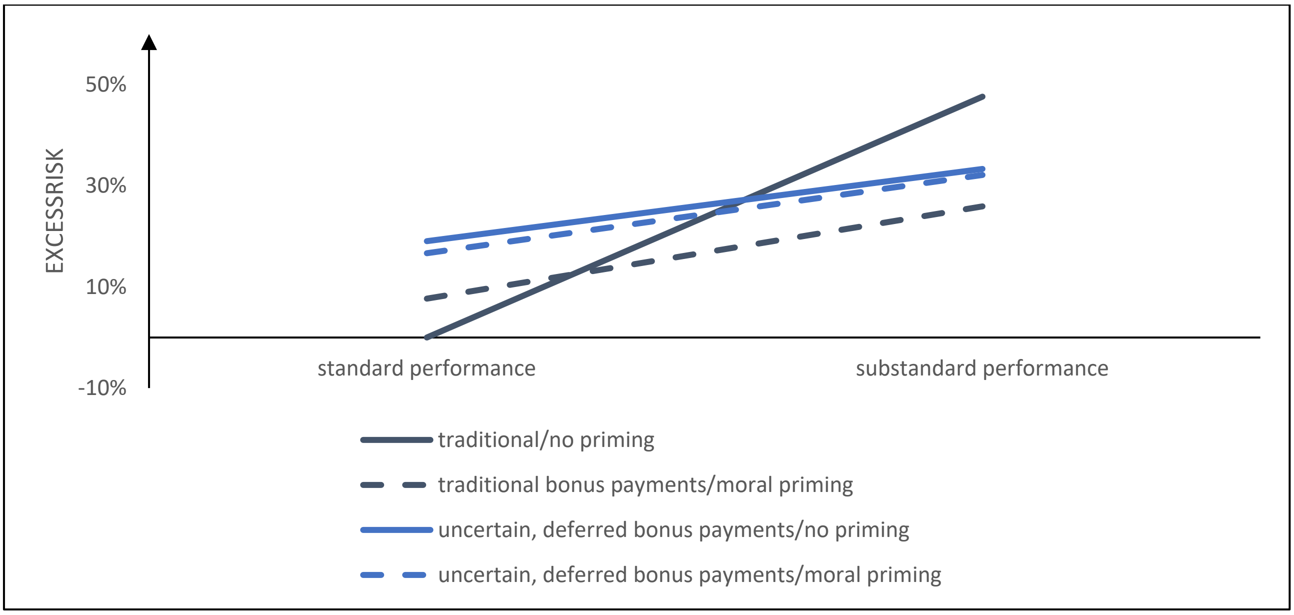


The diagram displays the results of an Ordinary Least Squares regression analysis of the change in accepted variance of ROI (RISK) (see Table 3 panel C).

[1] Results reported for participants who correctly answered the manipulation check questions (failure rate: 6.7%).

Figure 4

Means of the share of participants investing in investment alternative H (EXCESSRISK)[1]



The diagram shows the mean values of the change in accepted variance of ROI (RISK) between the first and the second business year for each of the eight treatment groups.

[1] Results reported for participants who correctly answered the manipulation check questions (failure rate: 6.7%).

Table 1

Investment Alternatives

Panel A: Investment Alternatives in the first business year

Investment	Probability of success (%)	Initial investment (EX$)	Cashflow (EX$)		Expected ROI (%)	Variance of ROI (%)
			Success	Failure		
A	50	1,000,000	1,050,000	1,050,000	5	0
B	50	1,000,000	1,200,000	900,000	5	2.25
C	50	1,000,000	1,450,000	650,000	5	16
D	80	1,000,000	1,700,000	-1,550,000	5	169

The table shows the investment alternatives participants can choose from in the first business year.

Panel B: Investment Alternatives in the second business year

Investment	Probability of success (%)	Initial investment (EX$)	Cashflow (EX$)		Expected ROI (%)	Variance of ROI
			Success	Failure		
E	50	4,600,000	4,830,000	4,830,000	5	0
F	50	4,600,000	5,520,000	4,140,000	5	2.25
G	50	4,600,000	6,670,000	2,990,000	5	16
H	80	4,600,000	7,820,000	-7,130,000	5	169

The table shows the investment alternatives participants can choose from in the second business year.

Table 2

Descriptive statistics of investment decisions[1]

Panel A: Summary of investment decisions in the first business year

Investment Alternative	A	B	C	D
Uncertain deferred bonus/no priming	25	4	5	11
Uncertain deferred bonus/moral priming	29	11	7	5
Traditional bonus/no priming	34	7	3	3
Traditional bonus/moral priming	40	3	5	5
Total	**128**	**25**	**20**	**24**

The table shows the number of participants per treatment group who chose investment alternative A, B, C, and D respectively. Since participants receive information related to the performance manipulation after making the first investment decision, the table does not differentiate between standard and substandard performance.

Panel B: Summary of investment decisions in the second business year

Investment Alternative	E	F	G	H
Standard performance/uncertain deferred bonus/no priming	10	5	2	4
Standard performance/uncertain deferred bonus/moral priming	14	4	2	4
Substandard performance/uncertain deferred bonus/no priming	5	0	11	8
Substandard performance/uncertain deferred bonus/moral priming	6	1	12	9
Standard performance/traditional bonus/no priming	10	14	2	0
Standard performance/traditional bonus/moral priming	13	6	5	2
Substandard performance/traditional bonus/no priming	5	1	5	10
Substandard performance/traditional bonus/moral priming	5	1	14	7
Total	**68**	**32**	**53**	**44**

The table shows the number of participants per treatment group who chose investment alternative E, F, G, and H respectively.

Panel C: Means (standard deviation) of the accepted variance of ROI in the first business year

PRIMING		*Moral Priming*	*No Priming*	Total
COMPENSATION	*Traditional*	17.58% (0.50) N=53	12.14% (0.42) N=47	15.03% (0.46) N=100
	Uncertain deferred	18.88% (0.50) N=52	43.29% (0.72) N=45	30.20% (0.62) N=97
TOTAL		18.22% (0.49) N=105	27.38% (0.60) N=92	22.50% (0.55) N=197

The table shows means (standard deviations) and the number of observations (N) of the accepted variance of ROI in the first business year across four treatment groups. Since participants receive information related to the performance manipulation after making the first investment decision, the table does not differentiate between standard and substandard performance.

Panel D: Means (standard deviation) of the accepted variance of ROI in the second business year

PERFORMANCE		*Substandard*			*Standard*			TOTAL		
PRIMING		*Moral Priming*	*No Priming*	Total	*Moral Priming*	*No Priming*	Total	*Moral Priming*	*No Priming*	Total
COMPENSATION	*Traditional*	52.19% (0.71) N=27	84.39% (0.83) N=21	66.28% (0.77) N=48	16.60% (0.45) N=26	2.44% (0.04) N=26	9.52% (0.33) N=52	34.73% (0.62) N=53	39.06% (0.68) N=47	36.77% (0.65) N=100
	Uncertain deferred	61.26% (0.76) N=28	63.67% (0.76) N=24	62.37% (0.75) N=52	29.88% (0.64) N=24	34.25% (0.67) N=21	31.92% (0.65) N=45	46.77% (0.72) N=52	49.94% (0.73) N=45	48.24% (0.72) N=97
TOTAL		56.81% (0.73) N=55	73.34% (0.79) N=45	64.25% (0.76) N=100	22.97% (0.55) N=50	16.65% (0.47) N=47	19.91% (0.51) N=97	40.70% (0.67) N=105	44.38% (0.71) N=92	42.42% (0.68) N=197

The table shows means (standard deviations) and the number of observations (N) of the accepted variance of ROI in the second business year across the eight treatment groups.

[1] Results reported for participants who correctly answered the manipulation check questions (failure rate: 6.7%).

Table 3

Descriptive statistics and analysis results for the change in accepted variance of ROI (RISK)[1]

Panel A: Means (standard deviation) of the change in accepted variance of ROI (RISK)

PERFORMANCE		***Substandard***			***Standard***			**TOTAL**		
PRIMING		***Moral Priming***	***No Priming***	**Total**	***Moral Priming***	***No Priming***	**Total**	***Moral Priming***	***No Priming***	**Total**
COMPENSATION	***Traditional***	37.81% (0.63) N=27	58.51% (1.08) N=21	46.87% (0.85) N=48	-4.31% (0.71) N=26	1.39% (0.05) N=26	-1.46% (0.50) N=52	17.15% (0.70) N=53	26.91% (0.77) N=47	21.74% (0.73) N=100
	Uncertain deferred	46.91% (0.83) N=28	19.90% (0.83) N=24	34.44% (0.83) N=52	5.71% (0.59) N=24	-8.49% (0.61) N=21	-0.92% (0.59) N=45	27.89% (0.75) N=52	6.65% (0.74) N=45	18.04% (0.75) N=97
TOTAL		42.45% (0.73) N=55	37.92% (0.96) N=45	40.41% (0.84) N=100	0.50% (0.65) N=50	-3.02% (0.41) N=47	-1.21% (0.54) N=97	22.47% (0.72) N=105	17.00% (0.76) N=92	19.92% (0.74) N=197

The table shows means (standard deviations) and the number of observations (N) of the dependent variable RISK across the eight treatment groups.

Panel B: ANOVA model of the change in accepted variance of ROI (RISK)[2]

	DF	MS	*F*	*p*-value[3]
COMPENSATION	1	0.289	0.6	0.440
PRIMING	1	0.463	0.96	0.329
COMPENSATION * PRIMING	1	1.989	4.12	0.044
PERFORMANCE	1	8.449	17.48	0.000
LOSSAVERSION[4]	6	1.131	2.34	0.034
Error	186	0.483		

COMPENSATION – dummy variable (0=Traditional Bonus; 1=Uncertain Deferred Bonus).
PRIMING – dummy variable (0=No Priming; 1=Moral Priming).
PERFORMANCE – dummy variable (0=Substandard Performance; 1=Standard Performance).

Panel C: Linear regression results for the change in accepted variance of ROI (RISK)[2]

	OLS for RISK N = 197	
Variable	**Coefficient**	**p-value[3]**
Constant	0.80***	0.000
COMPENSATION	-0.28*	0.066
PRIMING	-0.15	0.300
PERFORMANCE	-0.70***	0.002
COMPENSATION * PRIMING	0.38*	0.063
PERFORMANCE * LOSSAVERSION	0.10	0.143
LOSSAVERSION[4]	-0.10**	0.047
	Adj. R^2	**VIF**
	8.58%	3.49

COMPENSATION – dummy variable (0=Traditional Bonus; 1=Uncertain Deferred Bonus).
PRIMING – dummy variable (0=No Priming; 1=Moral Priming).
PERFORMANCE – dummy variable (0=Substandard Performance; 1=Standard Performance).

[1] Results reported for participants who correctly answered the manipulation check questions (failure rate: 6.7%).

[2] Untabulated results including a dummy variable for the location of the experimental session indicate that there is no statistically significant influence of the country the experiment was conducted in (Germany vs. Switzerland). Similarly, untabulated results including a dummy variable for the language of the experimental instructions indicate that there is no statistically significant influence of the language of administration (German vs. English). The results remain qualitatively the same.

[3] *p* values for all paths are reported two-tailed.

[4] Measure of loss aversion following Gächter et al. (2007).

* significance at 10%-level
** significance at 5%-level
*** significance at 1%-level

Table 4

Descriptive statistics and analysis results for the share of participants investing in investment alternative H (EXCESSRISK)[1]

Panel A: Means (standard deviation) of the share of participants investing in investment alternative H (EXCESSRISK)

PERFORMANCE		*Substandard*			*Standard*			TOTAL		
PRIMING		*Moral Priming*	*No Priming*	**Total**	*Moral Priming*	*No Priming*	**Total**	*Moral Priming*	*No Priming*	**Total**
COMPENSATION	***Traditional***	25.93% (0.45) N=27	47.62% (0.51) N=21	35.42% (0.48) N=48	7.69% (0.27) N=26	0.00% (0.00) N=26	3.85% (0.19) N=52	16.98% (0.38) N=53	21.28% (0.41) N=47	19.00% (0.39) N=100
	Uncertain deferred	32.14% (0.48) N=28	33.33% (0.48) N=24	32.69% (0.47) N=52	16.67% (0.38) N=24	19.05% (0.40) N=21	17.78% (0.39) N=45	25.00% (0.44) N=52	26.67% (0.45) N=45	25.77% (0.44) N=97
TOTAL		29.09% (0.46) N=55	40.00% (0.50) N=45	34.00% (0.48) N=100	12.00% (0.33) N=50	8.51% (0.28) N=47	10.31% (0.31) N=97	20.95% (0.41) N=105	23.91% (0.43) N=92	22.34% (0.42) N=197

The table shows means (standard deviations) and the number of observations (N) of the dependent variable EXCESSRISK across the eight treatment groups.

Panel B: ANOVA model of the share of participants investing in investment alternative H with priming interaction (EXCESSRISK)[2]

	DF	MS	*F*	*p*-value[3]
COMPENSATION	1	0.003	0.02	0.892
PRIMING	1	0.000	0	0.976
COMPENSATION * PRIMING	1	0.209	1.4	0.238
PERFORMANCE	1	2.395	16.06	0.000
LOSSAVERSION[4]	6	0.171	1.14	0.338
EXTREMERISK[5]	1	2.701	18.12	0.000
Error	185	0.149		

COMPENSATION – dummy variable (0=Traditional Bonus; 1=Uncertain Deferred Bonus).
PRIMING – dummy variable (0=No Priming; 1=Moral Priming).
PERFORMANCE – dummy variable (0=Substandard Performance; 1=Standard Performance).

Panel C: ANOVA model of the share of participants investing in investment alternative H with loss aversion interaction (EXCESSRISK)[2]

	DF	MS	*F*	*p*-value[3]
COMPENSATION	1	0.096	0.67	0.413
LOSSAVERSION[4]	6	0.240	1.68	0.129
COMPENSATION * LOSSAVERSION	6	0.348	2.44	0.027
PRIMING	1	0.020	0.14	0.710
PERFORMANCE	1	2.473	17.33	0.000
EXTREMERISK[5]	1	2.882	20.18	0.000
Error	180	0.143		

COMPENSATION – dummy variable (0=Traditional Bonus; 1=Uncertain Deferred Bonus).
PRIMING – dummy variable (0=No Priming; 1=Moral Priming).
PERFORMANCE – dummy variable (0=Substandard Performance; 1=Standard Performance).

Panel D: Probit regression results for the propensity to invest in investment alternative H (EXCESSRISK)[2]

	Probit for EXCESSRISK N = 197	
Variable	**Coefficient**	**p-value[3]**
Constant	-0.08	0.804
COMPENSATION	-0.40	0.272
LOSSAVERSION[4]		
medium	-1.13***	0.009
high	-0.58	0.118
COMPENSATION * LOSSAVERSION[4]		
LOSSAVERSION medium	1.41**	0.012
LOSSAVERSION high	0.21	0.698
PRIMING	-0.04	0.867
PERFORMANCE	-0.96***	0.000
EXTREMERISK[5]	1.19***	0.000
	Pseudo R^2	**VIF**
	20.08%	2.28

COMPENSATION – dummy variable (0=Traditional Bonus; 1=Uncertain Deferred Bonus).
PRIMING – dummy variable (0=No Priming; 1=Moral Priming).
PERFORMANCE – dummy variable (0=Substandard Performance; 1=Standard Performance).

[1] Results reported for participants who correctly answered the manipulation check questions (failure rate: 6.7%).
[2] Untabulated results including a dummy variable for the location of the experimental session indicate that there is no statistically significant influence of the country the experiment was conducted in (Germany vs. Switzerland). Similarly, untabulated results including a dummy variable for the language of the experimental instructions indicate that there is no statistically significant influence of the language of administration (German vs. English). The results remain qualitatively the same.
[3] *p* values for all paths are reported two-tailed.

[4] Measure of loss aversion following Gächter et al. (2007).
[5] Dummy variable measuring participants' investment choice in the first business year, where 0 = investment in investment alternative A, B, or C, 1 = investment in investment alternative D.

*	significance at 10%-level
**	significance at 5%-level
***	significance at 1%-level

Table 5

Descriptive statistics and analysis results for the share of participants investing in investment alternative D (EXTREMERISK)[1]

Panel A: Means (standard deviation) of the share of participants investing in investment alternative D (EXTREMERISK)

PRIMING		***Moral Priming***	***No Priming***	**Total**
COMPENSATION	***Traditional***	9.43% (0.30) N=53	6.38% (0.25) N=47	8.00% (0.27) N=100
	Uncertain deferred	9.62% (0.30) N=52	24.44% (0.43) N=45	16.49% (0.37) N=97
TOTAL		9.52% (0.29) N=105	15.22% (0.36) N=92	12.18% (0.33) N=197

The table shows means (standard deviations) and the number of observations (N) of the dependent variable EXTREMERISK across the four treatment groups. Since participants receive information related to the performance manipulation after making the first investment decision, the table does not differentiate between standard and substandard performance.

Panel B: ANOVA model of the share of participants investing in investment alternative D (EXTREMERISK)[2]

	DF	MS	*F*	*p*-value[3]
COMPENSATION	1	0.282	2.90	0.090
PRIMING	1	0.418	4.30	0.040
COMPENSATION * PRIMING	1	0.499	5.13	0.025
LOSSAVERSION[4]	6	0.332	3.42	0.003
Error	187	0.097		

COMPENSATION – dummy variable (0=Traditional Bonus; 1=Uncertain Deferred Bonus).
PRIMING – dummy variable (0=No Priming; 1=Moral Priming).
PERFORMANCE – dummy variable (0=Substandard Performance; 1=Standard Performance).

Panel C: Probit regression results for the propensity to invest in investment alternative D (EXTREMERISK)[2]

	Probit for EXTREMERISK N = 197	
Variable	**Coefficient**	**p-value[3]**
Constant	-1.22***	0.002
COMPENSATION	0.77**	0.031
PRIMING	0.17	0.640
COMPENSATION * PRIMING	-0.77	0.115
LOSSAVERSION[4]	-0.09	0.264
	Pseudo R^2 6.05%	**VIF** 2.09

COMPENSATION – dummy variable (0=Traditional Bonus; 1=Uncertain Deferred Bonus).
PRIMING – dummy variable (0=No Priming; 1=Moral Priming).
PERFORMANCE – dummy variable (0=Substandard Performance; 1=Standard Performance).

[1] Results reported for participants who correctly answered the manipulation check questions (failure rate: 6.7%).

[2] Untabulated results including a dummy variable for the location of the experimental session indicate that there is no statistically significant influence of the country the experiment was conducted in (Germany vs. Switzerland). Similarly, untabulated results including a dummy variable for the language of the experimental instructions indicate that there is no statistically significant influence of the language of administration (German vs. English). The results remain qualitatively the same.

[3] *p* values for all paths are reported two-tailed.

[4] Measure of loss aversion following Gächter et al. (2007).

* significance at 10%-level
** significance at 5%-level
*** significance at 1%-level

6 Conclusion

This dissertation examines the incentive properties of bonus bank schemes both in a rational economics framework and from a behavioral perspective to provide a better understanding of their effect on managers' and employees' behavior and thus ultimately their effect on shareholder interest.

The first article of this dissertation discusses the concepts of bonus bank schemes proposed in the practitioners' and academic literature. Based on a formalization of the proposed remuneration schemes in an analytical model, we find that bonus bank schemes provide efficient investment incentives under restrictive conditions only. We show that managers will make efficient investment decisions regardless of their individual employment horizon if a share of the net present value of new investment projects is credited to their bonus bank account. Since managers have private information on the net present value of newly initiated investment projects, this requirement shifts the incentive problem from efficient investment decision making to truthful reporting. When equity market values are not applicable to determine the true net present value of newly initiated investment projects, we find that allowing managers to sell their bonus bank account to the succeeding manager upon job termination can induce truthful reporting and thus efficient investment decisions under restrictive conditions concerning the succeeding manager's abilities.

The second article of this dissertation adopts a behavioral perspective and isolates the effect of bonus deferral on investment decision making. We examine responses from 167 participants in a 2x2 between-subjects experiment and find that bonus deferral affects decision makers' behavior beyond altering the economic value of bonus payments. More specifically, we discover that managers are more willing to make an investment that provides long-term benefits to the firm but imposes immediate cost on their bonus when bonus payments are deferred. Additionally, we demonstrate that deferring economically equivalent bonus payments alters managers' willingness to make a long-term investment by increasing their focus on their managerial responsibility and their reputation. Bonus deferral is thus a useful tool for mitigating managers' inflated concern with the short term due to relatively short employment horizons. Accordingly, we find that the positive effect of deferred bonus payments is moderated by managers' employment horizon, that is, the effect of bonus deferral on managers' willingness to make a long-term investment is only relevant when their employment horizon is short.

The third article of this dissertation extends the second article by examining the individual and combined effects of bonus deferral and bonus recovery on effort provision. We conduct a 2x2 between-subjects experiment and examine the performance of 148 participants on a multi-dimensional effort-sensitive task. The analysis provides evidence for a positive effect of bonus deferral on performance quantity but not performance quality. Our results further suggest that bonus recovery induces a stronger emphasis on the performance dimension related to bonus recovery, but at the expense of other performance dimensions: bonus recovery increases performance in the performance dimension related to bonus recovery and reduces performance in other performance dimensions. Bonus recovery seems to cause an exaggerated concern with the performance dimension related to bonus recovery. Additionally, bonus recovery provisions counteract the positive effects of bonus deferral by inducing a stronger focus on monetary decision factors, thus resulting in lower overall task performance.

The fourth article of this dissertation examines how bonus deferral and bonus recovery affect managers' risk taking behavior over time, that is, when current performance jeopardizes the payment of deferred bonuses. Analyzing the investment decisions of 212 participants in a 2x2x2 between-subjects experiment, I find that the principal driving force of risk taking behavior is current performance. Performance below a target level induces higher risk taking regardless of the compensation scheme. I further find that external cues of moral values such as a firm slogan generally decrease additional risk taking. However, bonus bank schemes with bonus deferral and bonus recovery result in higher additional risk taking when external cues increase awareness of moral values. I do not find evidence for a general increase of the propensity to accept excessive risk under bonus bank schemes in periods of underperformance. However, when decision makers are characterized by a medium level of loss aversion and performance is below the target level, bonus bank schemes result in a higher willingness to accept excessive risk. Additionally, these remuneration schemes induce higher risk taking when bonus payments are not contingent on current performance outcomes. These results suggest that combinations of bonus deferral and bonus recovery cause a complex network of behavioral incentives. Consequently, the impact of these compensation schemes on decision makers' behavior strongly depends on decision makers' characteristics, as well as organizational and situational factors.

The first contribution of this dissertation is the formalization of bonus bank schemes to provide a systematic review of the functional elements of bonus bank schemes. The regulatory requirements for bonus bank schemes are nonspecific with respect to the details of the design of these remuneration schemes (Directive 2010/76/EU; BEAR; Dodd-Frank). The systematization of the elements, parameters and conditions influencing the effectiveness of bonus bank schemes lays the foundation for a more structured understanding of the incentive properties of these remuneration schemes. It allows researchers, regulators and firms to reconsider the specific design of bonus bank schemes to improve alignment of managerial behavior with firm objectives. The formal analysis of the incentive properties of bonus bank schemes in an analytical model further allows future research to disentangle economic and behavioral effects of these compensation schemes in archival and experimental studies.

Secondly, the finding that deferring economically equivalent bonus payments induces decision makers to think more long-term and to put a stronger emphasis on their responsibility within the firm is an important contribution to the continuous improvement of remuneration scheme design. This result suggests that bonus deferral is a helpful tool to address diverging interests between managers and the firm. Firms may improve alignment between managerial behavior and firm objectives by simply deferring payout of bonuses determined in established remuneration schemes without adjusting performance measures used to evaluate managers' performance or altering the means of payment.

Thirdly, the finding that bonus recovery provisions encourage decision makers to focus on the performance dimension related to bonus recovery implies that bonus recovery provisions may be a helpful mechanism to prevent undesirable outcomes and highlight tasks or task dimensions that are particularly important for firm prospects. Hence, standard setters' intention to deter misreporting by requiring firms to implement bonus recovery triggered by accounting restatements (e.g., Chan et al. 2012; Chen et al. 2015) seems justified. However, we also find that bonus recovery provisions may cause decision makers to over-emphasize tasks or task dimensions related to bonus recovery at the expense of their other responsibilities, such that overall firm prospects may be impaired. The finding that bonus recovery provisions counteract the positive effects of bonus deferral contributes to the understanding of the behavioral incentives of bonus bank schemes. It suggests that firms considering implementing bonus deferral with or without bonus recovery provisions need to weigh the benefits of highlighting specific tasks or task dimensions and the cost of managers' and employees' reducing their emphasis on their responsibility relative to monetary compensation.

One limitation of this dissertation is the focus on the behavioral incentive properties of bonus bank schemes. While the first article lays the foundation for understanding bonus bank schemes by examining an analytical model, the remainder of the articles of this dissertation follow an experimental approach. Experimental research is characterized by a high degree of internal validity at the cost of lower external validity and generalizability (Argyris 1975; Scandura and Willams 2000). In the articles of this dissertation, participants were graduate or undergraduate business students with similar knowledge and experience. The primary advantage of participants' homogeneous background combined with a clean design of the experimental tasks is that it allows to clearly identify the factors driving participants' behavior. On the other hand, however, student participants may have had difficulty imagining the setting described in the experimental instructions such that the experimental results underestimate the effect of some of the manipulations. Additionally, real world managers are exposed to a large set of monetary and nonmonetary incentives and are likely to be influenced by a treasure trove of experiences that may interact with the incentive properties of bonus bank schemes. Experimental studies are not suitable for identifying potential additional factors and capturing their interaction with bonus bank schemes to influence managers' behavior.

Since a reform in 2013, the German Corporate Governance Code has requested listed firms in Germany to report compensation benefits granted in the current period, including the maximum and minimum compensation achievable, and compensation benefits received in the current period for each management board member individually (Regierungskommission. 4.2.5 German Corporate Governance Code. 2017). This information allows to differentiate between deferred bonuses that are conditional on predetermined performance targets and bonus payments based on current performance realizations. Future research may use this information to validate experimental results on the incentive properties of bonus bank schemes.

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