Essays on Analytical Research in Accounting and Auditing

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Zusammenfassung

Diese Dissertation beinhaltet vier Beiträge zur analytischen Forschung in der Rechnungslegung und Wirtschaftsprüfung. Der erste Beitrag befasst sich mit der Frage, ob Unternehmen ihre Einschätzung über das Potenzial ihrer Arbeitnehmer offenlegen sollten. In einem spieltheoretischen Modell wird gezeigt, dass die Stärke der internen Kontrollen Einfluss auf diese Entscheidung haben kann. Die Offenlegung der Einschätzung setzt Anreize erfolgreich zu erscheinen. Dies kann durch eine höhere Arbeitsleistung oder durch ein höheres Maß an Manipulation erreicht werden. Wenn die internen Kontrollen schwächer sind, werden Einschätzungen nicht offengelegt, um ein höheres Maß an Manipulation zu verhindern. Der zweite Beitrag analysiert die Auswirkungen des erweiterten Bestätigungsvermerks des Abschlussprüfers und insbesondere der Einführung sog. *key audit matters* (KAM) auf Investitionsentscheidungen eines Unternehmens. KAM sind besonders wichtige Sachverhalte im Rahmen der Prüfung und sollen den Informationswert des Bestätigungsvermerks erhöhen. Der vorliegende Beitrag zeigt, dass der Bericht von KAM durch sinkende Informationsasymmetrie ineffiziente Investitionsentscheidungen wie Überinvestition erhöhen kann. Durch die verbesserte Informationslage können jedoch auch die negativen Investitionsanreize privater Vorteile eines Managers besser bewertet und so abgeschwächt werden. Der dritte Beitrag analysiert die Auswirkungen von Informationsasymmetrien und des Konzepts der Wesentlichkeit auf Investitionsentscheidungen eines Unternehmens. Bisherige Literatur zeigt, dass gleichzeitige Informationsasymmetrie über die Profitabilität und die Höhe einer Investition, Investitionsentscheidungen tatsächlich verbessern kann, indem sich Über- und Unterinvestitionsanreize ausgleichen. Der vorliegende Beitrag zeigt jedoch, dass beide Arten von Informationsasymmetrie, bei Entscheidungen zwischen sicheren und riskanten Investitionen, auch nur Überinvestitionsanreize setzen können und so das optimale Investitionsniveau nie erreicht wird. Insgesamt kann Wesentlichkeit die Investitionsentscheidungen, in Abhängigkeit von der Marktpreisreaktion oder der Vorteilhaftigkeit der Veröffentlichung weiterer Informationen, verbessern oder verschlechtern. Der letzte Beitrag analysiert die Auswirkungen von steigender Konformität zwischen Handels- und Steuerbilanz (Maßgeblichkeit) und zeigt, dass in Abhängigkeit von dem Ausgangslevel an Maßgeblichkeit ein Anstieg insgesamt zu steigenden oder sinkenden Steuerzahlungen führen kann. Für erfolgreiche Projekte führt eine steigende Maßgeblichkeit zu einer höheren Wahrscheinlichkeit für hohe Steuerzahlungen. Als Folge steigen die Anreize eine Steuerprüfung durchzuführen, sodass Steuerhinterziehung schwieriger wird. Bei einem nicht erfolgreichen Projekt steigt jedoch die Wahrscheinlichkeit für geringe Steuerzahlungen. Die Anreize eine Steuerprüfung durchzuführen sinken somit und Steuerhinterziehung wird einfacher. Die Wahrscheinlichkeit für ein erfolgreiches Projekt wird durch das Level an Maßgeblichkeit beeinflusst, da dies Steuern und somit indirekte Investitionskosten erhöhen kann.

Summary

This dissertation comprises four articles concerning analytical research on accounting and auditing. The first article analyzes the question, whether employers should disclose their assessment of employees. Using a game-theoretic model, we show that the strength of the internal controls can affect the decision of disclosing employer assessment. High potential employees have strong incentives to appear successful, which employees achieve through effort or manipulation. For a weak internal controls system, employers withhold their assessment to avoid higher manipulation. The second article analyzes the effect of the expanded auditor's report and, in particular, the introduction of so-called *key audit matters* (KAM) on firms' investment decisions. KAM are the most significant matters during the audit and shall increase the auditor's report's informational value. In a theoretical model, we show that KAM reporting can increase inefficient investment behavior such as overinvestment by decreasing the information asymmetry. On the contrary, having more information regarding the investment, the financial market can also better anticipate the effects of private benefits on managers' investment decisions. As a result, KAM reporting can mitigate the adverse investment effects of managers' private benefits. The third article analyzes the effect of information asymmetry and materiality on firms' investment decisions. Prior literature shows that information asymmetry about both the investment profitability and the investment level can be value enhancing as over- and underinvestment incentives can perfectly balance each other. This article shows that for a decision between a safe and risky investment, both types of information asymmetry together can even always result in overinvestment and never be value enhancing. Moreover, materiality can increase or decrease the investment efficiency depending on the market price response and whether additional disclosures are desirable. The last article analyzes the effect of increasing book-tax conformity. The results show that depending on the baseline level of book-tax conformity, the expected tax revenue can increase or decrease for increasing book-tax conformity. If the firm's project outcome is high, higher book-tax conformity increases the probability of a correct high tax treatment and, thereby, decreases the probability of understated tax reports as tax audit incentives are high. If the firm's project outcome is low, the probability of a correct low tax treatment increases, thereby increasing the probability of understated tax reports as tax audit incentives are low. As a result, the firm understates the tax report more often. Increasing investment costs in the form of taxes, book-tax conformity influences the probability of a high or low project outcome.

Schlagwörter: Talentmanagement · Informationsausweis · Potenzialeinschätzung · Ausweis der Mitarbeitereinschätzung · Manipulation · Investitionsentscheidung · Investitionsanreize · Informationsasymmetrie · Wesentlichkeit · Investitionseffizienz · Genauigkeit der Rechnungslegung · Key Audit Matters · Bestätigungsvermerk · Maßgeblichkeit · Steuerhinterziehung · Steuervermeidung

Keywords: Talent Management · Information Disclosure · Potential Assessment · Employee Assessment Disclosure · Misreporting · Investment Decision · Investment Incentives · Information Asymmetry · Materiality · Investment Efficiency · Accounting Precision · Key Audit Matters · Auditor's Report · Book-tax Conformity · Tax Evasion · Tax Avoidance

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Chapter 1

Introduction

1.1 Motivation

Economic decisions such as effort and investment decisions are central for firms' economic success. Several factors, such as information asymmetry and disclosures, promotion incentives, and taxes, influence firms' and managers' effort and investment decisions. Analyzing how these various factors influence decisions is essential for both regulators and firms. When designing accounting rules, mandatory disclosure rules, tax regulations, or audit standards, regulators should be aware of any adverse effects. Firms should be aware of any adverse effects when incentivizing employees.

One important tool to motivative employees are bonus payments. Besides that, managerial guidance suggests that to further motivative employees and boost firm profits, employers should disclose their assessments of employees' potential (Effron and Ort, 2010; Gandossy and Effron, 2004). Disclosing assessments increases employee engagement, commitment, and trust in the employer's reward system (Lawler, 1972; Hamner, 1975; Effron and Ort, 2010). On the contrary, disclosure can also demotivate low potential types (Beer, 1987). Managerial guidance advises to disclose assessments as the benefit of motivation outweighs the demotivation. It is a paradox to observe that studies indicate that employers often withhold assessments (Bournois and Roussillon, 1992; Dries and Pepermans, 2008; Silzer and Church, 2010). This paradox raises the question of why employers prefer to withhold assessments? Prior studies neglect one key factor of the decision to disclose assessments – the strength of the internal controls system. Disclosing assessments increases incentives to appear successful. Besides working harder, the employee can appear successful through manipulation, which in turn harms firm profits.

Besides effort decisions, other central economic decisions are firms' investment decisions. Making an investment decision, firms often maximize the short- and long-term shareholder value by maximizing the expected cash flows and the expected market price resulting from investment (Kanodia et al., 2005). The resulting market price depends on the market's information about the investment. Prior literature shows that information asymmetry about the investment profitability or the investment level results in inefficient investment behavior (Stein, 1989; Bebchuk and Stole, 1993; Kanodia and Mukherji, 1996; Kanodia et al., 2005). The market obtains information from the audited financial statement. Thus, the information contained in the auditor's report and the accounting report are central factors in firms' investment decisions.

Recent regulatory changes possibly influencing the information contained in the auditor's report are the new audit standards ISA 701 (issued by the International Auditing and Assurance Standard Board (IAASB)) and AS 3101 (issued by the Public Company Oversight Board (PCAOB)). The new standards require auditors to disclose so-called *key audit matters* (KAM) or *critical audit matters* (CAM). KAM are the most significant matters during the audit and matters that relate to challenging, subjective or complex auditor judgment. The new standards aim to increase the auditor's report's decision usefulness and informational value. If the reporting of KAM, in line with the aim of the new standards, decreases the information asymmetry, KAM reporting might influence firms' investment decisions. Depending on the type of information asymmetry, this might decrease investment efficiency and, thus, KAM reporting might have unintended detrimental consequences on firms' real decisions.

Alongside the auditor's report, it is crucial to analyze the information contained in the accounting report and the consequences on investment decisions. Bebchuk and Stole (1993) show that information asymmetry about the investment level induces underinvestment and information asymmetry about the investment profitability induces overinvestment. Kanodia et al. (2005) show that accounting imprecision can be value enhancing if information asymmetry about the investment level and the investment profitability exists. The results imply that an optimal degree of accounting imprecision exists. These prior results overlook one key factor of disclosure and information asymmetry – materiality. Issuing an accounting report, firms need to disclose material information, i.e., additional descriptions or disaggregations. Transactions often qualify as material depending on quantitative characteristics, e.g., the investment amount is high compared to the total assets, or the effect on the firm's return is high. Compared to an exogenous imprecision of an accounting measure, the investment level influences the expected market price in two ways, considering materiality. First, if the market receives precise information about the investment level, the investment level influences the resulting market price (direct effect). Second, the investment level influences the probability that the market receives precise information (indirect effect). The higher the investment level, the higher the probability that the investment and, thus, the subsequent accounting qualify as material. As a result, additional disclosures are mandatory, which reduces information asymmetry. Making an investment decision, a firm considers not only the direct effect but also the indirect effect. It is crucial to analyze the effect of materiality to understand and analyze firms' investment decisions in the presence of information asymmetry.

Besides the expected market price and the expected cash flows, taxes play an important role in firms' investment decisions. Firms often try to maximize their after-tax profits. As tax regulations influence the expected tax payments and, therefore, the after-tax profit, regulators should consider possible investment effects. Tax regulators design a tax system to raise the government's tax revenues and provide economic incentives or disincentives to engage in certain activities (Atwood et al., 2010). One prominent tool to do this is increasing the book-tax conformity. Studies suggest that higher book-tax conformity reduces the reporting discretion in financial statements and tax reports, and therefore decreases accounting scandals (Watts, 2003; Hanlon and Shevlin, 2005) and decreases understated tax reports (Atwood et al., 2012; Blaufus et al., 2017; Chen and Gavious, 2017; Niggemann, 2020). However, besides reducing accounting scandals, the book-tax conformity might also influence ex-ante real decisions, i.e., investment decisions. As higher book-tax conformity is likely to induce higher tax payments (Chan et al., 2013), it can decrease investment incentives. Moreover, reduced investment incentives might decrease the expected tax revenue as investments are fundamental for economic success and growth. Therefore, it is essential to investigate the influence of increasing book-tax conformity on firms' investment decisions, reporting strategies, and the resulting expected tax revenue.

1.2 Contribution and Main Findings

This thesis consists of four articles. Table 1.1 provides an overview of the articles, the co-authors, and the presentations at international conferences.

Title	Coauthors	Conferences
To Tell or Not To Tell: The Incentive Effects of Disclosing Employer Assessments	Abhishek Ramchandani	HARC 2021; JAAF India Symposium 2021; AAA 2021 Southwest Region Meeting
How Key Audit Matters Can Induce Inefficient Investment Behavior	Michelle Peters	GEABA 2018; ARFA 2019
Information Asymmetry and the Effect of Materiality		
The Impact of Book-Tax-Conformity on Reporting and Investment Behavior	Michelle Peters; Rebecca Reineke	EAA 2019; ARW 2019; VHB 2019; GEABA 2019

Table 1.1: Article overview.

The first article *To Tell or Not To Tell: The Incentive Effects of Disclosing Employer Assessments* presented in Chapter 2 addresses the employers' decision of whether to tell or not tell their assessments of their employees. By doing so, the article explains the paradoxical observations that managerial guidance, on the one hand, suggests that telling assessments is desirable as it motivates high potential employees, but, on the other hand, employers often still choose to withhold their assessments. In a game-theoretic model, we show that the decision of telling or not telling also depends on the firm's internal controls system. Disclosing a positive assessment increases employees' incentives to appear successful. The employee can achieve this through working harder or manipulating. If the internal controls system is weak, employers withhold their assessments as employees substitute manipulation for effort, which decreases firm profits.

Alongside effort decisions, investment decisions are central for firms' economic success. The last three articles, therefore, analyze different factors influencing firms' and managers' investment decisions. The second article entitled *How Key Audit Matters Can Induce Inefficient Investment Behavior* presented in Chapter 3 analyzes the effect of so-called *key audit matters* (KAM) or *critical audit matters* (CAM) on managers' investment decisions. Regulators introduced KAM to enhance the informational value of the auditor's report. The matters disclosed as KAM should, thereby, contain matters that were most significant during the audit. If KAM reporting now, in line with the aim of the newly introduced requirements, decreases information asymmetry, KAM reporting might influence managers' ex-ante real decisions, e.g., investment decisions. A decreasing information asymmetry changes firms' market valuations. Changing market valuations, thereby, change managers' investment incentives. In a theoretical model, we show that managers strategically (over-)invest to induce a KAM reporting, which signals good prospects and, thereby, increases firm valuations. KAM reporting, therefore, increases inefficient investment behavior in the form of overinvestment. However, as the information asymmetry decreases, the market also better prices possible effects from managers' private benefits. Consequently, KAM reporting also mitigates adverse investment effects resulting from managers' private benefits.

The third article entitled *Information Asymmetry and the Effect of Materiality* presented in Chapter 4 analyzes the effect of materiality. Prior literature shows that information asymmetry induces inefficient investment behavior. However, information asymmetry about the investment profitability and the investment level can be value enhancing as over- and underinvestment incentives balance each other perfectly. These studies neglect the concept of materiality. If an investment qualifies as material, additional disclosures are mandatory. Consequently, the information asymmetry decreases.

The results show that materiality increases or decreases investment efficiency depending on the market price response and the desirability of disclosures. The higher an investment amount, the higher the probability that it qualifies as material. Therefore, choosing a higher investment level influences the market price in a direct way (increasing or decreasing the market price) and in an indirect way (increasing the probability of disclosure/ decreasing the degree of information asymmetry). As firms and managers often benefit from high market prices, both the direct and the indirect effect influence firms' investment decisions. Considering the effect of materiality is, therefore, crucial when analyzing the effect of information asymmetry.

Besides the market valuation also monetary incentives like tax incentives influence managers' and firms' investment decisions. The fourth article entitled *The Impact of Book-Tax Conformity on Reporting and Investment Behavior* presented in Chapter 5, therefore, analyzes the effect of increasing book-tax conformity on firms' investment and subsequent reporting decisions. A firm's investment decision is, thereby, followed by a standard tax inspection game. Increasing book-tax conformity deteriorates investment incentives as it increases investment costs in the form of higher tax payments. However, decreasing investments can either be beneficial or detrimental for the tax authority as it increases or decreases expected tax revenues. Depending on the baseline level of book-tax conformity, a marginal increase and, thereby, lower investments can increase or decrease the probability of understated tax reports. The results show that the effect of higher book-tax conformity is ambiguous. Regulators should, therefore, consider unintended consequences on firms' investment decisions and the expected tax revenue.

Chapter 2

To Tell or Not To Tell: The Incentive Effects of Disclosing Employer Assessments*

Abstract

Should employers disclose their assessments of their employees? Popular managerial advice suggests that telling employees that they are assessed to have high potential leads to greater effort and engagement, boosting firm profits. However, some employers still choose to withhold employee assessments. What explains this paradoxical observation? We show that disclosing a positive assessment to an employee increases his incentive to appear successful. Success can be achieved either by working harder or by misreporting. If the internal controls system is sufficiently weak, the employee excessively substitutes misreporting for effort, thereby decreasing firm profits. Consequently, employers withhold assessments.

Notes

A version of this paper has been published on SSRN (Available at SSRN: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3712274).

* This chapter is joint work with Abhishek Ramchandani (The University of Texas at Austin).

2.1 Introduction

> ...the question of 'tell or don't tell' has been well and truly answered with a resounding 'yes.'
>
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>
> JAMES PETERS
> *Senior Partner, Korn Ferry*

Employers often have a good gauge of which junior-level employees have the *potential* to be leaders or managers within the firm (Ready et al., 2010). We call this gauge an employer's *assessment* of whether an employee has the potential to succeed in a leadership role. Should employers *disclose* (or *tell*) these assessments[1] to their employees? The popular managerial guidance book, 'One Page Talent Management' (Effron and Ort, 2010), suggests that many employers prefer to withhold their assessments.[2] Foremost, the authors of the book conjecture, employers worry that disclosing assessments might lead some employees to become discouraged about their prospects within the firm, thereby decreasing productivity. The authors bemoan this lack of transparency and argue why employers should be more transparent. In this paper, we suggest that this advice to be more transparent overlooks a vital determinant of the decision to tell – the *strength* of the firm's internal controls (that is, how easy or difficult it is for the employee to generate a false report regarding his performance). We thus explain why some employers choose not to disclose assessments.

Popular managerial guidance books, advice from consulting firms, and prior literature have extensively focused on the effort incentives of employees who are told of their potential to advance within an organization. Common reasons in the literature for not telling employees of their potential include avoiding employee demotivation (Beer, 1987) and reducing employee turnover. Reasons for transparency include increased employee engagement and commitment as well as greater trust in the reward system (Lawler, 1972; Hamner, 1975; Effron and Ort, 2010). While the academic literature might not have reached a consensus on what should be done, consulting firms and managerial advice books advocate transparency. For instance, the epigraph above recommends that employers should disclose

[1] Disclosing assessments is different from providing performance feedback where the employer provides a specific evaluation of the employee's performance on a task without alluding to the potential to advance in the future. A helpful framework is to think of assessments as forward-looking information and performance feedback as backward-looking information about the employee.

[2] An informal survey estimates that 73% of employers prefer not to disclose assessments: https://talentstrategygroup.com/wp-content/uploads/2020/02/Calculating-the-Optimal-Length-of-Time-to-Lie.pdf.

assessments.[3] Gandossy and Effron (2004) in 'Leading the Way' suggest, "[...] we think it is best to let high-potentials know their status [...] if there are real consequences to this status."

Despite the abundance of popular managerial advice, one in three employers prefers to withhold assessments as indicated by prior studies (Bournois and Roussillon, 1992; Dries and Pepermans, 2008; Silzer and Church, 2010). What explains this paradoxical observation? Popular advice argues that employers do not tell because they fear that some employees might be discouraged. We outline a novel determinant of the employers' decision to disclose – the strength of the internal controls system and the employees' ability to misreport their performance on the job.

To analyze how the strength of the internal controls system affects the disclosure of assessments, we develop a game-theoretic model in which an employer (referred to as 'she') interacts with an employee (referred to as 'he'). The employee can be of two types: good and bad. The types correspond to the employee's potential to be successful as a leader. Only the employer observes the employee's type; that is, the employer has an assessment of the employee. At the start of the game, the employer commits to disclosing the employee's type or keeping it private. This corresponds to the disclosure of assessments. Importantly, the employer's disclosure policy is chosen before she observes the employee's type.

The employee then works on gathering firm-specific human capital. The employee can either acquire 'high' or 'low' human capital; further, only he observes his acquired human capital. Examples of human capital include learning about the firm's processes or developing relationships with customers and vendors. This sort of firm-specific human capital is not necessarily observable to the employer. Upon observing his acquired human capital, the employee submits a report about it to the employer. Importantly, the employee can misreport his human capital at a cost imposed by the internal controls. For instance, the employee could claim to have close ties with the customers while, in reality, he does not. The employer then sorts the employee into a 'difficult' task or an 'easy' task. We interpret the difficult task as one with a 'leadership' focus and the easy task as one with a 'follower' focus. We assume that the employer sorts the good type employee with the high human capital into the difficult task while the bad type employee with high human capital is sorted into the easy task. This sorting structure follows Prendergast (1993). Intuitively, the employer prefers to sort the good type employee into the difficult task since he has the 'right' leadership ability. Further, we assume that all employee types are intrinsically motivated to be sorted into the difficult task; in our model, this corresponds to getting a private benefit when an employee is sorted into the difficult task. One rationalization of this private benefit is as follows: the leadership experience that comes with the difficult task makes the employee more attractive in the (unmodeled) future.

[3] The full article is available at https://www.kornferry.com/insights/articles/tell-or-dont-tell-talking-talent-your-employees.

We show that the employee disclosed to be the good type exerts the most effort into gathering human capital. He is followed by the employee who does not know his type. Finally, the employee who is disclosed to be the bad type exerts the least effort. To understand this result, it is helpful to explore two determinants of the employee's effort into gathering human capital.

First is the 'intrinsic motivation' of being sorted into the difficult task in the form of the private benefit. The employee disclosed to be of the bad type anticipates never being sorted into the difficult task and thus, has low intrinsic motivation. By similar logic, the employee disclosed to be of the good type always anticipates being sorted into the difficult task as long as he acquires high human capital and thus, has a strong intrinsic motivation to exert effort. The employee who does not know his assessment has an intermediate level of intrinsic motivation since he can either be the bad type or the good type.

The second is the employee's payoff from misreporting his human capital. Upon acquiring low human capital, the employee can misreport and potentially obtain the benefit of being sorted into the difficult task. However, as is with the intrinsic motivation, the employee disclosed to be the bad type does not have an incentive to misreport. He anticipates that he will never be sorted into the difficult task due to his type and, consequently, does not engage in costly misreporting. The employee disclosed to be the good type, on the contrary, has a strong incentive to misreport – as long as he reports that he acquired high human capital, he will be sorted into the difficult task. The employee who does not know his assessment has an intermediate incentive to misreport.

An insidious effect of misreporting is that it causes the employee to reduce the amount of effort he provides. Intuitively, if the employee can derive a benefit from shirking and then misreporting, why would he instead want to work? This adverse effect of misreporting on the employee's effort is largest for the employee who is disclosed to be of the good type since he has the greatest incentive to misreport.

When the employer discloses assessments, she gains greater effort from the good type employee but risks lower effort from the bad type employee. However, with the nondisclosure of assessments, she obtains an 'average' amount of effort from both types. Thus, the value of disclosure comes from the greater effort from the good type employee. As a result, disclosure is only optimal when the good type employee under disclosure exerts *sufficiently* greater effort than the average effort exerted by the employee under nondisclosure.

The second determinant of effort – the employee's payoff from misreporting – governs how much greater the good type's effort under disclosure is compared to the average effort exerted by the employee under nondisclosure. When the employee who is disclosed to be of the good type has a large payoff from misreporting, he excessively substitutes misreporting for effort. Thus, his effort is not much greater than the average effort exerted by the employee under nondisclosure. This reduces the value of disclosure for the employer, who instead prefers to withhold assessments. However, for stronger internal controls, misreporting gets costly. This restores effort incentives.

Consequently, our main result shows that for strong enough internal controls, the employee disclosed to be of the good type exerts sufficiently greater effort than the effort exerted by the employee who does not know his type. This makes disclosure of assessments optimal only beyond a certain threshold strength of the internal controls. For weaker internal controls, it is, in fact, optimal to withhold assessments.

Background Literature

We contribute to the literature by explaining why some employers withhold employee assessments. To the best of our knowledge, ours is the first game-theoretic model to tackle this problem. Our solution links the disclosure of assessments to employee effort and the strength of the internal controls system. Prior literature has focused extensively on the employee effort aspect while largely overlooking the internal controls system's strength. For instance, the most closely related paper, Lizzeri et al. (2002), examines the effects of providing performance feedback on employee effort and how that affects the cost of the optimal contract. It concludes that not providing feedback is optimal since it reduces the expected cost of compensation. Our focus is different: we examine assessments instead of feedback, and we focus on a novel mechanism – the internal controls system. Hamner (1975) and Lawler (1972) provide various reasons (such as increased employee engagement and commitment) as to why employers should be transparent with their employees. We examine an outcome that is in contradiction to their recommendation.

In recent years, other papers have also looked at theoretical aspects of employers providing feedback to employees. For instance, Goltsman and Mukherjee (2011), and Aoyagi (2010) outline the optimality of no, partial, or complete disclosure of feedback in a tournament setting. Gershkov and Perry (2009) too examine performance reviews in a tournament setting; however, their focus is primarily on the timing of the performance review rather than the disclosure of the results. Finally, in Prendergast (1992), an employer observes the employee's ability after the first-period task and uses a fast-track promotion to signal to high-ability workers. Our model does not have a signaling focus; instead, we focus on disclosure.

Another related stream of literature examines communication between a principal and a better-informed agent. Specifically, this literature analyzes how optimal contracting or the use of management control systems can mitigate this information asymmetry (see, for example, Christensen (1981); Penno (1984); Christensen (1982)). However, our setting differs from this literature as we assume a better-informed principal (employer). Consequently, our analysis focuses on the principal's decision to disclose information rather than contracting with the agent to receive information.

Our paper is also associated with the literature that examines how incentives can have negative effects. For example, Goldman and Slezak (2006) explore the idea that stock-based compensation might not only induce effort from employees but also cause them to misrepresent performance. Dutta and Gigler (2002) demonstrate that compensation contracts tied to earnings might encourage greater earnings management. Finally, Lazear (1989) shows that the provision of incentives through a wide 'wage-spread' might cause employees to sabotage each other. He uses this result to explain 'wage compression.' Our model has a similar flavor to this overall theme. In our model, the employer does not disclose assessments under certain conditions so that the employee works instead of misreporting his acquired human capital.

Finally, there are parallels between our paper and the literature on career concerns (Gibbons and Murphy, 1992; Holmström, 1999; Dewatripont et al., 1999; Song and Thakor, 2006; Autrey et al., 2010). In our paper, the employee's incentive to exert effort and misreport derives from his chance of being promoted to the difficult task; that is, similar to the literature on career concerns, the employee's action incentives derive from his future career prospects. However, in the typical career concerns model, the principal is unaware of the employee's type, and the agent undertakes an action to inflate the principal's perception of his type. In our setting, the principal – employer – is informed of the agent's – employee's – type. Thus, the economic incentives we outline are different.

2.2 Model Setup

We present a modified version of Prendergast (1993).

Players There are two risk-neutral players – an employer ('she') and an employee ('he').

Timeline There are six dates in the game. At Date 0, the employer publicly commits to a disclosure policy. At Date 1, the employer hires the employee and observes his type. She also potentially discloses the employee's type to him depending on her disclosure policy. At Date 2, the employee works on gathering firm-specific human capital. At Date 3, he observes his human capital and submits a (potentially manipulated) report about it to the employer. At Date 4, the employer sorts the employee appropriately into a 'difficult' or an 'easy' task. At Date 5, the payoffs are realized. Figure 2.1 depicts the timeline.

Employee Types and Disclosure The employee can be of two types, $\eta \in \{G, B\}$ where the G stands for 'good' and B stands for 'bad.' The prior probability of being the good type is β. Then, $\mathbb{P}[\eta = G] = \beta$ and $\mathbb{P}[\eta = B] = (1 - \beta)$. The employer can perfectly observe

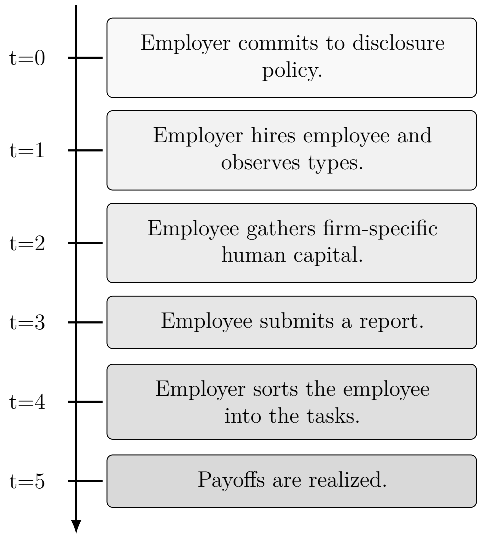

Figure 2.1: Timing of the game.

the employee's type while the employee's type is unknown to himself. This corresponds to the employer having an 'assessment' about the employee.[4]

The employer commits to a disclosure policy before observing the employee's type.[5] Then, according to her chosen policy, she either tells the employee her assessment or keeps it private. As is standard in the voluntary disclosure literature (Grossman, 1981; Dye, 1985), the employer's disclosure is assumed to be truthful.

For ease of exposition, we refer to the employee who is disclosed to be of type $\eta = G$ as the 'disclosed good type employee.' Similarly, we call the employee who is disclosed to be of type $\eta = B$ as the 'disclosed bad type employee.' When the employee does not know the employer's assessment, he is just referred to as the employee who does not know his type.

Firm-Specific Human Capital We model firm-specific human capital similar to Laux (2012). The employee exerts hidden effort e into obtaining human capital. Firm-specific human capital can be thought of as an employee's understanding of the firm's processes or his relationship with the firm's vendors and customers. The cost of exerting effort is given by $\frac{ce^2}{2}$ (and $c > 0$). The employee's realized human capital is denoted by $\theta \in \{H, L\}$

[4] We assume that the employer perfectly observes the employee's type to focus on the question 'Is the disclosure of assessments optimal?' A related setting, previously explored by Crémer (1995) or Laux (2017), is where the employer observes a noisy signal of the employee's type and then exerts effort into uncovering the employee's type. Our focus is not on the learning of the employee's type. This assumption of an informed principal has been used previously in various settings. For instance, see Beaudry (1994), Chade and Silvers (2002), and Benabou and Tirole (2003). Thus, our setting is different from the typical career concerns model as in Holmström (1999), where the agent's type is unknown to the principal, and the agent attempts to 'inflate' the principal's perception of his type through his actions.

[5] Ex-ante commitment to disclosure is broadly used in the literature. See, for instance, Goex and Wagenhofer (2009), Kamenica and Gentzkow (2011), Heinle and Verrecchia (2016), Michaeli (2017), Cianciaruso et al. (2021), and Friedman et al. (2021).

where H refers to 'high' and L refers to 'low' human capital. He acquires high human capital with probability e. Then, $\mathbb{P}[\theta = H] = e$ and $\mathbb{P}[\theta = L] = (1 - e)$.

Misreporting Only the employee observes his realized human capital, θ. He then submits a report $r = j$ with $j \in \{H, L\}$ to the employer. The employee can engage in misreporting, m, to report his human capital incorrectly.[6] For instance, the employee might not understand how or why a particular protocol is followed in the firm but might nonetheless report that he does understand. As will become clear later on, the employee only has an incentive to misreport when his human capital is low.

The misreporting technology is as follows. With probability m, the employee lies about his performance; with complementary probability, he has to report truthfully. That is, $\mathbb{P}[r = H|\theta = L] = m$ and $\mathbb{P}[r = L|\theta = L] = (1 - m)$. Manipulation is associated with a cost $\frac{km^2}{2}$ (and $k > 0$). We interpret k as the *strength* of the internal controls system.

A particularly useful interpretation of k in our setting is that of the tone-at-the-top (TATT). TATT is broadly understood as the ethical environment set by the top management in a firm and comprises an essential factor of the internal control environment (Penno, 2021). The better the TATT, the costlier it is for the employee to misreport his human capital. Relatedly, k can also be interpreted as the cost of deviating from a norm as in Kandel and Lazear (1992); if the norm set by the top management is, to be honest, then deviating from this norm imposes a cost on the employee.

Task Sorting We model the task sorting following Prendergast (1993). The employer needs to assign the employee to either a 'difficult' (D) task or an 'easy' (E) task. D can be thought of as a task with 'leadership' responsibility, and E can be thought of as a task with a 'follower' responsibility. Within this context, the employee's type, η, can be interpreted as his ability to lead well.

The employer's payoff from sorting the employee into the two tasks depends on the employee's characteristics summarized by the vector (η, θ).

The output in task D is given by

$$\text{Output} = \begin{cases} Y & (G, H), \\ 0 & \text{Any other employee characteristics.} \end{cases} \tag{2.1}$$

[6] There *appears* to be an asymmetry in our model where the employer has to disclose truthfully, but the employee might misreport. However, even if we do not explicitly require truthful disclosure from the employer, the game's structure ensures that the employer's disclosure will be truthful. As will become clear later, under disclosure, the employer offers a different wage to the good and the bad type employee. These different wages are optimal for each type. So even without explicitly requiring truthful disclosure from the employer, the employee can infer his type from the wage contract offered to him.

The output in task E is given by

$$\text{Output} = \begin{cases} Z & (G,H) \text{ or } (B,H), \\ 0 & \text{Any other employee characteristics.} \end{cases} \tag{2.2}$$

It is assumed that $Y > Z > 0$; that is, the difficult task (D) generates greater output than the easy task (E).

The outputs in the two tasks in Equations (2.1) and (2.2) point to two features of the employer's sorting preferences. First, the employer only prefers an employee who has high firm-specific human capital. The employer does not retain an employee with low firm-specific human capital.[7] Thus, the employer retains only the employee who reports $r = H$.[8] This output structure ensures that the employee never misreports his human capital as low when it is actually high. Second, the employer prefers to sort the good type into task D and the bad type into task E. Incorrectly sorting the bad type leads to an output of zero while incorrectly sorting the good type leads to a decrease in output of $Y - Z > 0$.

We assume that the employee always prefers to be sorted into task D. This preference is modeled as a private benefit. Specifically, when the employee is promoted to task D, he receives a private benefit $\psi > 0$.[9] This preference can be rationalized by interpreting the leadership responsibility that comes with D as a valuable experience that leads to better opportunities in the (unmodeled) future.

Contracting The employer offers a wage, W, at the end of tasks D or E to the employee if either Y or Z is realized. In other words, the employer only pays the employee once it is clear that he acquired high human capital. We assume that the employee is protected by limited liability, and thus, $W > 0$. It is worth emphasizing that the wage is paid for

[7] An alternate specification is that an employee with $\theta = L$ is sorted into E and generates positive output $Z_2 < Z$ instead of generating zero. Under such a specification, the employer would retain the employee who reports $r = L$. However, none of our other results would change. Z_2 is normalized to zero to economize on notation.

[8] A more formal way to show this would be as follows. Assume that sorting the 'wrong' employee yields an arbitrarily small payoff $-\varepsilon < 0$ instead of zero. That is, retaining the wrong employee is associated with a small cost to the employer. Now, assume that the employee reports $r = L$. In that case, the employer strictly prefers not to retain this employee since it will cost her ε. If the employee reports $r = H$, the employer's posterior probability that the employee succeeded is given by Bayes' rule: $\mathbb{P}[\theta = H | r = H] = \frac{e}{e+(1-e)m}$. Without loss of generality, assume that the employee's type is good. Then, the employer's expected payoff from sorting this employee into D is: $\mathbb{P}[\theta = H | r = H]Y - (1 - \mathbb{P}[\theta = H | r = H])\varepsilon > 0$ for an arbitrarily small ε. Thus, the employer only retains the employee who reports $r = H$.

[9] Previous papers have also used private benefits as a modeling tool especially in settings with task retentions; for instance, see Hermalin and Weisbach (1998) or Laux (2017).

the employee's effort in gathering human capital. It is not paid for the outputs obtained in tasks D or E since these outputs are assumed to be exogenous for simplicity.[10]

In the appendix, we explore a more detailed contract where the employer offers a wage contingent on the report r and also offers a wage at the end of tasks D or E if an output of zero is realized. We show that in equilibrium, all these other wages are zero. Intuitively, the employer does not offer a positive wage for an output of zero on tasks D or E since rewarding failure only makes it harder to induce effort from the employee. She also does not offer a positive wage based on the report since it induces greater misreporting.

Payoffs The employer's ex-ante payoff in the case of disclosure, V_A (where A stands for 'assessment'), is

$$V_A := \beta e_G(Y - W_G) + (1-\beta)e_B(Z - W_B). \tag{2.3}$$

The first (second) term on the right is the expected output net of the compensation from the good (bad) type. Since the employee knows his type with disclosure, he exerts effort e_G (e_B) and is compensated with a wage W_G (W_B) if he is the good (bad) type.

In the case of nondisclosure, both types are pooled and, therefore, exert a 'pooled' amount of effort. The compensation is also not conditioned on the employee's specific type since the employer does not disclose the assessment. Thus, the employer's ex-ante payoff in case of nondisclosure, V_{NA} (where NA stands for 'no assessment'), is

$$V_{NA} := e_{NA}(\beta Y + (1-\beta)Z - W_{NA}). \tag{2.4}$$

V_A and V_{NA} have a similar form. The two differences are as follows. In V_{NA}, the employer anticipates a pooled amount of effort from both types, e_{NA}, instead of type-specific efforts, e_G and e_B, in V_A. Similarly, she anticipates paying out a pooled wage, W_{NA}, in V_{NA} instead of type-specific wages, W_G and W_B, in V_A.

The employee's ex-ante payoff in the case of nondisclosure is

$$U_{NA} := e_{NA}(\beta\psi + W_{NA}) + (1-e_{NA})\left(m_{NA}\beta\psi - \frac{km_{NA}^2}{2}\right) - \frac{ce_{NA}^2}{2}. \tag{2.5}$$

The first term on the right is the employee's expected payoff from developing high human capital. The second term is his expected payoff from misreporting. Finally, the last term on the right is his cost of effort.

In the case of disclosure, the employee learns his type and accordingly substitutes $\beta = 1$ or $\beta = 0$ appropriately into Equation (2.5). Additionally, the pooled quantities – W_{NA},

[10] An alternate contractual form would be to structure the sorting into the tasks like a tournament (as in Lazear and Rosen (1981) or Lazear (1989)). Then, each task – D or E – is associated with a task-specific wage. We analyze this contractual form in the appendix and show that our results continue to hold.

m_{NA}, and e_{NA} – are replaced by the type appropriate quantities. For instance, when $\beta = 1$ (i.e., when the employee is disclosed to be the good type), the pooled quantities are replaced by W_G, m_G, and e_G.

Discussion of Prendergast (1993) Our model differs from Prendergast (1993) in the following significant way. In his model, the employee's characteristics, (η, θ), are assumed to be symmetrically known or unknown to both the employer and the employee. We introduce asymmetry; specifically, the employee's type, η, is known to the employer while his acquired human capital, θ, is known (at least at the time of sorting) only to himself. This asymmetry allows us to examine two key ingredients of our setup: disclosure of assessments (η) and misreporting of the employee's acquired human capital (θ).
There are other modeling differences. For instance, in Prendergast (1993), the employee's acquisition of human capital does not stochastically depend on effort. He can acquire it for a fixed cost. In contrast, we introduce the acquisition of human capital that stochastically depends on the employee's effort. Another difference is that in his model, the employee types are continuous. To simplify our model, we analyze binary types since we also explore effort and misreporting.

2.3 Disclosure of Assessments

In this section, the employer discloses her assessment of the employee. We solve the game by backward induction. The first step is to solve the employee's misreporting decision, given that he observes his human capital to be low ($\theta = L$).

2.3.1 Misreporting

Type $\eta = G$ The good type solves the following problem:

$$\max_{m} \quad \mu_G := m\psi - \frac{km^2}{2}, \tag{2.6}$$

where μ_G captures the good type's ex-ante payoff from engaging in misreporting. The first term on the right is the expected private benefit of being sorted into D, while the second term is the cost of misreporting.
The arg max of Equation (2.6) is given by

$$m_G^* := \frac{\psi}{k}. \tag{2.7}$$

The solution to Equation (2.6) is given by

$$\mu_G^* := \frac{\psi^2}{2k}. \tag{2.8}$$

Type $\eta = B$ The bad type never misreports. This is due to two reasons. First, since the employer knows the employee's type, he is never sorted to D, and thus, there is no private benefit to misreporting. Second, there is no wage benefit to misreporting since the employer only offers a wage once the outputs in D or E are realized. At this point, the employee's true human capital is revealed.[11]

2.3.2 Effort

We now solve for the employee's effort decision.

Type $\eta = G$ The good type solves the following problem:

$$\max_{e} \quad U_G := e(W+\psi) + (1-e)\mu_G^* - \frac{ce^2}{2}. \tag{2.9}$$

The good type employee's expected payoff U_G in Equation (2.9) is obtained by substituting $\beta = 1$ into U_{NA} from Equation (2.5). The first term on the right in Equation (2.9) is the employee's payoff from acquiring high human capital. The second term is his anticipated payoff from misreporting his human capital if he acquires low human capital (μ_G^* is derived in Equation (2.8)). The final term is his cost of exerting effort.
The first-order condition (FOC) to the problem in Equation (2.9) is given by

$$W + \psi - \mu_G^* - ce = 0. \tag{IC: $\eta = G$}$$

This FOC determines the good type employee's labor supply and serves as the good type's incentive-compatibility constraint (IC).

Type $\eta = B$ The bad type solves the following problem:

$$\max_{e} \quad U_B := eW - \frac{ce^2}{2}. \tag{2.10}$$

The bad type employee's expected payoff U_B in Equation (2.10) is obtained by substituting $\beta = 0$ into U_{NA} from Equation (2.5). The first term on the right in Equation (2.10) is the employee's payoff from acquiring high human capital. The second term is his cost of exerting effort.
The FOC to Equation (2.10) is given by

$$W - ce = 0. \tag{IC: $\eta = B$}$$

[11] This argument is proved more rigorously in the appendix where we show that the employer indeed sets the report-contingent wage to zero.

2.3.3 Optimal Contract

Finally, we explore the optimal contract.

Type $\eta = G$ The employer solves the following problem when she contracts with a good type employee:

$$\begin{aligned}
\max_{e} \quad & V_G := e(Y - W) \\
& \text{Subject to:} \\
& \text{IC: } W + \psi - \mu_G^* - ce = 0 \\
& W \geq 0
\end{aligned} \tag{2.11}$$

with V_G capturing the employer's payoff from the good type employee. She maximizes V_G subject to the employee's IC constraint and the non-negativity constraint on the wage. The arg max to the problem in Equation set (2.11) is given by

$$e_G^* := \frac{Y + \psi - \mu_G^*}{2c}. \tag{2.12}$$

Substituting e_G^* into the good type's IC allows us to solve for the optimal wage offered to the good type employee:[12]

$$W_G^* := \frac{Y - \psi + \mu_G^*}{2}. \tag{2.13}$$

Type $\eta = B$ The employer solves the following problem when she contracts with a bad type employee:

$$\begin{aligned}
\max_{e} \quad & V_B := e(Z - W) \\
& \text{Subject to:} \\
& \text{IC: } W - ce = 0 \\
& W \geq 0
\end{aligned} \tag{2.14}$$

with V_B capturing the employer's payoff from the bad type employee. She maximizes V_B subject to the non-negativity constraint on the wage and the employee's IC constraint. The arg max to the problem in Equation set (2.14) is given by

$$e_B^* := \frac{Z}{2c}. \tag{2.15}$$

Substituting e_B^* into the bad type's IC allows us to solve for the optimal wage given to the bad type employee:

$$W_B^* := \frac{Z}{2}. \tag{2.16}$$

[12] To enforce the non-negativity constraint on the wage, we assume $Y > \psi$.

Assumption 1. *To ensure interior solutions for m_G^*, e_B^*, and e_G^*, it is assumed that*

$$k \in \left(\psi, \frac{\psi^2}{2(\psi + Y - 2c)}\right),$$
$$c \in \left(\frac{2Y + \psi}{4}, \frac{Y + \psi}{2}\right).$$

We call the 'permissible' values of k defined by Assumption 1 the 'valid domain of k.' Lemma 2.1 summarizes the equilibrium values for when the employer discloses assessments.

Lemma 2.1. *When the employer discloses assessments:*

1. *The good type misreports $m_G^* = \frac{\psi}{k}$, exerts effort $e_G^* = \frac{Y+\psi-\mu_G^*}{2c}$, and is paid a wage $W_G^* = \frac{Y-\psi+\mu_G^*}{2}$.*
2. *The bad type does not misreport, exerts effort $e_B^* = \frac{Z}{2c}$, and is paid a wage $W_B^* = \frac{Z}{2}$.*
3. *The employer's ex-ante equilibrium payoff, V_A^*, is described by Equation (2.3) with the appropriate equilibrium values plugged in.*

2.4 Nondisclosure of Assessments

In this section, the employer withholds her assessment of the employee. As in the previous section, we solve the game by backward induction. First, we solve the employee's misreporting decision given that he observes his human capital to be low ($\theta = L$).

2.4.1 Misreporting

The employee's problem is given by

$$\max_{m} \quad \mu_{NA} := m\beta\psi - \frac{km^2}{2}, \tag{2.17}$$

where μ_{NA} captures the employee's ex-ante payoff from engaging in misreporting when he does not know the employer's assessment. The employee's payoff from misreporting, μ_{NA}, resembles μ_G – the good type's payoff from misreporting (defined in Equation (2.6)) – except that the private benefit is multiplied by β. Since the employee does not know his type without disclosure, his private benefit from misreporting is discounted by the probability of being the good type.

The arg max to Equation (2.17) is

$$m_{NA}^* := \frac{\beta\psi}{k}. \tag{2.18}$$

The solution to the problem in Equation (2.17) is given by

$$\mu^*_{NA} := \frac{\beta^2\psi^2}{2k}. \tag{2.19}$$

2.4.2 Effort

We now solve the employee's effort decision. His problem is given by

$$\max_e \quad U_{NA} := e(W+\beta\psi) + (1-e)\mu^*_{NA} - \frac{ce^2}{2}. \tag{2.20}$$

U_{NA} is a simplified version of Equation (2.5) and captures the employee's ex-ante payoff when the assessment is unknown. The first term on the right is the employee's expected payoff from developing high human capital. Note that he only gets the private benefit, ψ, of being sorted into D when his type is good, which happens with probability β. The second term is his anticipated payoff from misreporting if he acquires low human capital (as defined in Equation (2.19)). The third term is his cost of effort.

The FOC to the maximization problem in Equation (2.20) is given by

$$W - ce - \mu^*_{NA} + \beta\psi = 0. \tag{IC: NA}$$

This FOC serves as the employee's incentive compatibility constraint for when he does not know the employer's assessment.

2.4.3 Optimal Contract

We now examine the employer's optimal contract. The employer solves the following problem:

$$\begin{aligned} \max_e \quad & V_{NA} := e(\beta Y + (1-\beta)Z - W) \\ & \text{Subject to:} \\ & \text{IC: } W - ce - \mu^*_{NA} + \beta\psi = 0 \\ & W \geq 0 \end{aligned} \tag{2.21}$$

with V_{NA} capturing the employer's ex-ante payoff. Her problem is to maximize her ex-ante payoff subject to the employee's IC constraint and the non-negativity constraint on the wage.

The employer maximizes her ex-ante payoff by offering an *identical* contract to both types even though she eventually observes the employee's type. If the employer conditions the effort she induces on her private information by offering different wages for both types, the employee would be able to infer his type from the offered contract.[13] To ensure that she remains within the paradigm of nondisclosure, the employer then induces an effort level that is not contingent on her private information; that is, she offers an *identical* contract designed at the ex-ante stage to both types. Thus, in the nondisclosure setting, the employer 'posts' a type-independent wage for the task of acquiring firm-specific human capital such that both types exert the same amount of effort. In the disclosure setting, the employer tailors the wage to the employee's type for acquiring human capital such that both types exert different effort.

The arg max to the problem in Equation (2.21) is given by

$$e^*_{NA} := \frac{\beta(Y+\psi)+Z(1-\beta)-\mu^*_{NA}}{2c}. \tag{2.22}$$

Substituting e^*_{NA} into the IC yields the equilibrium wage

$$W^*_{NA} := \frac{\beta(Y-\psi)+Z(1-\beta)+\mu^*_{NA}}{2}. \tag{2.23}$$

Lemma 2.2 summarizes the equilibrium values for when the employer does not disclose assessments.

Lemma 2.2. *When the employer does not disclose assessments:*

1. *The employee misreports* $m^*_{NA} := \frac{\beta\psi}{k}$, *exerts effort* $e^*_{NA} := \frac{\beta(Y+\psi)+Z(1-\beta)-\mu^*_{NA}}{2c}$, *and is paid a wage* $W^*_{NA} := \frac{\beta(Y-\psi)+Z(1-\beta)+\mu^*_{NA}}{2}$.[14]
2. *The employer's ex-ante equilibrium payoff,* V^*_{NA}, *is described by Equation (2.4) with the appropriate equilibrium values plugged in.*

2.5 Optimal Disclosure Policy

2.5.1 Comparison and Analysis of Equilibrium Effort and Misreporting

Proposition 2.1 summarizes the comparison of the equilibrium effort and misreporting.

Proposition 2.1 (Comparison of Effort and Misreporting)**.**

1. *The employee disclosed to be of type* $\eta = G$ *('disclosed good type employee') misreports the most, and is followed by the employee who is not told his type. The employee disclosed to be of type* $\eta = B$ *('disclosed bad type employee') does not misreport. Formally,*

$$m^*_B = 0 < m^*_{NA} < m^*_G.$$

[13] Effectively, the employer would signal the employee's type through her offered contract (this sort of signaling is reminiscent of Leland and Pyle (1977)). We wish to avoid this kind of signaling since our focus is on the incentive effects of explicit disclosure and nondisclosure of assessments.

[14] It can be checked that Assumption 1 guarantees interior solutions for m^*_{NA} and e^*_{NA}.

2. *The employee disclosed to be of type $\eta = G$ exerts the most effort, and is followed by the employee who is not told his type. The employee disclosed to be of type $\eta = B$ exerts the least effort. Formally,*

$$e_B^* < e_{NA}^* < e_G^*.$$

Proof. See appendix. □

The intuition leading to the results in part (1) of Proposition 2.1 is as follows: The employee's incentive to misreport derives from his private benefit, ψ, of being sorted into D. The disclosed bad type employee knows that he is never sorted into D and thus never misreports. The disclosed good type employee knows that as long as he reports that his human capital is high, he will be sorted into D. This gives him a strong incentive to misreport if his human capital is low. The employee who does not know his type misreports an average amount since his prior belief of being the good type is β and of being the bad type $(1-\beta)$.

There are three determinants of the equilibrium effort. First is the employee's private benefit of being sorted into D. The private benefit provides the employee with intrinsic motivation to exert effort. This intrinsic motivation is the largest for the disclosed good type employee since he knows he will be sorted into D as long as he acquires high human capital. By the same logic, the disclosed bad type employee has no intrinsic motivation to exert effort since he never anticipates being sorted into D. The employee who does not know his type has an average amount of intrinsic motivation derived from a β probability of being the good type and a $(1-\beta)$ probability of being the bad type.

The second determinant of the equilibrium effort is the wage offered to the employee. One component of the optimal wage is the employee's anticipated output in either task D or E. Since the good type produces Y and the bad type produces Z and $Z < Y$, the employer provides larger extrinsic motivation by increasing the output component of the optimal wage provided to the disclosed good type employee. The employee who does not know his type is offered an average extrinsic motivation since he produces Y with probability β and Z with probability $(1-\beta)$.[15]

The third determinant of equilibrium effort is the employee's payoff from misreporting. Since misreporting allows the employee potentially to obtain a private benefit of being sorted into D, it decreases his incentive to exert effort. After all, why would the employee work if, instead, he could shirk and then derive a benefit from misreporting? Following part (1) of Proposition 2.1, the incentive to shirk due to the possibility of misreporting is greatest for the disclosed good type employee and lowest for the disclosed bad type

[15] The second component of the optimal wage is the employee's anticipated misreporting. In equilibrium, the ordering of the optimal wages will depend on the combination of the output component and the misreporting component.

employee. Like the intuition in the first two determinants, the employee who does not know his type has an average incentive to shirk. The combination of the three determinants of the equilibrium effort – intrinsic motivation, extrinsic motivation, and shirking due to misreporting – lead to the result in part (2) of Proposition 2.1.

Corollary 2.1. *The disclosed good type employee's payoff from misreporting is the largest. The employee who does not know his type has the second-largest payoff from misreporting. The disclosed bad type employee's payoff from misreporting is the least. Formally,*

$$\mu_B^* = 0 < \mu_{NA}^* < \mu_G^*.$$

The employee's payoff from misreporting depends on two factors. First is the expected payoff from being sorted into D. This payoff is the largest for the disclosed good type employee since he gets ψ with certainty. The employee who does not know his type expects $\beta\psi$ since there is only a β probability that he is the good type. Second is the amount of misreporting that the employee engages in. Following Proposition 2.1, the disclosed good type employee misreports the most, followed by the employee who does not know his type. Both factors complement each other and thus, lead to the result in Corollary 2.1. Since the disclosed bad type employee never misreports, his payoff from misreporting is zero.

Proposition 2.2 summarizes the comparative statics of the equilibrium payoffs from misreporting, efforts and wages with respect to the cost of misreporting k.

Proposition 2.2 (Comparative Statics)**.**

1. *The equilibrium payoffs from misreporting μ_G^* and μ_{NA}^* are decreasing in the strength of the internal controls, k. Formally, $\frac{d\mu_G^*}{dk} < 0$ and $\frac{d\mu_{NA}^*}{dk} < 0$.*

   Moreover,
   $$\frac{d\mu_G^*}{dk} < \frac{d\mu_{NA}^*}{dk}.$$

2. *The equilibrium efforts e_G^* and e_{NA}^* are increasing in the strength of the internal controls, k. Formally, $\frac{de_G^*}{dk} > 0$ and $\frac{de_{NA}^*}{dk} > 0$.*

   Moreover,
   $$\frac{de_G^*}{dk} > \frac{de_{NA}^*}{dk}.$$

3. *The equilibrium wages W_G^* and W_{NA}^* are decreasing in the strength of the internal controls, k. Formally, $\frac{dW_G^*}{dk} < 0$ and $\frac{dW_{NA}^*}{dk} < 0$.*

   Moreover,
   $$\frac{dW_G^*}{dk} < \frac{dW_{NA}^*}{dk}.$$

Proof. See appendix. □

Part (1) of Proposition 2.2 states that an increase in the strength of the internal controls, k, decreases the equilibrium payoff from misreporting. This result is quite intuitive – stronger internal controls deter misreporting by making it more costly. However, this reduction in misreporting is greater for the disclosed good type employee than for the employee who does not know his type. This is because the disclosed good type employee's misreporting choice is more sensitive to k than is the misreporting choice of the employee who does not know his type. Specifically, the disclosed good type employee's misreporting choice is determined by k. In contrast, the employee who does not know his type bases his misreporting decision on k and the prior probability of being the good type, β. The key idea here is that the uncertainty of type mutes the effect of stronger internal controls on the employee's incentive to misreport.

Part (2) of Proposition 2.2 states that the equilibrium efforts are increasing in stronger internal controls, k. The intuition here is that effort and misreporting behave as substitutes. If the employee can derive a payoff from exerting low effort and then misreporting, his incentive to work hard is diminished. Consequently, since misreporting is costlier for a larger k, the employee chooses to exert greater effort. Furthermore, this increase in effort is larger for the disclosed good type employee than the employee who does not know his type. This follows from part (1) of Proposition 2.2 – since a larger k decreases the disclosed good type's payoff from misreporting more (as compared to the employee who does not know his type), his effort increases more with a greater k.

Part (3) of Proposition 2.2 states that the equilibrium wages are decreasing in stronger internal controls, k. The equilibrium wages are determined by the employee's supply of effort as defined by the IC constraints. The more motivated the employee is to exert effort, the lower is the wage required. From part (2) of Proposition 2.2, we know that stronger controls increase the employee's incentive to exert effort. Moreover, this increase is greater for the disclosed good type employee than for the employee who does not know his type. Consequently, stronger controls reduce the equilibrium wages by motivating the employee to exert effort by making misreporting relatively unattractive. Additionally, this effect is strongest for the disclosed good type employee.

To answer the question of when the employer discloses or withholds assessments, we compare the employer's ex-ante payoff with and without disclosure. The difference in the employer's expected payoffs between the two disclosure policies is described by

$$\Delta V := V_A^* - V_{NA}^* = \Delta O - \Delta W. \tag{2.24}$$

ΔO is the difference in the expected outputs between the two disclosure regimes:

$$\Delta O := \underbrace{\beta e_G^* Y + (1-\beta) e_B^* Z}_{\text{Expected Output Under Disclosure}} - \overbrace{e_{NA}^* (\beta Y + (1-\beta) Z)}^{\text{Expected Output Under Nondisclosure}} . \tag{2.25}$$

ΔW is the difference in the expected wages between the two disclosure regimes:

$$\Delta W := \underbrace{\beta e_G^* W_G^* + (1-\beta) e_B^* W_B^*}_{\text{Expected Wage Under Disclosure}} - \overbrace{e_{NA}^* W_{NA}^*}^{\text{Expected Wage Under Nondisclosure}} . \tag{2.26}$$

To analyze the effects of stronger internal controls on the employer's optimal disclosure policy, we examine how ΔO and ΔW vary with k. Corollary 2.2 summarizes the results.

Corollary 2.2. *For the valid domain of k, ΔO is increasing in k and ΔW is decreasing in k.*

Proof. See appendix. □

Corollary 2.2 follows from parts (2) and (3) of Proposition 2.2. An increase in k increases the disclosed good type employee's effort sufficiently more than it increases the effort exerted by the employee who does not know his type. Consequently, the difference in the expected outputs, ΔO, is increasing in k. An increase in k also decreases the wage for the disclosed good type employee sufficiently more than it does for the employee who does not know his type. Then, ΔW is decreasing in k. The contribution of Corollary 2.2 is to highlight that the effects in parts (2) and (3) of Proposition 2.2 are *sufficiently* large.

2.5.2 Analysis of the Optimal Disclosure Policy

Our overarching goal in this section is to compare V_A^* with V_{NA}^*; that is, we want to compare the employer's ex-ante payoff with and without disclosure to derive her optimal disclosure policy as a function of the internal controls. The following numerical example provides intuition for our main result.

Numerical Parameters We assume that $\psi = 2.5$, $Y = 2$, $Z = 1$, and $\beta = 0.75$. These are our 'unbounded' exogenous parameters. In contrast, c and k are bounded according to Assumption 1. Plugging in the values for the exogenous parameters into Assumption 1 yields the following numerical bounds on k and c:

$$k \in (2.5, 6.25),$$
$$c \in (1.625, 2.25).$$

Thus, we assume $c = 2$. Figure 2.2 depicts ΔO, ΔW, and ΔV as functions of k (in the valid domain of k) for the numerical example. Figure 2.2 shows that there exists a k threshold (labeled as $\bar{k}$) such that for $k < \bar{k}$, $\Delta V < 0$ and for $k > \bar{k}$, $\Delta V > 0$. That is, for a sufficiently small (large) k, nondisclosure (disclosure) is optimal.

We can now state our main result regarding the employer's choice of disclosure versus nondisclosure.

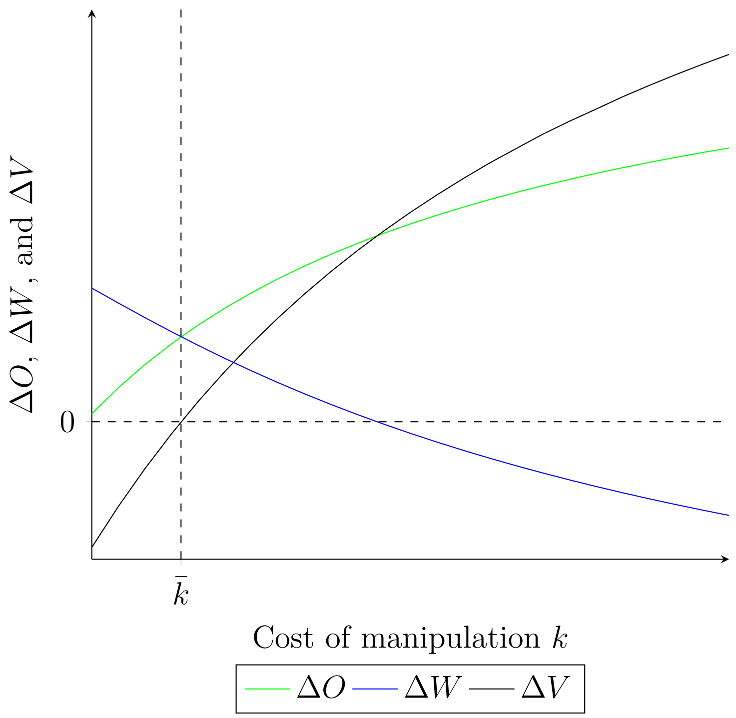

Figure 2.2: ΔO, ΔW, and ΔV plotted for $\psi = 2.5, Y = 2, Z = 1, \beta = 0.75$, and $c = 2$.

Proposition 2.3. *There exists a threshold $\bar{k}$ such that for all $k < \bar{k}$ ($k > \bar{k}$), the employer chooses to withhold (disclose) assessments.*

Proof. See appendix. □

The intuition for Proposition 2.3 is as follows. The employer chooses to disclose iff $\Delta V > 0$. Rewriting this condition, the employer chooses to disclose iff

$$\Delta V = \Delta O - \Delta W > 0.$$

where the second equality follows from Equation (2.24). Intuitively, the difference in the payoffs from disclosure and nondisclosure can be broken down into the difference in expected outputs, ΔO, and expected wages, ΔW.

From Corollary 2.2, we know that the difference in expected outputs is increasing in k. When the employer discloses the assessments, the disclosed good type employee not only exerts greater effort compared to the employee who does not know his type but also misreports more (Proposition 2.1). The disclosed bad type employee exerts lesser effort compared to the employee who does not know his type. Thus, the value of the disclosure of assessments comes from the larger effort of the disclosed good type employee – however, this value is diminished by the disclosed good type employee's misreporting. A larger k increases the employee's incentive to exert effort by making misreporting relatively more unattractive. Further, following Proposition 2.2, a larger k increases the disclosed good type employee's effort more than it increases the effort exerted by the employee who does not know his type. Thus, larger values of k make the disclosure of assessments more attractive by increasing the difference in expected outputs, ΔO.

Similarly, from Corollary 2.2, we can observe that the negative of the difference of expected wages, $-\Delta W$, is also increasing in k. Since stronger controls increase the disclosed good type employee's incentive to exert effort more than they increase the effort incentives for the employee who does not know his type, the wage offered to the disclosed good type employee also decreases faster with a larger k (Proposition 2.2). Consequently, larger values of k also make the disclosure of assessments more attractive by reducing the difference in the expected wages, ΔW.

Thus, for a large enough k, the expected output net of the compensation costs is larger when the employer discloses assessments. This induces the employer to disclose assessments *only* when the internal controls are strong enough; otherwise, it is optimal to withhold assessments.

2.6 Conclusion

In this paper, we explain why some employers do not disclose assessments to employees. Popular managerial guidance books and consulting firms argue that disclosing assessments increases engagement and effort from 'good' employees, boosting profits. However, this then raises the question, 'why do so many firms withhold assessments?' We provide a novel solution to this question by linking the disclosure of assessments to the strength of the internal controls. Specifically, the value of the disclosure of assessments comes from the greater effort exerted by the employees who are disclosed to be of the good type. However, the potential for misreporting decreases *how much* greater this effort is. Stronger internal controls reduce misreporting and restore effort incentives. Thus, our fundamental insight is that some employers might withhold assessments when the internal controls are relatively weak.

Our model generates the following predictions that can be tested well experimentally:

1. The effort exerted by the disclosed good type employees is greater than the average effort exerted by the employees whose types are not disclosed.

2. The disclosed good type employees misreport more than the employees whose types are not disclosed.

3. The disclosure of assessments is more likely in firms with strong internal controls than in firms with weak internal controls.

We encourage future research to test our theory.

2.7 Appendix

2.7.1 Proof of Proposition 2.1

Proof. In equilibrium, $m_G^* = \frac{\psi}{k}$ and $m_{NA}^* = \frac{\beta\psi}{k}$. Now,

$$m_G^* > m_{NA}^* \implies 1 > \beta \tag{2.27}$$

which is true. Since m_{NA}^* is positive, this proves part (1).
We break part (2) into two parts. First, we prove $e_B^* < e_{NA}^*$. In equilibrium, $e_B^* = \frac{Z}{2c}$ and $e_{NA}^* = \frac{\beta(Y+\psi)+Z(1-\beta)-\mu_{NA}^*}{2c}$. Comparing the two and simplifying yields

$$e_B^* < e_{NA}^* \implies k > \frac{\beta\psi^2}{2(Y+\psi-Z)}. \tag{2.28}$$

Now, from Assumption 1, we know that k is bounded below by ψ. Thus, all that remains to check is that $\psi > \frac{\beta\psi^2}{2(Y+\psi-Z)}$:

$$\psi > \frac{\beta\psi^2}{2(Y+\psi-Z)} \implies 2(Y-Z)+\psi(2-\beta) > 0 \tag{2.29}$$

which is true since $Y > Z$. Thus, we conclude that $e_B^* < e_{NA}^*$.
Now we prove $e_{NA}^* < e_G^*$. In equilibrium, $e_G^* = \frac{Y+\psi-\mu_G^*}{2c}$. Comparing e_G^* with e_{NA}^* yields

$$e_G^* > e_{NA}^* \implies k > \frac{\psi^2(1+\beta)}{2(Y+\psi-Z)}. \tag{2.30}$$

As above, from Assumption 1, we know that k is bounded below by ψ. Thus, all that remains is to check that $\psi > \frac{\psi^2(1+\beta)}{2(Y+\psi-Z)}$:

$$\psi > \frac{\psi^2(1+\beta)}{2(Y+\psi-Z)} \implies -\psi(1-\beta) < 2(Y-Z) \tag{2.31}$$

which is true since $Y > Z$. Thus, we conclude that $e_G^* > e_{NA}^*$.
Combining both parts proves part (2). □

2.7.2 Proof of Proposition 2.2

Proof. We first tackle part (1). Taking straightforward derivatives of μ_G^* and μ_{NA}^* with respect to k proves the first part:

$$\frac{d\mu_G^*}{dk} = \frac{-\psi^2}{2k^2} < 0, \text{and} \tag{2.32}$$

$$\frac{d\mu_{NA}^*}{dk} = \frac{-\beta^2\psi^2}{2k^2} < 0. \tag{2.33}$$

Comparing both these derivatives and simplifying yields

$$\frac{d\mu_G^*}{dk} < \frac{d\mu_{NA}^*}{dk} \implies 1 > \beta^2 \tag{2.34}$$

which is true. This proves part (1).
We now tackle part (2). Taking derivatives of e_G^* and e_{NA}^* with respect to k proves the first part:

$$\frac{de_G^*}{dk} = \frac{\psi^2}{4ck^2} > 0, \text{and} \tag{2.35}$$
$$\frac{de_{NA}^*}{dk} = \frac{\beta^2\psi^2}{4ck^2} > 0. \tag{2.36}$$

Comparing both these derivatives and simplifying yields

$$\frac{de_G^*}{dk} > \frac{de_{NA}^*}{dk} \implies 1 > \beta^2 \tag{2.37}$$

which is true. This proves part (2).
We finally tackle part (3). Taking derivative of W_G^* and W_{NA}^* with respect to k proves the first part:

$$\frac{dW_G^*}{dk} = \frac{-\psi^2}{4k^2} < 0, \text{and} \tag{2.38}$$
$$\frac{dW_{NA}^*}{dk} = \frac{-\beta^2\psi^2}{4k^2} < 0. \tag{2.39}$$

Comparing both these derivatives and simplifying yields

$$\frac{dW_G^*}{dk} < \frac{dW_{NA}^*}{dk} \implies 1 > \beta^2 \tag{2.40}$$

which is true. This proves part (3). □

2.7.3 Proof of Corollary 2.2

Proof. We take a derivative of ΔO with respect to k and simplify:

$$\frac{d\Delta O}{dk} = \frac{(1-\beta)\beta\psi^2((1+\beta)Y - \beta Z)}{4ck^2} > 0 \tag{2.41}$$

which is true since $Y > Z$. Thus, $\frac{d\Delta O}{dk}$ is positive.
We take a derivative of ΔW with respect to k and simplify:

$$\frac{d\Delta W}{dk} = \frac{\beta(1-\beta)\psi^3\left(\psi(1+\beta+\beta^2) - 2k(1+\beta)\right)}{8ck^3} < 0 \implies k > \frac{\psi(1+\beta+\beta^2)}{2(1+\beta)}. \tag{2.42}$$

Now, we know that $k > \psi$ from Assumption 1. Comparing ψ with $\frac{\psi(1+\beta+\beta^2)}{2(1+\beta)}$ yields

$$\psi > \frac{\psi(1+\beta+\beta^2)}{2(1+\beta)} \implies \beta^2 < (1+\beta) \tag{2.43}$$

which is true. Thus, $\frac{d\Delta W}{dk}$ is negative. □

2.7.4 Proof of Proposition 2.3

Proof. We break this proof into two lemmata.

Lemma 2.3. *There exist thresholds $\underline{k}$ and $\bar{k}$ such that for $k \in \{\underline{k}, \bar{k}\}$, $\Delta V = 0$.*

Proof. We set $\Delta V = 0$ and isolate k. The expression $\Delta V = 0$ is quadratic in k. Thus, we get two roots for k.

$$\begin{aligned}\Delta V = 0 \implies k = &\frac{\psi^2}{2(Y+\psi-Z)^2}((1+\beta)(Y+\psi)-\beta Z \pm \\ &\sqrt{\beta(Y+\psi)^2+2Z(Y+\psi)-Z^2(1+\beta)}).\end{aligned} \tag{2.44}$$

We denote the smaller root (with the negative sign) as $\underline{k}$ and the larger root (with the positive sign) as $\bar{k}$. □

Lemma 2.4. *For the valid domain of k as defined in Assumption 1, the difference in expected payoffs is increasing in k. Formally, $\frac{d\Delta V}{dk} > 0$. Further, $\underline{k}$ is excluded by Assumption 1.*

Proof. We take a derivative of ΔV with respect to k and simplify:

$$\frac{d\Delta V}{dk} = \frac{\beta(1-\beta)\psi^2}{8ck^3}\left(2k((1+\beta)(Y+\psi)-\beta Z)-\psi^2(1+\beta+\beta^2)\right). \tag{2.45}$$

This derivative is positive when

$$\frac{d\Delta V}{dk} > 0 \implies k > \hat{k} = \frac{\psi^2(1+\beta+\beta^2)}{2((1+\beta)(Y+\psi)-\beta Z)}. \tag{2.46}$$

Note that $\hat{k}$ is a local extremum. We now examine the second-order condition (SOC) to determine whether it is a minimum or maximum.

The SOC is given by

$$\frac{d^2\Delta V}{dk^2} := \frac{(1-\beta)\beta\psi^2\left(-4k((1+\beta)(Y+\psi)-\beta Z)+3\psi^2\left(\beta^2+\beta+1\right)\right)}{8ck^4}. \tag{2.47}$$

Substituting $\hat{k}$ into the SOC yields

$$\frac{2(1-\beta)\beta((1+\beta)(Y+\psi)-\beta Z)^4}{\left(\beta^2+\beta+1\right)^3 c\psi^4} > 0. \tag{2.48}$$

This proves that $\hat{k}$ is a minimum.
Comparing with the smaller indifference threshold $\underline{k}$ identified in Lemma (2.3) yields

$$\begin{aligned} &\frac{\psi^2(1+\beta+\beta^2)}{2((1+\beta)(Y+\psi)-\beta Z)} > \underline{k} \\ \implies & 0 > -(1+\beta+\beta^2)(Y+\psi-Z)^2\left(\beta(Y+\psi)^2-(1+\beta)Z^2+2Z(Y+\psi)\right) \end{aligned} \tag{2.49}$$

which is true since the term on the right is negative. This allows us to establish that $\hat{k} > \underline{k}$.
Comparing with the larger indifference threshold $\bar{k}$ identified in Lemma (2.3) yields

$$\begin{aligned} &\frac{\psi^2(1+\beta+\beta^2)}{2((1+\beta)(Y+\psi)-\beta Z)} < \bar{k} \\ \implies & 0 <(Y+\psi)^2-(1+\beta)Z^2+2Z(Y+\psi)+ \\ & ((1+\beta)(Y+\psi)-\beta Z)\sqrt{\beta(Y+\psi)^2+2Z(Y+\psi)-Z^2(1+\beta)} \end{aligned} \tag{2.50}$$

which is again true since the term on the right is positive. This allows us to establish that $\hat{k} < \bar{k}$.
From Assumption 1, we know that $k > \psi$ to ensure interior solutions. Thus, we check if $\hat{k} < \psi$:

$$\frac{\psi^2(1+\beta+\beta^2)}{2((1+\beta)(Y+\psi)-\beta Z)} < \psi \implies 0 < 2(Y(1+\beta)-\beta Z)+\psi(1+\beta-\beta^2) \tag{2.51}$$

which is true since the term on the right is positive. Thus, we have $\hat{k} < \psi$. This allows us to order all the 'k' thresholds as:

$$\underline{k} < \hat{k} < \psi < \bar{k}. \tag{2.52}$$

Thus, the only 'valid' value of k that solves $\Delta V = 0$ is given by

$$\bar{k} = \frac{\psi^2}{2(Y+\psi-Z)^2}\left((1+\beta)(Y+\psi)-\beta Z+\sqrt{\beta(Y+\psi)^2+2Z(Y+\psi)-Z^2(1+\beta)}\right). \tag{2.53}$$

Moreover, for the valid domain of k ($k > \psi$), the difference in expected payoffs is always increasing in k. □

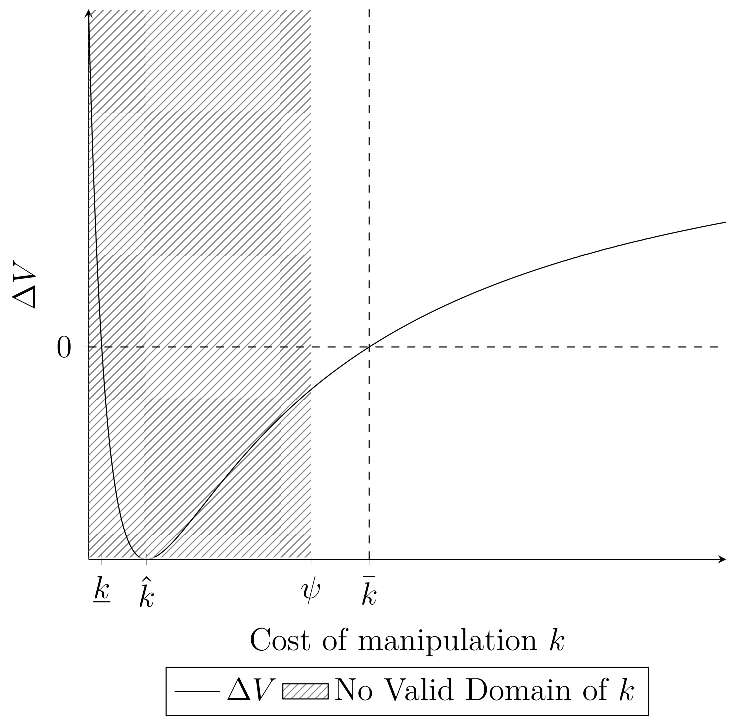

Figure 2.3: ΔV plotted for $\psi = 2.5, Y = 2, Z = 1, \beta = 0.75$, and $c = 2$.

Combining Lemmata 2.3 and 2.4 leads to the conclusion that the employer prefers to disclose assessments for $k > \bar{k}$ and prefers to not disclose assessments for $k < \bar{k}$. $\square$

Numerical Example of Proof of Proposition 2.3 In this numerical example, we graphically depict Lemmata 2.3 and 2.4. We assume $\psi = 2.5, Y = 2, Z = 1$, and $\beta = 0.75$. Plugging in the values into Assumption 1 yields the following numerical bounds on k and c:

$$k \in (2.5, 6.25),$$
$$c \in (1.625, 2.25).$$

We assume $c = 2$. Solving for $\bar{k}$ yields $\bar{k} = 3.03$.
Figure 2.3 depicts ΔV as a function of k. For $k > \bar{k}$, $\Delta V > 0$ and thus, the optimal disclosure policy is disclosure of assessments. For $\psi < k < \bar{k}$, $\Delta V < 0$, and thus, the optimal disclosure policy is to withhold assessments. The gray grid shows $\underline{k}$ and $\hat{k}$. However, these values are out of the valid domain of k as defined by Assumption 1.

2.7.5 Analysis of an Expanded Contract

In this section, we examine an expanded contract that potentially offers a wage conditioned on the report $r \in \{L, H\}$ and also potentially offers a wage when the employee generates zero output. We denote the wage offered conditional upon the report as $W_{1,r}$ where r can take on the values L or H. We denote the wage offered at the end of the game as $W_{2,O}$ where O stands for 'Outcome' and takes values in s (for success) and f (for failure). Thus, the entire contract takes the form of $(W_{1,L}, W_{1,H}, W_{2,s}, W_{2,f})$. In the main body, the wage we solve for is $W_{2,s}$.

Note that following standard results in the agency literature (see for instance, Tirole (2010)), it is never optimal to reward failure (with risk-neutrality), and thus, $W_{1,L}, W_{2,f} = 0$. The employer wants to incentivize effort. If she rewards failure, she will need to provide an even greater wage in the event of success to induce effort. Consequently, it is optimal to provide the lowest possible wage in the event of failure, which in our setting with limited liability is zero.

We first examine the case where assessments are disclosed. The first step is to solve the employee's misreporting decision given that he observes his human capital to be low ($\theta = L$). The good type solves the following problem:

$$\max_{m} \quad \mu_G := m(\psi + W_{1,H}) - \frac{km^2}{2} \tag{2.54}$$

where μ_G captures the good type's ex-ante payoff from engaging in misreporting. The first term on the right is the expected private benefit of being sorted into D while the second term is the cost of misreporting.

The arg max of Equation (2.54) is given by

$$m_G^* := \frac{\psi + W_{1,H}}{k}. \tag{2.55}$$

The solution to Equation (2.54) is given by

$$\mu_G^* := \frac{(\psi + W_{1,H})^2}{2k}. \tag{2.56}$$

The bad type's misreporting decision given that he observes his human capital to be low ($\theta = L$) is given by the following problem:

$$\max_{m} \quad \mu_B := m(W_{1,H}) - \frac{km^2}{2}. \tag{2.57}$$

where μ_B captures the bad type's ex-ante payoff from engaging in misreporting. The first term on the right is the expected private benefit of being sorted into D while the second term is the cost of misreporting.

The arg max of Equation (2.57) is given by

$$m_B^* := \frac{W_{1,H}}{k}. \tag{2.58}$$

The solution to Equation (2.57) is given by

$$\mu_B^* := \frac{(W_{1,H})^2}{2k}. \tag{2.59}$$

We now solve for the employee's effort decision. The good type solves the following problem:

$$\max_e \quad U_G := e(W_{1,H} + W_{2,s} + \psi) + (1-e)\mu_G^* - \frac{ce^2}{2}. \tag{2.60}$$

The first term on the right in Equation (2.60) is the employee's payoff from acquiring high human capital. The second term is his equilibrium payoff from successfully misreporting his human capital in the event he acquires low human capital (μ_G^* is derived in Equation (2.56)). The final term is his cost of exerting effort.

The first-order condition (FOC) to the problem in Equation (2.60) is given by

$$W_{1,H} + W_{2,s} + \psi - \mu_G^* - ce = 0. \tag{IC: $\eta = G$}$$

This FOC determines the good type employee's labor supply and serves as the incentive-compatibility constraint (IC).

The bad type solves the following problem:

$$\max_e \quad U_B := e(W_{1,H} + W_{2,s}) + (1-e)\mu_B^* - \frac{ce^2}{2}. \tag{2.61}$$

The first term on the right in Equation (2.61) is the employee's payoff from acquiring high human capital. The second term is his cost of exerting effort.

The FOC to Equation (2.61) is given by

$$W_{1,H} + W_{2,s} - \mu_B^* - ce = 0. \tag{IC: $\eta = B$}$$

Finally, we explore the optimal contract. The employer solves the following problem when she contracts with a good type employee:

$$\begin{aligned} \max_e \quad & V_G := e(Y - W_{1,H} - W_{2,s}) - (1-e)m_G^* W_{1,H} \\ & \text{Subject to:} \\ & \text{IC: } W_{1,H} + W_{2,s} + \psi - \mu_G^* - ce = 0 \\ & W_{1,H}, W_{2,s} \geq 0 \end{aligned} \tag{2.62}$$

V_G captures the employer's payoff from the good type employee. She maximizes V_G subject to the employee's IC constraint and the non-negativity constraint on the wage. The Lagrangian to this problem is:

$$\begin{aligned}\mathcal{L}_G :=& e(Y - W_{1,H} - W_{2,s}) - (1-e)m_G^* W_{1,H} - \\ &\lambda_G(W_{1,H} + W_{2,s} + \psi - \mu_G^* - ce)\end{aligned} \tag{2.63}$$

where λ_G is the Lagrange multiplier.
The FOC with respect to $W_{2,s}$ is

$$\frac{d\mathcal{L}_G}{dW_{2,s}} = -e - \lambda_G = 0. \tag{2.64}$$

As a consequence, we have $e_G^* = -\lambda_G$ and $\lambda_G < 0$.
The FOC with respect to $W_{1,H}$ is

$$\frac{d\mathcal{L}_G}{dW_{1,H}} = \frac{W_{1,H}(2e + \lambda_G - 2) + e(\psi - k) - k\lambda_G + \lambda_G\psi - \psi}{k} = 0. \tag{2.65}$$

Solving for $W_{1,H}$ yields

$$W_{1,H} = \frac{(e + \lambda_G)(k - \psi) + \psi}{2e + \lambda_G - 2}. \tag{2.66}$$

Substituting e_G^* into this wage yields

$$W_{1,H} = \frac{\psi}{e - 2} < 0. \tag{2.67}$$

Thus, in equilibrium, $W_{1,H,G}$ (where the subscript 'G' indicates this is the report-based wage for the disclosed good type) *must be zero.*
Solving the constraint equation for $W_{2,s}$ yields what we had in the main body:

$$W_{2,s,G}^* = W_G^*. \tag{2.68}$$

Intuitively, the employer never compensates on the report because the wage at the end of the game is just as effective at motivating the employee but does not induce him to engage in misreporting.

The employer solves the following problem when she contracts with a bad type employee:

$$\begin{aligned}\max_{e} \quad & V_B := e(Z - W_{1,H} - W_{2,s}) - (1-e)m_B^* W_{1,H} \\ & \text{Subject to:} \\ & \text{IC: } W_{1,H} + W_{2,s} - \mu_B^* - ce = 0 \\ & W_{1,H}, W_{2,s} \geq 0 \end{aligned} \tag{2.69}$$

V_B captures the employer's payoff from the bad type employee. She maximizes V_B subject to the non-negativity constraint on the wage and the employee's IC constraint. The Lagrangian to this problem is:

$$\mathcal{L}_B := e(Y - W_{1,H} - W_{2,s}) - (1-e)m_B^* W_{1,H} - \lambda_B(W_{1,H} + W_{2,s} - \mu_B^* - ce) \tag{2.70}$$

where λ_B is the Lagrange multiplier. The FOC with respect to $W_{2,s}$ is

$$\frac{d\mathcal{L}_B}{dW_{2,s}} = -e - \lambda_B = 0. \tag{2.71}$$

As a consequence, we have $e_B^* = -\lambda_B$ and $\lambda_B < 0$.
The FOC with respect to $W_{1,H}$ is

$$\frac{d\mathcal{L}_B}{dW_{1,H}} = \frac{W_{1,H}(2e + \lambda_B - 2) - k(e + \lambda_B)}{k} = 0. \tag{2.72}$$

Solving for $W_{1,H}$ yields

$$W_{1,H} = \frac{k(e + \lambda_B)}{2e + \lambda_B - 2}. \tag{2.73}$$

Substituting e_B^* into this wage yields

$$W_{1,H} = 0. \tag{2.74}$$

Thus, in equilibrium, $W_{1,H,B}$ (where the subscript 'B' indicates this is the report-based wage for the disclosed bad type) *must be zero*.
Solving the constraint equation for $W_{2,s}$ yields what we had in the main body:

$$W_{2,s,B}^* = W_B^*. \tag{2.75}$$

Intuitively, the employer never compensates on the report because the wage at the end of the game is just as effective at motivating the employee but does not induce him to engage in misreporting.

Now we turn to the case where the employer does not disclose assessments. First, we solve the employee's misreporting decision given that he observes his human capital to be low ($\theta = L$).
The employee's problem is given by

$$\max_{m} \quad \mu_{NA} := m(\beta\psi + W_{1,s}) - \frac{km^2}{2} \tag{2.76}$$

where μ_{NA} captures the employee's ex-ante payoff from engaging in misreporting when he does not know his assessment.
The $\arg\max$ to Equation (2.76) is

$$m^*_{NA} := \frac{\beta\psi + W_{1,s}}{k}. \tag{2.77}$$

The solution to the problem in Equation (2.76) is given by

$$\mu^*_{NA} := \frac{(\beta\psi + W_{1,s})^2}{2k}. \tag{2.78}$$

We now solve the employee's effort decision. His problem is given by

$$\max_{e} \quad U_{NA} := e(W_{1,H} + W_{2,s} + \beta\psi) + (1-e)\mu^*_{NA} - \frac{ce^2}{2}. \tag{2.79}$$

The first term on the right is the employee's expected payoff from developing high human capital. Note that he only gets the private benefit, ψ, of being sorted into D when his type is good, which happens with probability β. The second term is his anticipated payoff from misreporting if he acquires low human capital (as defined in Equation (2.78)). The third term is his cost of effort.
The FOC to the maximization problem in Equation (2.79) is given by

$$W_{1,H} + W_{2,s} - ce - \mu^*_{NA} + \beta\psi = 0. \tag{IC: NA}$$

This FOC serves as the employee's incentive compatibility constraint for when he does not know his assessment.
We now examine the employer's optimal contract. The employer solves the following problem:

$$\begin{aligned} \max_{e} \quad & V_{NA} := e(\beta Y + (1-\beta)Z - W_{1,H} - W_{2,s}) - (1-e)m^*_{NA}W_{1,H} \\ & \text{Subject to:} \\ & \text{IC: } W_{1,H} + W_{2,s} - ce - \mu^*_{NA} + \beta\psi = 0 \\ & W \geq 0 \end{aligned} \tag{2.80}$$

V_{NA} captures the employer's ex-ante payoff. Her problem is to maximize her ex-ante payoff subject to the employee's IC constraint and the non-negatvity constraint on the wage. The Lagrangian to this problem is:

$$\begin{aligned}\mathcal{L}_{NA} :=& e(\beta Y + (1-\beta)Z - W_{1,H} - W_{2,s}) - (1-e)m^*_{NA}W_{1,H} - \\ & \lambda_{NA}(W_{1,H} + W_{2,s} - ce - \mu^*_{NA} + \beta\psi)\end{aligned} \tag{2.81}$$

where λ_{NA} is the Lagrange multiplier. The FOC with respect to $W_{2,s}$ is

$$\frac{d\mathcal{L}_{NA}}{dW_{2,s}} = -e - \lambda_{NA} = 0. \tag{2.82}$$

Thus, we have $e^*_{NA} = -\lambda_{NA}$ and $\lambda_{NA} < 0$.
The FOC with respect to $W_{1,H}$ is

$$\frac{d\mathcal{L}_{NA}}{dW_{1,H}} = \frac{\beta\lambda_{NA}\psi - \beta\psi + W_{1,H}(2e + \lambda_{NA} - 2) + \beta e\psi - ek - \lambda_{NA}k}{k} = 0. \tag{2.83}$$

Solving for $W_{1,H}$ yields

$$W_{1,H} = \frac{\beta\psi + (e + \lambda_{NA})(k - \beta\psi)}{2e + \lambda_{NA} - 2}. \tag{2.84}$$

Substituting e^*_{NA} into this wage yields

$$W_{1,H} = -\frac{\beta\psi}{\lambda_{NA} + 2} < 0. \tag{2.85}$$

Thus, in equilibrium, $W_{1,H,NA}$ (where the subscript 'NA' indicates this is the report-based wage for the employee who does not know his assessment) *must be zero.*
Solving the constraint equation for $W_{2,s}$ yields what we had in the main body:

$$W^*_{2,s,NA} = W^*_{NA}. \tag{2.86}$$

In this section, we have shown that it is never optimal to provide a positive wage contingent on the report, and that the 'simple' contract we analyze in the main body is, in fact, the most optimal contract.

2.7.6 Analysis of Task-Specific Wages

We now assume that the employer offers a task-specific wage, i.e., employer offers wage W_D or W_E for being successful in task D or E.

Disclosure The wages offered to the good and bad type are identical to the type-specific wages in Section 2.3 ($W_D^A = W_G$ and $W_E^A = W_B$). Employees know their types and the employer's sorting structure. The employer's sorting structure is strongly correlated to the employee's type – the good type is sorted into the difficult task and the bad type is sorted into the easy task. Therefor, the employer's problem of solving for a type-specific wage is identical to solving for a task-specific wage.

Nondisclosure: Employee Misreporting and Effort The employee who does not know his type assumes that with probability β he will be sorted into the difficult task and receives wage W_D^{NA} and W_E^{NA} otherwise.
The wage is paid after the output is realized and is never paid after misreporting. The employee's misreporting is identical for the type-specific and the task-specific contract, m^*_{NA} and μ^*_{NA}.
The employee solves the following effort problem:

$$\max_e \quad U_{NA} := e\left(\beta\left(W_D^{NA} + \psi\right) + (1-\beta)W_E^{NA}\right) + (1-e)\mu^*_{NA} - \frac{ce^2}{2}. \tag{2.87}$$

The FOC for the problem in Equation (2.87) is given by

$$\beta(W_D^{NA} + \psi) + (1-\beta)W_E^{NA} - \mu^*_{NA} - ce = 0. \tag{2.88}$$

Nondisclosure: Optimal Contract The employer solves the following problem:

$$\begin{aligned} \max_e \quad & V_{NA} := e\left(\beta(Y - W_D^{NA}) + (1-\beta)(Z - W_E^{NA})\right) \\ & \text{Subject to:} \\ & \text{IC: } e = \frac{\beta(W_D^{NA} + \psi) + (1-\beta)W_E^{NA} - \mu^*_{NA}}{c} \\ & W \geq 0 \end{aligned} \tag{2.89}$$

The arg max to the employer's problem in Equation set (2.89) is given by

$$e_{NA}^{D,E} := \frac{2k(\beta(Y+\psi) + (1-\beta)Z) - \beta^2\psi^2}{6ck}. \tag{2.90}$$

The optimal wage offered to the employee being successful in task D is given by

$$W_D^{NA} := \frac{2k\,(\beta(2Y-\psi)-(1-\beta)Z)+\beta^2\psi^2}{6k\beta}. \tag{2.91}$$

The optimal wage offered to the employee being successful in task E is given by

$$W_E^{NA} := \frac{2k\,(-\beta(Y+\psi)+2Z(1-\beta))+\beta^2\psi^2}{6(1-\beta)k}. \tag{2.92}$$

It can be checked that Assumption 1 also guarantees interior solution for $e_{NA}^{D,E}$.

Comparisons Similar to the results in the main body, the high type exerts the most effort and misreports the most with task-specific contracts. Formally,

$$m_B^* = 0 < m_{NA}^* < m_G^*, \tag{2.93}$$

and

$$e_B^* < e_{NA}^{D,E} < e_G^*. \tag{2.94}$$

These results mimic Proposition 2.1.

For the valid domain of k, there exists a threshold $\bar{k}_{D,E}$ such that for $k = \bar{k}_{D,E}$, $\Delta V_{D,E} = 0$. $\Delta V_{D,E}$ has the same interpretation as ΔV. To solve for this threshold, we set $\Delta V_{D,E}$ to zero and isolate k:

$$\begin{aligned}\Delta V_{D,E} :=& \frac{\beta\psi^4 + 4k^2\left(\beta(\psi+Y)^2+(1-\beta)Z^2\right) - 4\beta k\psi^2(\psi+Y)}{16ck^2} \\ &- \frac{\left(\beta^2\psi^2 - 2k(\beta(\psi+Y)+Z(1-\beta))\right)^2}{18ck^2} = 0 \\ \implies k =& \bar{k}_{D,E} = \frac{\beta\left(8\beta^3-9\right)\psi^4}{6\Omega + 2\beta\psi^2\left(-9(\psi+Y)+8\beta(\beta(Y+\psi)+Z(1-\beta))\right)}\end{aligned} \tag{2.95}$$

with

$$\Omega = \sqrt{(\beta-1)\beta\psi^4\left(8(\beta-1)\beta^2(\psi+Y)^2+16(\beta-1)\beta Z(\psi+Y)+\left(-8\beta^3+8\beta+1\right)Z^2\right)}. \tag{2.96}$$

This threshold replicates part of Proposition 2.3.

All we now have to show is that $\Delta V_{D,E}$ is monotonically increasing (to completely replicate Proposition 2.3). Combined, this would show that for $k < \bar{k}_{D,E}$, the employer prefers not to disclose assessments, and for $k > \bar{k}_{D,E}$, the employer prefers to disclose assessments.

We differentiate $\Delta V_{D,E}$ with respect to k and simplify:

$$\begin{aligned}\frac{d\Delta V_{D,E}}{dk} &= \frac{\beta\psi^2\left(\left(8\beta^3-9\right)\psi^2-2k\left(-9(Y+\psi)+8\beta\left(\beta(Y+\psi)+(1-\beta)Z\right)\right)\right)}{72ck^3}>0\\ \implies k>\hat{k}_{D,E} &= \frac{\left(8\beta^3-9\right)\psi^2}{2\left(-9(Y+\psi)+8\beta\left(\beta(Y+\psi)+(1-\beta)Z\right)\right)}.\end{aligned} \tag{2.97}$$

Note that $\hat{k}_{D,E}$ is a local extremum. We now examine the SOC to determine whether it is a minimum or a maximum.

The SOC is given by

$$\frac{d^2\Delta V_{D,E}}{dk^2}=\frac{\beta\psi^2\left(3\left(9-8\beta^3\right)\psi^2+4k\left(-9(Y+\psi)+8\beta\left(\beta(Y+\psi)+(1-\beta)Z\right)\right)\right)}{72ck^4}. \tag{2.98}$$

Substituting $\hat{k}_{D,E}$ into the SOC yields

$$-\frac{2\beta\left(-9(Y+\psi)+8\beta\left(\beta(Y+\psi)+(1-\beta)Z\right)\right)^4}{9c(8\beta^3-9)^3\psi^4}>0. \tag{2.99}$$

It can be checked that $\hat{k}_{D,E}<\psi<\bar{k}_{D,E}$. Consequently, for the valid domain of k ($k>\psi$), the difference in expected payoffs is always increasing in k. The optimal disclosure policy is, therefore, to disclose assessments if $k>\bar{k}_{D,E}$ and not disclose assessments otherwise. This replicates the result of Proposition 2.3, and, thus, shows that our results are robust to the assumption of task-specific wages.

Chapter 3

How Key Audit Matters Can Induce Inefficient Investment Behavior*

Abstract

Recent empirical literature shows that the market reacts to the reporting of *key audit matters* (KAM) by changing firm valuations. These results imply that KAM reporting works as a signal to the market. Anticipating the signaling effect of KAM, firms might change pre-reporting real decisions. Using a theoretical model, we analyze such unintended consequences on firms' pre-reporting investment decisions. We show that KAM reporting can increase overinvestment. As KAM reporting can decrease information asymmetry between the firm and financial statement users regarding an investment, managers strategically invest to induce a KAM reporting, which signals good prospects and increases the firm's valuation. However, KAM reporting can also mitigate the adverse investment effects of managers' private benefits.

* This chapter is joint work with Michelle Peters (Hochschule Weserbergland).

3.1 Introduction

Inviting to comment the International Auditing and Assurance Standard Board's (IAASB) project on the auditor's report, Chairman Prof. Arnold Schilder recognizes the need for change: "More than ever before [...] users of audited financial statements are calling for more pertinent information for their decision-making in today's global business environment with increasingly complex financial reporting requirements." (IAASB, 2012). In response to these calls, both the Public Company Oversight Board (PCAOB) and the IAASB passed new standards requiring auditors to disclose *critical audit matters* (CAM) or *key audit matters* (KAM) in their auditor's report.[1] Assuming, in line with the aim of the newly introduced requirements, that KAM reporting decreases the information asymmetry, this paper aims to examine how KAM reporting affects a manager's ex-ante real decision.

The auditor's report, generally published along with the financial statement, communicates the audit opinion. If the financial statement is within legal requirements, i.e., gives a reasonable view of the financial results, financial position, and cash flows (represents fairly), the auditor issues an unmodified audit opinion. If the financial statement does not fairly represent, the auditor issues a modified audit opinion or denies the audit opinion. This simple pass/ fail reporting model discloses few client-specific insights in the audit process.

Under AS 3101, a critical audit matter is a matter that "[...] (1) relates to accounts or disclosures that are material to the financial statements and (2) involved especially challenging, subjective, or complex auditor judgment." Similar to that, ISA 701 defines key audit matters as matters that "[...] in the auditor's professional judgment, were of most significance in the audit of the financial statements of the current period." Following the definition of CAM/KAM, the new requirements expand the auditor's obligations to enhance the decision usefulness and relevance of the auditor's report. As communicating CAM informs investors of significant issues to understand the financial statement, investors support the proposed requirement. CAM reporting should enhance the investor's confidence in the financial statement (PCAOB, 2017).

Academic literature already raises concerns regarding unintended consequences of the expanded auditor's reporting model. In an experiment, Bentley et al. (2021) show that one unintended consequence of KAM reporting could be that managers change their pre-reporting decisions, i.e., the types of business activities they engage in. Moreover, Cade and Hodge (2014) show that disclosures such as KAM can affect managers' communication openness. Both studies show the importance of examining any unintended consequences of KAM reporting.

[1] In the following, we refer to the reporting of critical or key audit matters as KAM reporting.

What is missing in these experiments is a clarification of the underlying mechanism influencing managers' decisions. Using a theoretical model, we analyze a manager's investment decision in the pre- and post-KAM reporting regimes. We consider a firm's manager making an investment decision. The investment's return varies in the firm's future prospects. The firm's reporting includes the potential investment's accounting treatment and the proper valuation of the firm's existing assets.[2] After the manager has prepared the financial statement, a statutory auditor conducts an audit and issues the auditor's report. The financial market values the firm based on its expectations about future cash flows.

The financial market cannot perfectly observe the manager's investment decision from the financial statement. This lack of information can result from several reasons, e.g., when investment costs are expensed for financial statement purposes or shown in aggregated accounts on the balance sheet. For imprecise accounting measures, separating investments from operating cash flows can be quite difficult (Kanodia et al., 2005). For example, Bebchuk and Stole (1993) state, especially research & development costs (R&D costs) may be camouflaged with regular expenses and, thus, not perfectly observable for financial statement users.

In the pre-KAM reporting regime, the auditor issues a simple pass/fail auditor's report without client-specific information. The following key consequences of the pre-KAM reporting regime are intuitive:

1. Facing private benefits for investing, the manager overinvests.[3] The idea of private benefits has already been analyzed in formal models showing that overinvestment can occur depending on the state of the world (Harris and Raviv, 1990; Stulz and Johnson, 1985; Hart and Moore, 1994).

2. Without information, the actual investment does not affect the firm valuation. The financial market values the firm based on the expectations about the investment. Consequently, making an investment decision, the manager ignores the financial market's firm valuations.

In the post-KAM reporting regime, the auditor expands the auditor's report with a KAM paragraph about the most significant matters encountered during the audit. Under ISA 701, the auditor takes into account: "[...] areas of higher assessed risk of material misstatement, [...] significant auditor judgments relating to areas in the financial statements that involved significant management judgment, [...] the effect on the audit of significant events or transactions that occurred during the period." An investment can be seen as a significant event or an area that involves significant management judgment or discretion. Therefore, the auditor adds a KAM paragraph about the reporting of the investment

[2] The asset valuation depends on an impairment test. This test, in turn, depends on the assets' expected future cash flows varying in the firm's prospects.

[3] We define overinvestment as investment in a project with negative net present value (NPV).

with a certain probability. In line with the aim of the newly introduced requirements, we assume that KAM reporting decreases the information asymmetry about the investment. Observing a KAM, the financial market can perfectly anticipate the manager's investment decision.

Adding KAM to the auditor's report shall inform financial statement users of significant issues and, thereby, focuses the financial statement users' attention on such issues to better understand the financial statement (PCAOB, 2017; IAASB, 2015). Focusing the attention on imprecise accounting measures thus enhances the information in the audited financial statement, including the auditor's report.

Although a few studies cannot demonstrate a significant increase in the auditor's report information value after implementing the requirement of KAM (Boolaky and Quick, 2016; Carver and Trinkle, 2017), experimental and empirical findings confirm the aim of KAM reporting and, thereby, our assumption of increased information. For example, Almulla and Bradbury (2019) find that investors price the information in KAM. In addition to that, Klevak et al. (2020) show that the financial market negatively reacts to KAM and that KAM often relate to issues already raised in earnings conference calls. Experimental findings can explain why the financial market reacts to KAM, although the issues described in KAM are often already disclosed. Christensen et al. (2014) show that disclosure of KAM can have an information and a credibility effect. Non-professional investors are more likely to invest after receiving an auditor's report including KAM (information effect). The likelihood of investing is higher if a specific issue is addressed in a KAM than if it is only addressed in a manager's footnote disclosure (credibility effect). Analyzing the effect of auditor's emphasis of matter (EOM), which is similar to KAM, Kelton and Montague (2018) can also show this credibility effect. Using an eye-tracking study, Sirois et al. (2018) show that KAM have an attention directing effect: Financial statement users access information highlighted in a KAM faster and pay more attention to this information. This attention directing effect can explain the information effect of KAM, which is also confirmed by Köhler et al. (2020). However, they only find a communicative value of KAM for professional but not for non-professional investors.

Due to this information, credibility, and attention directing effects of KAM, we assume that the information asymmetry about the manager's investment decision decreases due to KAM reporting. We find that anticipating the changing market reactions, the manager changes her pre-reporting investment decision. This result is in line with those of Graham et al. (2005) and Libby et al. (2015) showing in surveys and experiments that managers change pre-reporting real decisions to induce a preferred reporting outcome. We further find that this change in the pre-reporting investment decision can increase overinvestment. Inefficient investment results due to a *signaling effect* of KAM reporting. The sign of this effect depends on two components:

1. Observing a KAM about an investment, the financial market receives more (precise) information about the investment. It anticipates a high probability of good prospects for the firm, as the manager would not have invested otherwise. An increasing firm valuation and, thus, increasing investment incentives result (*updating-belief effect*).

2. The market anticipates increasing investment incentives and, thus, incentives to overinvest. Anticipated overinvestment reduces the firm valuation (*loss effect*). The manager's investment incentives decrease.

Whenever the updating-belief effect dominates the loss effect, KAM reporting increases overinvestment. Intuitively, a dominating updating-belief effect results for a high investment's profitability. In addition, high cash flows from operating activity increase investment incentives. The lower an expected loss from an investment compared to cash flows from operating activity, the lower an expected loss effect. More interestingly, we can show that KAM reporting can mitigate adverse effects from private benefits. With KAM reporting, the financial market values the manager's investment incentives more precisely. The financial market anticipates that high private benefits increase investment incentives, which can induce overinvestment (direct effect of private benefits). Consequently, the firm valuation decreases (negative loss-effect), which decreases investment incentives (indirect effect of private benefits). For high private benefits, the indirect effect outweighs the direct effect. Therefore, KAM reporting decreases overinvestment incentives resulting from private benefits.

We add to the existing literature addressing the expanded auditor's report, showing that KAM reporting can affect auditor liability and judgment (Backof et al., 2019; Brasel et al., 2016; Gimbar et al., 2016; Kachelmeier et al., 2020; Asbhar and Ruhnke, 2019; Vinson et al., 2019), audit quality (Gutierrez et al., 2018; Li et al., 2019; Reid et al., 2019) market reactions (Christensen et al., 2014; Sirois et al., 2018; Köhler et al., 2020) and managers' decisions (Bentley et al., 2021; Cade and Hodge, 2014; Gold et al., 2020). Theoretical evidence shows that audit risk or audit quality disclosures can affect firms' decisions regarding the financial reporting system, audit effort, and investment efficiency. Deng and Wen (2020) show that firms ex-ante choose lower precision of its financial reporting system if the auditor discloses audit risk. Higher audit risk is followed by less responsive market pricing, which reduces misstatement costs. Chen et al. (2019) analyze how audit quality disclosures, which is similar to KAM, affect auditors' effort and investors' investment efficiency. They show that audit quality disclosures decrease audit effort and investment efficiency. Investment efficiency in their model is the expected loss from forsaking a good project and from undertaking a bad project (under- and overinvestment). Depending on the financial reporting quality and the audit quality, the investors can observe the true state of the project (good or bad). Different to Chen et al. (2019) we do not consider external financing from investors and instead analyze managerial investment decisions that investors value. That is, Chen et al. (2019) assume that the manager always continues with the project whenever investors invest, whereas, in our model, the manager's investment decision depends on several factors. Moreover, our model focuses less on audit quality and effort as we do not consider the auditor's endogenous effort decision.

Using a theoretical model, we show that KAM reporting can induce undesired real effects by reducing the information asymmetry. Kanodia (1980) already developed a real effects framework. It is shown that disclosure changes market valuations and affects real decisions. Spence (1974) analyzes the properties of a market signaling equilibrium. Similar to our results, Bebchuk and Stole (1993) show that overinvestment occurs if the investment level is observable, but information asymmetry about the investment's profitability exists.

Kanodia et al. (2005) develop an optimal degree of imprecision. Information asymmetry about the investment's profitability leads to overinvestment. If the investment's profitability is common knowledge, underinvestment results if an imprecise accounting signal measures the investment level. Consequently, in a world with information asymmetry, an optimal degree of imprecision exists, which reduces overinvestment incentives.

Our result of a signaling effect of KAM reporting is similar to the overinvestment intuition in prior models. This intuition is as follows: Higher investments signal higher profitability, which results in a signaling equilibrium with overinvestment. Without KAM, the market has no information about the investment's profitability and whether an investment was made. The firm then ignores the market price. With KAM, the information asymmetry about the latter, i.e., was an investment made, decreases. The firm then overinvests to signal higher profitability to the market.

In former models, information asymmetry and accounting imprecision are given by a general accounting signal. We analyze the effect of information contained in the auditor's report. Using assumptions specific to the auditor's report and the newly introduced KAM disclosure, we add to the existing auditing literature and, thereby, to a better understanding of unintended consequences of KAM reporting.

The rest of the paper proceeds as follows. First, Section 3.2 presents the basic model assumptions and the sequence of events. In Section 3.3, the manager's investment decision is determined. Next, Section 3.4 analyzes the effect of KAM reporting on the manager's investment decision in more detail. Section 3.5 summarizes and concludes.

3.2 Model Setup

We consider a model comprising three risk-neutral players: the firm's manager (she), a statutory auditor, and the financial market. The manager makes an investment decision and prepares the financial statement. The statutory auditor conducts an audit and issues an auditor's report. Together with the auditor's report, the firm publishes the audited financial statement, which provides information about the firm's probability of having good prospects and, therefore, the firm's expected future cash flows. The provided information vary with the probability of good prospects, the manager's investment decision, and the corresponding auditor's report. The financial market values the firm using the information provided. Making an investment decision, the manager anticipates the auditor's reporting and the subsequent firm valuation.

In particular, the firm holds an asset – initially valued at historical costs X_h –, which generates future cash flows (referred to as 'cash flows from operating activity').[4] The manager conducts an annual impairment test, comparing the asset's historical costs to the asset's recoverable amount. Accounting standards define the recoverable amount as the *value-in-use*, i.e., the present value of the estimated future cash flows resulting from the asset. Here, pX depicts the estimated future cash flows from the firm's operating activity, with p as the probability of good prospects, uniformly distributed between *zero* and *one*, and X as the cash flows from operating activity in case of good prospects. We assume an interest rate of *zero* so that expected cash flows from operating activity pX give the asset's value-in-use.[5]

If the historical costs exceed the value-in-use, the asset is impaired, and the manager recognizes the asset at value-in-use. If the value-in-use exceeds the historical costs, the asset is not impaired, and the manager recognizes the asset at historical costs. As the value-in-use (pX) increases in the probability of good prospects whereas the historical costs (X_h) remains constant, a threshold denoted by $\tilde{p}$ exists, determining whether the asset is impaired. Consequently, for

$$p \begin{cases} < \tilde{p},\ pX < X_h, \text{ the manager recognizes the asset at } pX \text{ (value-in-use) and for} \\ \geq \tilde{p},\ pX \geq X_h, \text{ the manager recognizes the asset at } X_h \text{ (historical costs).} \end{cases}$$

As the manager is conversant with the firm and the firm's industry, the probability of good prospects p are the manager's private information. Therefore, the manager is able to conduct the impairment test in accordance with accounting standards.

In addition, the manager can invest in a new project. Investment in the new project entails costs, denoted by Z. The project is successful if the firm's prospects are good

[4] One can also interpret the initial asset as an aggregation of all firm's assets.

[5] According to IAS 36, firms have to conduct an annual impairment test for several assets. IAS 36 defines the recoverable amount as the maximum of the *fair value less costs to sell* and the *value-in-use*. We assume that the value-in-use exceeds the fair value less costs to sell and therefore gives the recoverable amount. US-GAAP requires an impairment test whenever an indicator of impairment occurs. US-GAAP defines the asset's recoverable amount as the asset's undiscounted cash flows. As we assume an interest rate of *zero*, the recoverable amount based on the US-GAAP corresponds to that based on the IFRS.

(with probability p). Put more formally, the investment generates a future return R_I with

$$R_I = \begin{cases} R > 0 & \text{if the prospects are good } (p) \text{ and} \\ 0 & \text{otherwise } (1-p). \end{cases}$$

The probability p reflects the probability of good firm's prospects. We assume that both the cash flows from operating activity and the investment's return depend on the probability p. For a firm that operates in one line of business, good prospects can imply a high probability of high cash flows from operating activity and new investment projects.

After making an investment decision, the manager prepares the financial statement. The financial statement perfectly reflects the result of the impairment test as the financial statement users observe the asset's valuation. However, the financial statement does not perfectly reflect the investment for various reasons, e.g., the manager expenses investment costs and (or) the financial statement shows these costs in aggregated accounts. Kanodia et al. (2005) argue that accounting measurements can be imprecise so that separating investments from operating cash flows can be difficult. For example, R&D costs are usually expensed for financial statement purposes and recognized in the P&L statement in aggregated accounts such as 'other operating expenses'.[6] Therefore, financial statement users usually cannot separate R&D costs from other expenses. Bebchuk and Stole (1993) state that R&D costs, in particular, may be camouflaged with regular expenses and thus may be unobservable. Consequently, the accounting of R&D costs is imprecise from a financial statement user's point of view.

The statutory auditor conducts an audit, where the auditor learns about the firm's probability of good prospects p. Our focus lies solely on analyzing the effect of the introduction of KAM on investment decisions. We assume perfect audit technology and do not consider any managerial incentives to commit fraud. Thus, the auditor's opinion is always unqualified.

The impairment test and the accounting of the investment can entail complex accounting decisions, which qualify as a KAM. However, a KAM about the impairment does not disclose new or more (precise) information about the probability of good prospects. Financial statement users already observe the asset's valuation. If the manager values the asset at historical costs, the financial statement users correctly anticipate that the asset is not impaired, which implies $p \geq \tilde{p}$. If the manager values the asset at value-in-use, the financial statement users correctly anticipate that the asset is impaired, which implies $p < \tilde{p}$. In

[6] According to the US-GAAP (SFAS 142.10), internally generated research and development costs have to be expensed as they are incurred. IAS 38 requires an intangible asset to be recognized on the balance sheet, i.e., the development costs are capitalized, if and only if it can be demonstrated that a new product is feasible and viable and the management intends to complete the development. In contrast, all research costs have to be expensed for financial statement purposes. Moreover, all costs have to be expensed whenever the research costs cannot be separated from the development costs.

addition, observing pX (value-in-use) the financial statement users correctly anticipate p as X is common knowledge. Including a KAM, describing that an impairment test led to an impairment (or not) and how the auditor conducted the audit of this impairment test does not entail new information about p. Consequently, we do not explicitly consider the case where the impairment decision is a KAM as our results do not change.

In addition, the auditor can choose the accounting of the investment costs as a KAM. Assuming the example of R&D costs, the decision of whether the costs are expensed or capitalized can represent a significant matter during the audit process. The point of commencement of capitalization of such costs is an area of management judgment, and there is a risk that costs are expensed that should have been capitalized or vice versa. This is also stated in the 2018 auditor's report of the German listed company Dialog Semiconductor. The corresponding auditor's report includes a KAM paragraph describing the firm's decision to expense or capitalize R&D expenditures for financial statement purposes. The auditor notes that this decision implies a high degree of management discretion and entails a higher risk of material misstatement (Dialog Semiconductor, 2018). Consequently, the accounting of R&D costs can reflect a material risk. Therefore, we assume that the auditor discloses a KAM *Accounting of Investment Costs* with a positive probability q, which is exogenously given and common knowledge.[7]

The financial market values the firm after observing the audited financial statement and the corresponding auditor's report. In the pre-KAM reporting regime, the financial market anticipates the manager's investment opportunities. However, the financial market does not observe the decision, as the financial statement does not perfectly depict the investment. The manager, for example, recognized the costs in the P&L, where other expenses camouflage these costs. In the post-KAM reporting regime, a KAM *Accounting of Investment Costs* directly implies that the manager invested in a new project.[8]

In the following period the firm's cash flows from operating activity and investment are realized. The timing of the game is depicted in Figure 3.1.

Benchmark Investment Decision

According to investment theory, an investment is optimal whenever its net present value is positive. Therefore, investment is optimal for

$$pR - Z \geq 0. \tag{3.1}$$

[7] We forgo endogenizing q by considering the relevance of an investment compared to the whole financial statement for the sake of simplicity. Endogenizing the relevance of the investment would only shift q, and the results would not qualitatively change.

[8] In the following, we use the term KAM *Accounting of Investment Costs* and KAM interchangeably. Disclosing a KAM, thereby, always means that the auditor discloses a KAM about the accounting of investment costs as we do not consider other examples of KAM.

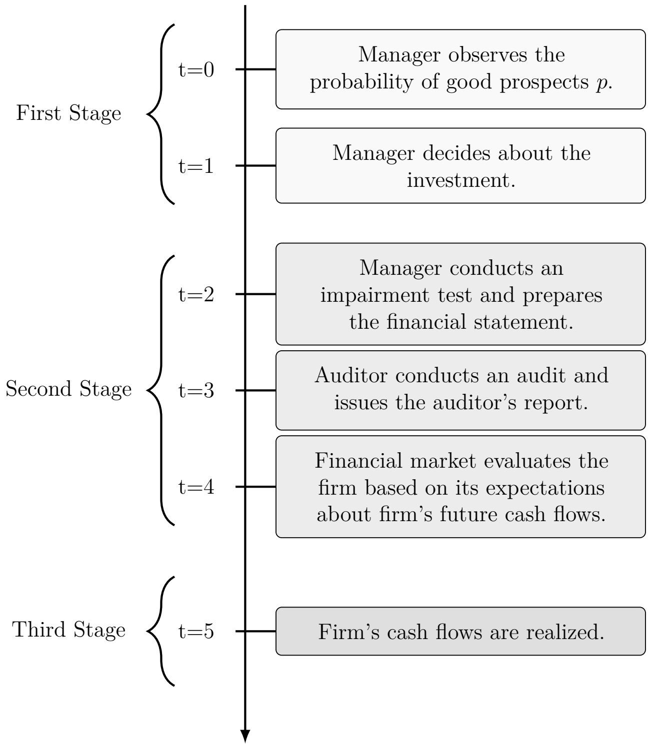

Figure 3.1: Timing of the game.

Rearranging with respect to p yields that investment is optimal whenever the probability of good prospects is high, i.e., greater than a benchmark investment threshold, denoted by p^*:

$$p \geq p^* = \frac{Z}{R}. \tag{3.2}$$

To ensure that an investment can be optimal, we assume $Z < R$.

Deviation from p^* results in a probability of over- or underinvestment. We define *overinvestment* as investing in a project with a negative NPV and *underinvestment* as not investing in a project with a positive NPV. The magnitude of the difference between the actual investment threshold and the benchmark investment threshold gives the ex-ante probability of over- or underinvestment. The greater the difference, the greater the probability of over- or underinvestment. We refer to this difference as the *over-* or *underinvestment interval*.

3.3 Manager's Investment Decision

3.3.1 Manager's Expected Utility

The manager is interested in maximizing her expected utility, comprising three components: positive private benefits for investing, the firm's expected market value and, the expected future cash flows. The components are realized at different stages during the period. We do not consider any discount effects.

Private Benefits The manager receives private benefits rB with $B > 0$ and

$$r = \begin{cases} 1, & \text{in case of an investment and} \\ 0, & \text{otherwise.} \end{cases}$$

The private benefits depict advantages the manager experiences due to company growth under the manager's control (e.g., power, influence, prestige, and promotion opportunities).[9] Former literature already studied managerial empire-building incentives. Jensen (1986) develops an empire-building idea, which explains why managers have incentives to induce their firms to grow beyond the optimal size. Formal models incorporate this empire-building, showing that depending on the state of the world, overinvestment can occur (Stulz and Johnson, 1985; Harris and Raviv, 1990; Hart and Moore, 1994).

Expected Market Valuation Following prior investment literature, we assume that the manager is interested in the firm's market valuation (Narayanan, 1985; Bebchuk and Stole, 1993; Kanodia and Mukherji, 1996; Kanodia et al., 2005). A high firm's market valuation enhances the manager's prestige, reputation, and job promotion possibilities. Therefore, the manager's expected utility increases in her expectations about the firm's market valuation.

In the pre-KAM reporting regime, the audited financial statement and the auditor's report do not disclose precise information about an investment. However, recognizing the manager's investment incentives, the financial market correctly anticipates the manager's investment threshold denoted by $\hat{p}$. Based on the firm's asset valuation, the financial market forms its beliefs about the firm's prospects and, thus, the manager's investment decision.

Observing the manager values the asset at X_h (historical costs), the financial market anticipates that the asset is not impaired, which implies $p \geq \tilde{p}$. Given $\hat{p} < \tilde{p}$, the financial market correctly anticipates an investment. Given $\hat{p} \geq \tilde{p}$, the financial market anticipates an investment with probability $p \geq \hat{p}$.

Observing the manager values the asset at pX (value-in-use), the financial market anticipates that the asset is impaired, which implies $p < \tilde{p}$. In addition, observing pX, the financial market infers the true probability of good prospects p from the asset valuation, as X is common knowledge. As the financial market observes p and anticipates $\hat{p}$, it correctly anticipates investment for $p > \hat{p}$ and no investment otherwise. Table 3.1 summarizes

[9] The manager receives private benefits irrespective of the investment's NPV.

Asset valuation	No Impairment ($p \geq \tilde{p}$)		Impairment ($p < \tilde{p}$)	
$\hat{p}$	$\leq \tilde{p}$	$> \tilde{p}$	$\leq p$	$> p$
Good prospects	$p \geq \tilde{p}$		p	
Investment decision	Investment	No information	Investment	No Investment

Table 3.1: Information about the manager's investment decision and the probability of good prospects p in the pre-KAM reporting regime.

the information contained in the financial statement in the pre-KAM reporting regime. The grey rows depict the possible asset valuations and possible financial market's correct anticipation of $\hat{p}$ compared to $\tilde{p}$.

Observing an audited financial statement, given no impairment ($p \geq \tilde{p}$) and anticipating $\hat{p} > \tilde{p}$, the financial market values the firm as

$$\mathbb{E}[MV^{\text{noImpairment},\hat{p}>\tilde{p}}] = \int_{\tilde{p}}^{1} \left(pX + \int_{\hat{p}}^{1} (pR - Z)\, dp \right) dp$$

$$\implies \mathbb{E}[MV^{\text{noImpairment},\hat{p}>\tilde{p}}] = \frac{X\,(1+\tilde{p})}{2} + \frac{(1-\hat{p})}{(1-\tilde{p})} \left(\frac{R\,(1+\hat{p})}{2} - Z \right). \tag{3.3}$$

The first term captures the expected cash flow from operating activity. The second term captures the expected return from investment. The financial market anticipates that the manager only invests if the probability of good prospects exceeds her investment threshold ($p \geq \hat{p} > \tilde{p}$). Given $\hat{p} \leq \tilde{p}$, the financial market perfectly anticipates that the manager invests in the new project and values the firm as

$$\mathbb{E}[MV^{\text{noImpairment},\hat{p}\leq\tilde{p}}] = \int_{\tilde{p}}^{1} (pX + pR - Z)\, dp$$

$$\implies \mathbb{E}[MV^{\text{noImpairment},\hat{p}\leq\tilde{p}}] = \frac{(1+\tilde{p})}{2}(X+R) - Z. \tag{3.4}$$

Observing an audited financial statement, given impairment ($p < \tilde{p}$ and perfectly observing p) and anticipating $\hat{p} > p$, the financial market anticipates that the manager does not invest and values the firm as

$$\mathbb{E}\left[MV^{\text{Impairment},\hat{p}>p}\right] = pX. \tag{3.5}$$

Anticipating $\hat{p} \leq p$, the financial market perfectly anticipates investment and values the firm as

$$\mathbb{E}\left[MV^{\text{Impairment},\hat{p}\leq p}\right] = p(X+R) - Z. \tag{3.6}$$

Cash Flow Realization The manager participates with a positive share β in the firm's realized cash flows. We do not assume limited liability, so the manager also participates in the loss of investment. The expected share in the firm's future cash flows with investment is

$$\mathbb{E}\left[CF_I\right] = \beta\left(p\left(X+R\right)-Z\right), \tag{3.7}$$

and without investment is

$$\mathbb{E}\left[CF_{nI}\right] = \beta p X. \tag{3.8}$$

Taking all three components together, the manager's expected utility at the beginning of stage 1 is given by

$$\mathbb{E}\left[U_i^j\right] = \underbrace{\mathbb{E}\left[MV^j\right]}_{\substack{\text{firm's exp.}\\ \text{market value}}} + \underbrace{\mathbb{E}\left[CF_i\right]}_{\substack{\text{exp. share in the}\\ \text{firm's future CF}}} + \underbrace{rB}_{\substack{\text{private}\\ \text{benefit}}} \tag{3.9}$$

with $j \in \{\text{Impairment}, \hat{p} > \tilde{p}; \text{Impairment}, \hat{p} \leq \tilde{p}; \text{no Impairment}, \hat{p} > p; \text{no Impairment}, \hat{p} \leq p\}$ and $i \in \{I{=}\text{Investment}; nI{=}\text{no Investment}\}$.

3.3.2 Manager's Investment Decision in the Pre-KAM Reporting Regime

Maximizing her expected utility, the manager invests if her expected utility with investment is greater than without. To derive the manager's investment decision, we first state the case without impairment followed by the case with impairment.

Without Impairment (Asset Valued at $\mathbf{X_h}$) Given $\hat{p} > \tilde{p}$, the manager invests if

$$\underbrace{\mathbb{E}\left[MV^{\text{noImpairment},\hat{p}>\tilde{p}}\right] + \mathbb{E}\left[CF_I\right] + B}_{\text{Expected Utility with Investment}} \geq \underbrace{\mathbb{E}\left[MV^{\text{noImpairment},\hat{p}>\tilde{p}}\right] + \mathbb{E}\left[CF_{nI}\right]}_{\text{Expected Utility without Investment}}. \tag{3.10}$$

Given $\hat{p} \leq \tilde{p}$, the manager invests if

$$\underbrace{\mathbb{E}\left[MV^{\text{noImpairment},\hat{p}\leq\tilde{p}}\right] + \mathbb{E}\left[CF_I\right] + B}_{\text{Expected Utility with Investment}} \geq \underbrace{\mathbb{E}\left[MV^{\text{noImpairment},\hat{p}\leq\tilde{p}}\right] + \mathbb{E}\left[CF_{nI}\right]}_{\text{Expected Utility without Investment}}. \tag{3.11}$$

The expected firm value does not vary with the manager's investment decision. Consequently, the manager ignores the resulting expected firm value. Both investment decisions – for $\hat{p} >$ or $\leq \tilde{p}$ – shorten to

$$\mathbb{E}[CF_I] + B \geq \mathbb{E}[CF_{nI}]. \tag{3.12}$$

Inserting the manager's expected share in the firm's cash flows with and without impairment (Equations (3.7) and (3.8)) reveals that the manager invests for

$$\beta\,(p\,(X+R)-Z)+B \geq \beta pX. \tag{3.13}$$

Rearranging with respect to p yields that for

$$p\begin{cases} \geq \hat{p} = \frac{Z\beta - B}{R\beta}, & \text{the manager invests and for} \\ < \hat{p}, & \text{the manager does not invest.} \end{cases} \tag{3.14}$$

With Impairment (Asset Valued at pX) Without impairment and given $\hat{p} > p$, the manager does not invest if

$$\underbrace{\mathbb{E}\left[MV^{\text{Impairment},\hat{p}>p}\right]+\mathbb{E}\left[CF_I\right]+B}_{\text{Expected Utility with Investment}} < \underbrace{\mathbb{E}\left[MV^{\text{Impairment},\hat{p}>p}\right]+\mathbb{E}\left[CF_{nI}\right]}_{\text{Expected Utility without Investment}}. \tag{3.15}$$

Without impairment and given $\hat{p} \leq p$, the manager invests if

$$\underbrace{\mathbb{E}\left[MV^{\text{Impairment},\hat{p}\leq\tilde{p}}\right]+\mathbb{E}\left[CF_I\right]+B}_{\text{Expected Utility with Investment}} \geq \underbrace{\mathbb{E}\left[MV^{\text{Impairment},\hat{p}\leq\tilde{p}}\right]+\mathbb{E}\left[CF_{nI}\right]}_{\text{Expected Utility without Investment}}. \tag{3.16}$$

From Equations (3.15) and (3.16) follows that the manager, again, ignores the expected firm value and invests for $p \geq \hat{p} = \frac{\beta Z - B}{\beta R}$.
In the pre-KAM regime, the manager always invests for $p \geq \hat{p} = \frac{\beta Z - B}{\beta R}$ independent of impairment. The financial market perfectly infers the manager's investment threshold and, depending on $\tilde{p}$, the investment decision. However, the actual investment decision does not affect the firm valuation. Consequently, making an investment decision, the manager ignores the expected firm valuation.
High investment incentives, i.e., a low manager's investment threshold result if the private benefits from investment, B, or the share in the investments return, βR, are high. The manager invests in accordance with the benchmark investment decision without private benefits ($B = 0$):

$$\hat{p}\,[B=0] = p^*. \tag{3.17}$$

For positive private benefits, the manager's investment decision always induces a positive probability of overinvestment:

$$p^* - \hat{p} = \frac{B}{R\beta} > 0. \tag{3.18}$$

The manager always invests for private benefits that are higher than the manager's share in the investment costs, i.e., $B > Z\beta$. In case of a loss, the private benefits then completely compensate the manager. To further analyze cases where the manager receives private benefits for investing but does not always invest, we assume $0 < B \leq Z\beta$. Under this assumption, Proposition 3.1 summarizes the results.

Proposition 3.1. *In the pre-KAM reporting regime, the manager invests for* $p \geq \hat{p}$, *which always induces a positive probability of overinvestment given by the overinvestment interval* $(p^* - \hat{p}) = \frac{B}{\beta R}$.

3.3.3 Manager's Investment Decision in the Post-KAM Reporting Regime

In the post-KAM reporting regime, the auditor is obligated to include KAM in the auditor's report. In the case of investment, the subsequent accounting qualifies as a KAM and, thus, the auditor includes a KAM *Accounting of Investment Costs* in the report with probability q. With probability $(1-q)$ or in case of no investment, the auditor does not include a KAM *Accounting of Investment Costs*. Figure 3.2 summarizes the resulting auditor's reporting decision with $\hat{p}^K$ depicting the manager's investment threshold in the post-KAM reporting regime.

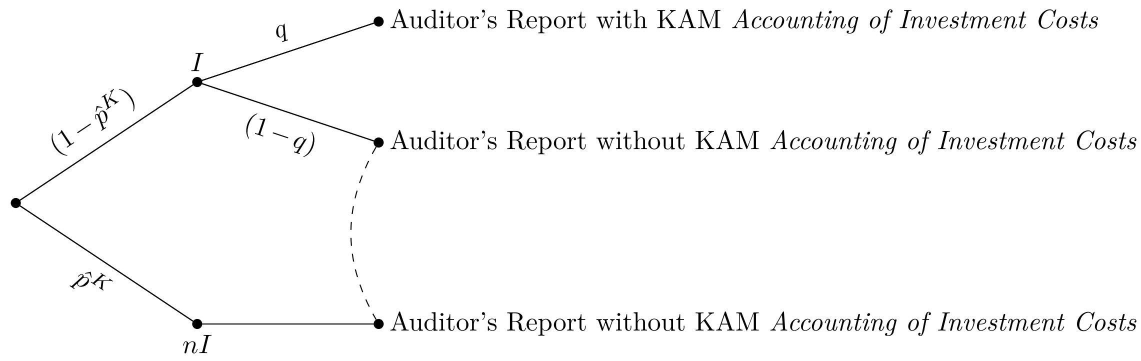

Figure 3.2: Auditor's reporting decision.

An auditor's report including a KAM *Accounting of Investment Costs* contains additional information about:

1. The manager's investment decision, and
2. The probability of goods prospects (in case of no impairment).

KAM reporting does not disclose additional information in case of impairment, as the financial market perfectly infers p from the audited financial statement (in the pre- and post-KAM reporting regime). Thus, KAM reporting does not change the manager's investment decision. Lemma 3.1 summarizes the result in case of impairment.

$\hat{p}^K$	$> \tilde{p}$		$\leq \tilde{p}$
Auditor's Report	KAM	No KAM	KAM/ No KAM
Good prospects	$p \geq \hat{p}^K$	$p \in \left(\tilde{p}, \hat{p}^K\right)$ or $p \geq \hat{p}^K$	$p \geq \tilde{p} \geq \hat{p}^K$
Investment decision	Investment	No information	Investment

Table 3.2: Information about the manager's investment decision and the probability of good prospects p (without impairment) in the post-KAM reporting regime.

Lemma 3.1. *The implementation of KAM reporting does not affect the manager's investment decision in case of impairment. The manager invests for* $p \geq \hat{p}$.

The auditor's report in the post-KAM reporting regime discloses more information without impairment. Table 3.2 summarizes the information disclosed in the audited financial statement and the corresponding auditor's report. The grey rows depict the possible financial market's inference about $\hat{p}^K$ compared to $\tilde{p}$ and the auditor's reporting decision. For $\hat{p}^K \leq \tilde{p}$, the financial market anticipates investment independent of the auditor's KAM reporting decision. As the financial market always anticipates investment, the actual investment decision does not influence the firm valuation. The manager ignores the expected market value and invests for $p \geq \hat{p}^K = \hat{p}$.
For $\hat{p}^K > \tilde{p}$, the expected market value depends on the auditor's reporting decision. Observing an auditor's report including a KAM, the financial market anticipates that the manager has invested and, thus, that the probability of good prospects exceeds the manager's investment threshold ($p \geq \hat{p}^K$). The manager, therefore, expects the financial market to value the firm as

$$\mathbb{E}\left[MV_{\text{KAM}}\right] = \int_{\hat{p}^K}^{1} \left(p\left(X+R\right) - Z\right) dp$$
$$\implies \mathbb{E}\left[MV_{\text{KAM}}\right] = \frac{\left(X+R\right)\left(1+\hat{p}^K\right)}{2} - Z. \tag{3.19}$$

Observing an auditor's report without a KAM, the financial market anticipates that the manager has not invested or that the investment was not a significant matter during the audit process. The financial market estimates the conditional probabilities of investment or no investment using Bayesian updating. Thus, the expected market value is given by

$$\begin{aligned}
\mathbb{E}[MV_{\text{noKAM}}] =& P(I|\text{noKAM}) \left(\int_{\hat{p}^K}^{1} (p(X+R)-Z)\, dp \right) + \\
& P(nI|\text{noKAM}) \left(\int_{\tilde{p}}^{\hat{p}^K} (pX)\, dp \right) \\
\implies \mathbb{E}[MV_{\text{noKAM}}] =& P(I|\text{noKAM}) \left(\frac{(X+R)(1+\hat{p}^K)}{2} - Z \right) + \\
& P(nI|\text{noKAM}) \left(\frac{(X(\hat{p}^K+\tilde{p}))}{2} \right). \qquad (3.20)
\end{aligned}$$

The first term of the expected market values captures the case of an investment, which was not a significant matter, and the second term captures the case of no investment.

The manager anticipates that the auditor includes a KAM with probability q. Consequently, the manager's expected utility with investment is given by

$$\mathbb{E}[U_I] = q\mathbb{E}[MV_{\text{KAM}}] + (1-q)\mathbb{E}[MV_{\text{noKAM}}] + \mathbb{E}[CF_I] + B. \qquad (3.21)$$

The first term captures the expected market value with a KAM report and the second term captures the expected market value without a KAM report. The third and fourth terms capture the manager's share in the firm's expected cash flows and the private benefits for investing. The expected utility without investment is given by

$$\mathbb{E}[U_{nI}] = \mathbb{E}[MV_{\text{noKAM}}] + \mathbb{E}[CF_{nI}]. \qquad (3.22)$$

Without investment, the auditor never includes a KAM in the auditor's report and, thus, the firm's expected market value is always given by Equation (3.20).
We can now state the manager's investment decision in the post-KAM reporting regime:

$$\begin{aligned}
& \mathbb{E}[U_I] > \mathbb{E}[U_{nI}] \\
\implies & q\mathbb{E}[MV_{\text{KAM}}] + (1-q)\mathbb{E}[MV_{\text{noKAM}}] + \mathbb{E}[CF_I] + B > \mathbb{E}[MV_{\text{noKAM}}] + \mathbb{E}[CF_{nI}]. \qquad (3.23)
\end{aligned}$$

Rearranging and inserting the expected cash flows (Equations (3.7) and (3.8)) yields

$$\underbrace{\beta(pR-Z)+B}_{\substack{\text{Investment Decision}\\ \text{pre-KAM reporting regime}}} + \underbrace{q(\mathbb{E}[MV_{\text{KAM}}]-\mathbb{E}[MV_{\text{noKAM}}])}_{\text{Signaling Effect}(S[\mathbb{E}[MV_{\text{KAM}}]-\mathbb{E}[MV_{\text{noKAM}}]])} > 0 \implies p \geq \hat{p}^K. \qquad (3.24)$$

Lemma 3.2 summarizes the comparison of the manager's investment thresholds, $\hat{p}^K$, to the optimal investment threshold, p^*.[10]

Lemma 3.2. *In the post-KAM reporting regime, given no impairment and $\tilde{p} < \hat{p}^K$, the manager invests for $p \geq \hat{p}^K$, which induces a positive probability of overinvestment given by the overinvestment interval $(p^* - \hat{p}^K)$.*

Proof. See appendix. □

3.4 The Signaling Effect of KAM Reporting

Equation (3.24) shows that the investment decision differs in the pre- and post-KAM reporting regime if KAM reporting induces a positive or negative *signaling effect.* A positive signaling effect, i.e., the expected firm value with KAM is higher than without KAM, increases investment incentives and, thus, increases the overinvestment interval in the post-KAM reporting regime. A negative signaling effect, i.e., the expected firm value without KAM is higher than with KAM, decreases investment incentives and, thus, decreases the overinvestment interval in the post-KAM reporting regime.
Inserting the expected firm values (Equations (3.19) and (3.20)) in the signaling effect shown in Equation (3.24) and rearranging yields

$$
\begin{aligned}
&S[\mathbb{E}[MV_{\text{KAM}}] - \mathbb{E}[MV_{\text{noKAM}}]] \\
&= qP(nI|\text{noKAM}) \left(\underbrace{\frac{R\left(1+\hat{p}^K\right)}{2} - Z}_{\substack{\gtrless 0 \\ \text{Loss-Effect}}} + \underbrace{\frac{X}{2}\left(\left(1+\hat{p}^K\right) - \left(\hat{p}^K + \tilde{p}\right)\right)}_{\substack{>0 \\ \text{Updating-Belief Effect}}} \right). \qquad (3.25)
\end{aligned}
$$

The signaling effect depends on two different effects - the *loss effect* and the *updating-belief effect.* The signaling effect is always positive for a positive loss effect, resulting in a higher overinvestment interval. The signaling effect can be positive or negative for a negative loss effect, depending on which effect, i.e., loss effect or updating-belief effect dominates. Lemma 3.3 summarizes this result.

Lemma 3.3. *The signaling effect of KAM reporting depends on the loss effect, which can decrease investment incentives, and the updating-belief effect, which increases investment incentives.*

Proof. See appendix. □

The intuition behind the loss effect and the updating-belief effect is as follows: Observing an auditor's report including a KAM, the financial market anticipates the manager's

[10] For the detailed derivation, see the Appendix.

investment. Thus, evaluating the firm, the financial market considers the expected loss in case of overinvestment. We refer to this effect of KAM reporting as the *loss effect*. If overinvestment is severe, i.e., the investment threshold is sufficiently low, the loss effect is negative, and investment incentives decrease due to a lower expected firm valuation.

In valuing the firm, the financial market also considers the expected cash flows from operating activity. Observing a KAM, the financial market anticipates that the probability of good prospects exceeds the manager's investment threshold, i.e., $p \geq \hat{p}^K > \tilde{p}$. Without a KAM, the market instead anticipates $p \geq \tilde{p}$. An investment resulting in a KAM reduces uncertainty about the probability of good prospects and induces a higher belief about the probability of good prospects. This higher belief results in higher expected cash flows from operating activity. We refer to this effect of KAM reporting as the *updating-belief effect*. The updating-belief effect is always positive and increases investment incentives due to a higher expected firm valuation.

If the updating-belief effect dominates the loss effect, investment incentives increase in the post-KAM reporting regime compared to the pre-KAM reporting regime and, thus, the overinvestment interval increases. If a negative loss effect dominates the updating-belief effect, the overinvestment interval decreases.

Proposition 3.2 summarizes the results regarding the effect of several factors like the manager's private benefits, impairment rules, and the firm's cash flows from operating activity on the manager's investment decision.

Proposition 3.2. *KAM reporting increases overinvestment whenever*

1. *the investment's profitability is high, i.e.,* $(R-Z) > \frac{B}{\beta} - X(1-\tilde{p})$.
2. *the firm's cash flows from operating activity are high, i.e.,* $X > \frac{\beta(Z-R)+B}{\beta(1-\tilde{p})}$.
3. *the manager's private benefits,* B*, are low, i.e.,* $B < \beta(R-Z+X(1-\tilde{p}))$.
4. *the impairment threshold,* $\tilde{p}$*, is low, i.e.,* $\tilde{p} < \frac{\beta(X+R-Z)-B}{\beta X}$.

Proof. See appendix. □

Part (1) of Proposition 3.2 states that for high investment profitability, the overinvestment interval is greater in the post-KAM reporting regime. The intuition behind this is as follows: The higher the investment's profitability (higher R or lower Z), the lower is the expected loss, i.e., a low negative loss effect or a positive loss effect emerges. Consequently, the updating-belief effect and the loss effect are positive, or the updating-belief effect dominates the low negative loss effect, resulting in higher investment incentives.

Part (2) of Proposition 3.2 states that for high cash flows from operating activity, the overinvestment interval is greater in the post-KAM reporting regime. The intuition is as follows: The higher the cash flows from operating activity (higher X), the higher the updating-belief effect, resulting in higher investment incentives.

Part (3) of Proposition 3.2 states that for lower private benefits, the overinvestment interval is greater in the post-KAM reporting regime and vice versa. This result is quite counterintuitive. The intuition is as follows: In the pre-KAM reporting regime, overinvestment is solely driven by the manager's private benefits. The expected market value does not affect the manager's investment decision. However, in the post-KAM reporting regime, private benefits affect the manager's investment decision directly and indirectly:

1. Direct effect: Receiving private benefits, the manager's investment incentives increase.

2. Indirect effect: The expected market value affects the manager's investment decision in the post-KAM reporting regime. Equation (3.25) shows that the loss effect is increasing in the manager's investment threshold. Anticipating that $\hat{p}^K$ is decreasing for higher private benefits, the financial market rates the expected loss higher, i.e., the loss effect, and investment incentives decrease.

The manager weighs both the direct and indirect effect. As the manager anticipates the resulting (negative/decreasing) loss effect, the effect of private benefits on the manager's investment decision is less salient in the post-KAM regime. For high private benefits, the indirect effect dominates, and the overinvestment interval is even smaller in the post-KAM reporting regime. Consequently, KAM reporting can mitigate the adverse effects of high private benefits on the manager's investment decision.
Part (4) of Proposition 3.2 states that for a lower impairment threshold $\tilde{p}$, the overinvestment interval is greater in the post-KAM reporting regime. The intuition is as follows: A low impairment threshold $\tilde{p}$ implies a high uncertainty about the firm's prospects. Without impairment, the market assumes $p \geq \tilde{p}$. Observing a KAM, the market anticipates the investment and, therefore, $p \geq \hat{p} > \tilde{p}$. The higher the prior uncertainty, i.e., the lower the impairment threshold, the higher the updating-belief effect. The updating-belief effect increases investment incentives and, thus, a greater overinvestment interval results. The more information the market can deduce from a KAM, the higher the manager's incentives to strategically invest to signal good prospects.

3.5 Conclusion

The auditor's report is the only publicly observable result of the audit process and the only verified source of information besides the audited financial statement for stakeholders. In the pre-KAM reporting regime, the auditor states a simple pass/ fail reporting model without presenting client-specific information about the audit process. Financial statement users raised concerns about the decision usefulness and the relevance of the auditor's report. Responding to the criticism that auditor's reports were boilerplate, the IAASB and the PCAOB released new standards, requiring auditors to include those matters in their reports that required significant attention during the audit or matters of significant risk, i.e., KAM. With the aim to enhance the decision usefulness and the informational value of the auditor's reports, KAM reporting affects market reactions. Alongside analyzing how market reactions change, it is crucial to analyze how these changes can affect real decisions such as investments.

Using a game-theoretical model, we analyze whether a manager changes her pre-reporting real decisions if she anticipates the effect of KAM reporting on market reactions. Assuming that an auditor can include a KAM about the accounting of an investment, we analyze a manager's investment decision in the pre- and post-KAM reporting regime.

As a result, we show that KAM reporting, which should enhance the credibility and decision usefulness of the auditor's report has an unexpected impact on the manager's pre-reporting investment decision. Depending on the resulting market valuation, the manager strategically invests to induce a KAM report and, consequently, affects the market valuation. The reason is as follows: In the pre-KAM reporting regime, the financial market cannot perfectly observe the investment. The manager then ignores the resulting firm valuation and only considers the monetary effect of the investment in the form of expected cash flows. In the post-KAM reporting regime, the manager anticipates that an investment has a monetary effect and an effect on the firm's market valuation. Two effects drive the market valuation: Observing a KAM about an investment, the financial market receives more information and updates prior beliefs about the firm's probability of good prospects (updating-belief effect). Under the assumption that a manager is interested in a high market valuation, the updating-belief effect increases her investment incentives, resulting in overinvestment. However, the financial market anticipates overinvestment. Thus, the firm's market valuation decreases, resulting in decreasing investment incentives (loss effect).

We find that if the investment's profitability is high, the firm's cash flow from operating activity is high, or the impairment threshold is low, the updating-belief effect dominates the loss effect. Consequently, KAM reporting can induce inefficient investment behavior in the form of overinvestment. However, KAM reporting can also mitigate the adverse effects of private benefits on the manager's investment decision.

We add to the existing literature about KAM reporting by showing some unintended consequences of this regulatory change. The main findings of our study have implications for regulators, who introduced KAM reporting to enhance the decision usefulness and relevance for financial statement users. We show that more information included in the auditor's report can have adverse effects on the firms' real decisions.

3.6 Appendix

3.6.1 Proof of Lemma 3.2

Proof. Without impairment, the manager invests if

$$\begin{aligned}&\mathbb{E}[U_I] > \mathbb{E}[U_{nI}]\\ &\implies (\mathbb{E}[CF_I] - \mathbb{E}[CF_{nI}]) + B + q(\mathbb{E}[MV_{\text{KAM}}] - \mathbb{E}[MV_{\text{noKAM}}]) > 0. \end{aligned} \tag{3.26}$$

The first term captures the difference in expected cash flows, the second term captures the manager's private benefits, and the third term captures the difference in expected market values. Inserting the expected cash flows with and without investment from Equations (3.7) and (3.8) yields

$$\begin{aligned}&\beta(p(X+R) - Z - pX) + B + q(\mathbb{E}[MV_{\text{KAM}}] - \mathbb{E}[MV_{\text{noKAM}}]) > 0\\ &\implies \beta(pR - Z) + B + q(\mathbb{E}[MV_{\text{KAM}}] - \mathbb{E}[MV_{\text{noKAM}}]) > 0. \end{aligned} \tag{3.27}$$

Define

$$I[p] := \beta(pR - Z) + B + q(\mathbb{E}[MV_{\text{KAM}}] - \mathbb{E}[MV_{\text{noKAM}}]) \tag{3.28}$$

with

$$I[p] \begin{cases} < 0, & \mathbb{E}[U_I] < \mathbb{E}[U_{nI}], \text{ and the manager does not invest;}\\ = 0, & \mathbb{E}[U_I] = \mathbb{E}[U_{nI}], \text{ and the manager is indifferent; and}\\ > 0, & \mathbb{E}[U_I] > \mathbb{E}[U_{nI}], \text{ and the manager invests.} \end{cases} \tag{3.29}$$

Differentiating $I[p]$ with respect to p yields

$$\frac{\partial I[p]}{\partial p} = \beta R + q\underbrace{\left(\frac{\partial \mathbb{E}[MV_{\text{KAM}}]}{\partial p}\right) - \left(\frac{\partial \mathbb{E}[MV_{\text{noKAM}}]}{\partial p}\right)}_{=0} > 0. \tag{3.30}$$

The expected market values are not affected by the true probability of good prospects. The market infers the manager's anticipated investment threshold and bases the firm valuation on the manager's investment threshold. Thus, $I[p]$ is monotonically increasing in p. By inserting $p = p^* = \hat{p}^K$ in $I[p]$, one can show that there exists a manager's investment threshold $\hat{p}^K$ with $\hat{p}^K < p^*$.

If the manager's investment decision is identical to the benchmark investment decision, $I[p = p^* = \hat{p}^K] = 0$ must result, as the manager's investment threshold makes her indifferent between investment and no investment. However, $I[p = p^* = \hat{p}^K] > 0$ implies that

the manager's investment threshold is lower than the benchmark threshold, resulting in overinvestment.
Proof of $\hat{p}^K < p^*$:

$$I[p = p^* = \hat{p}^K] = B + q\left(\mathbb{E}\left[MV_{\text{KAM}}\right] - \mathbb{E}\left[MV_{\text{noKAM}}\right]\right) > 0. \tag{3.31}$$

The expected market value with KAM always exceeds the expected market value without KAM, if the market anticipates that the manager invests for $\hat{p}^K = p^*$. Proof:

$$\begin{aligned}
&\mathbb{E}\left[MV_{\text{KAM}}\right] - \mathbb{E}\left[MV_{\text{noKAM}}\right] = \frac{(X+R)\left(1+\frac{R}{Z}\right)}{2} - Z - \\
&\left(P(nI|\text{KAM})\frac{X\left(\tilde{p}+\frac{R}{Z}\right)}{2} + P(I|\text{noKAM})\left(\frac{(X+R)\left(1+\frac{R}{Z}\right)}{2} - Z\right)\right) > 0 \\
&\implies P(nI|\text{noKAM})\left(R - Z + X(1-\tilde{p})\right) > 0.
\end{aligned} \tag{3.32}$$

The term on the left is positive for $R > Z$. That is, the manager invests for $\hat{p}^K < p^*$, which results in an overinvestment interval of $p^* - \hat{p}^K$.

□

3.6.2 Proof of Lemma 3.3

Proof. Equation (3.24) shows that there exists a signaling effect of KAM reporting. Inserting the expected market values from Equations (3.19) and (3.20) yields

$$\begin{aligned}
&S[\mathbb{E}[MV_{\text{KAM}}] - \mathbb{E}[MV_{\text{noKAM}}]] = q(\frac{(X+R)(1+\hat{p}^K)}{2} - Z) - \\
&\left(P(I|\text{noKAM})(\frac{(X+R)(1+\hat{p}^K)}{2} - Z) + P(nI|\text{noKAM})\frac{X(\hat{p}^K+\tilde{p})}{2}\right) \\
&\implies q\left(\left((1-P(I|\text{noKAM}))\frac{(X+R)\left(1+\hat{p}^K\right)}{2} - Z\right) - P(nI|\text{noKAM})\frac{X\left(\hat{p}^K+\tilde{p}\right)}{2}\right) \\
&\implies qP(nI|\text{noKAM})\left(\underbrace{\frac{R\left(1+\hat{p}^K\right)}{2} - Z}_{\text{Loss Effect}} + \underbrace{\frac{X}{2}\left(\left(1+\hat{p}^K\right) - \left(\hat{p}^K+\tilde{p}\right)\right)}_{\text{Updating-Belief Effect}}\right).
\end{aligned} \tag{3.33}$$

For a low manager's investment threshold, the loss effect is negative:

$$\begin{aligned}
\frac{R\left(1+\hat{p}^K\right)}{2} - Z &< 0 \\
\hat{p}^K R &< 2Z - R \\
\hat{p}^K &< \frac{2Z-R}{R}.
\end{aligned} \tag{3.34}$$

The updating-belief effect is always positive:

$$
\begin{aligned}
\frac{X}{2}\left(1+\hat{p}^K\right)-\left(\hat{p}^K+\tilde{p}\right) &> 0 \\
1-\tilde{p} &> 0.
\end{aligned}
\tag{3.35}
$$

The updating-belief effect increases investment incentives, and therefore, the manager's investment threshold decreases. However, for a low manager's investment threshold, the loss effect is negative, resulting in a decreasing expected market value with KAM reporting. The loss effect then decreases investment incentives. □

3.6.3 Proof of Proposition 3.2

Proof. KAM reporting increases the overinvestment interval if $\hat{p}^K < \hat{p}$. The manager chooses the same investment threshold with and without KAM if $I[p=\hat{p}^K=\hat{p}]=0$. The investment threshold with KAM reporting $\hat{p}^K$ is smaller, i.e., $\hat{p}^K < \hat{p}$, if $I[p=\hat{p}^K=\hat{p}]>0$. Inserting $p=\hat{p}^K=\hat{p}$ in $I[p]$ (derived in Equation (3.28)) shows that the overinvestment interval in the post-KAM reporting regime increases if

$$
\begin{aligned}
\frac{qP(nI|\text{noKAM})}{2}\left(R(1+\hat{p})-2Z+X(1-\tilde{p})\right) &> 0 \\
\implies (R-Z) &> \frac{B}{\beta}-X(1-\tilde{p}), \text{ or} \\
\implies X &> \frac{\beta(Z-R)+B}{\beta(1-\tilde{p})}, \text{ or} \\
\implies B &< \beta(X(1-\tilde{p})+R-Z), \text{ or} \\
\implies \tilde{p} &< \frac{\beta(X+R-Z)-B}{\beta X}.
\end{aligned}
\tag{3.36}
$$

□

Chapter 4

Information Asymmetry and the Effect of Materiality

Abstract

This paper analyzes the effect of one key concept of mandatory disclosure on firms' investment decisions – *materiality*. If a transaction is material, additional disclosures are mandatory, and information asymmetry decreases. Choosing a higher investment level, thus, influences the expected market price directly and indirectly. A higher investment level either increases or decreases the market price with precise information (direct effect). The probability that the investment qualifies as material increases in the higher investment level. Thus, information asymmetry decreases, and the market prices the firm with precise information more often (indirect effect). Whether the direct and the indirect effect increase or decrease investment incentives depends on the market price response and the desirability of disclosures. The results suggest that materiality can increase or decrease investment efficiency.

4.1 Introduction

For decades, a wide variety of studies have analyzed the effects of information asymmetry, accounting measures, and disclosures on firms' investment decisions. Information asymmetry about firms' investments almost always exists, and the market prices the firm with imperfect information. The precision of accounting measures and disclosures influences the degree of information asymmetry and, thus, the market price. As the market price usually affects firms' investment decisions, regulators should consider the real effects of information asymmetry when deciding about accounting measures and mandatory disclosure.

Prior theoretical models show that information asymmetry can decrease the investment efficiency (Stein, 1989; Bebchuk and Stole, 1993). Nevertheless, in the presence of information asymmetry about the investment profitability, accounting imprecision – when measuring the investment level – can be value enhancing (Kanodia et al., 2005). These models assume an exogenously given degree of information asymmetry and, thereby, neglect one key factor of disclosure – *materiality.* For material transactions various disclosures are mandatory. Whether a transaction qualifies as material or not depends on the investment level. The investment level, thus, influences the disclosures and, thereby, the information asymmetry. The investment level affects the resulting market price in two ways:

1. The investment level directly affects the market price if the market has precise information.
2. The investment level affects the probability that the market has precise information.

In a theoretical model, I analyze the effects of materiality on firms' investment decisions in the presence of information asymmetry. The results show that materiality increases or decreases investment efficiency. Whether materiality is value enhancing or deteriorating depends on the market price response and the desirability of disclosure.[1] Thus, analyzing the combined effect of materiality and information asymmetry is crucial.

According to the FASB, "Materiality is entitiy specific. The omission or misstatement of an item in a financial report is material if, in light of surroundig circumstances, the magnitude of the item is such that it is probable that the judgment of a reasonable person relying upon the report would have been changed or influenced by the inclusion or correction of the item." Similar to that, the IASB's definition of materiality is "[...] if omitting, misstating or obscuring it could reasonably be expected to influence the decisions that the primary users of general purpose financial statements make on the

[1] The market price response describes whether the market price is increasing or decreasing in the investment level. A disclosure is assumed to be desirable if the market price with perfect/ precise information (resulting with disclosure) is higher compared to the market price without perfect/ precise information (resulting without disclosure).

basis of those financial statements, which provide financial information about a specific reporting entity."[2]

Materiality requires firms to disclose additional information if a transaction qualifies as material. Materiality depends on quantitative characteristics, e.g., the investment level, and qualitative characteristics, e.g., the nature of the investment. Quantitative characteristics are, for example, financial and monetary effects. However, even if the financial effects are minor, the nature of the transaction can affect the materiality judgment. Qualitative factors, for example, concern the organization's social responsibility or reputation. Following the quantitative characteristics of materiality, the higher the transaction compared to the total assets, the higher the probability that the transaction qualifies as material.

Accounting standards contain a list of minimum requirements of disclosures if the item is material. According to IAS 1, an entity shall disclose additional information if users are not able to understand the impact on the entity's financial position or performance with only the minimum disclosures that are required. Moreover, material items should be disclosed disaggregated and not obscured with immaterial information or aggregated with material items of different nature or function. These specific disclosures are mandatory only if the item qualifies as material. Such disclosures are, for example, additional information in the notes, which are not already presented in the financial statement, containing descriptions or disaggregations of transactions. In their annual report 2020, Volkswagen AG disclosed material transactions in their notes. They stated, for example, that they invest in a company developing a system for autonomous driving. In detail, they disclosed that they will invest one billion USD in total over the following years and contributing a consolidated subsidiary (Volkswagen AG, 2020).

In a theoretical model, I analyze how materiality influences the decision between a safe and risky investment in the presence of information asymmetry about the investment profitability and level. Firms often devote a lot of time and effort to seek new investment projects. As a result, firms have more information about an investment's profitability than financial statement users. Moreover, accounting reports often imprecisely measure investment costs, i.e., they might be shown in aggregated accounts and cannot be distinguished from other costs. Kanodia et al. (2005) argue that accounting measures often depend on subjective judgments, and it is often challenging to separate investments from operating cash flows, resulting in information asymmetry about the investment level.

The firm has investment capital and decides about the allocation in a safe or risky project. The firm's utility comprises the cash flows from investment (here from safe and risky investment) and the resulting firm's market price. Analyzing a single investment decision, Kanodia et al. (2005) assume a positive market price response, i.e., the market price increases in the investment level. However, the market price response can be positive or negative for a decision between two investment projects. Investment in a risky project is

[2] See FASB (2018) and IASB (2018).

always accompanied by less investment in a safe project. Consequently, the firm forgoes safe returns (opportunity cost). Therefore, the market prices the expected return and the opportunity costs of risky investment. If the firm's and the market's preferences regarding the safe and risky investment do not coincide, the market weighs the opportunity costs from risky investment differently. The preferences might not coincide if, for example, the market prices the effect on future periods higher. Investment in a safe project always generates a positive cash flow and ensures steady economic growth. A risky investment can also generate a loss, which decreases the expected capital for future investments. A firm's manager making the investment decision might decide more myopic. Thus, I assume that the market price response can be positive or negative.

Analyzing information asymmetry about the investment profitability and level separately, I partially replicate findings of prior literature. Bebchuk and Stole (1993) and Kanodia et al. (2005) suggest that information asymmetry about the investment profitability results in overinvestment, and information asymmetry about the investment level results in underinvestment. Information asymmetry about the investment profitability results in overinvestment, as the firm wants to signal higher profitability through higher investments. Information asymmetry about the investment level results in underinvestment, as the market price is based on perceptions and not on the actual investment level. The firm ignores the market price, which decreases investment incentives, resulting in underinvestment. For a decision between a safe and risky investment, the results show that, information asymmetry about the risky investment profitability also always results in overinvestment. However, information asymmetry about the risky investment level results in underinvestment only if the market price response is positive. For a negative market price response, information asymmetry about the risky investment level results in overinvestment. Whenever the market cannot price the firm with information about the risky investment level, the firm ignores the market value and maximizes the expected cash flows. A positive market price response increases investment incentives. Consequently, if the firm ignores the market price, the firm underinvests. A negative market price response decreases investment incentives. As a result, the firm overinvests in the presence of information asymmetry about the investment level.

In more realistic settings, firms often have superior information about the investment profitability and the investment level. Kanodia et al. (2005) show that there exists an optimal degree of accounting imprecision, which induces first best. Accounting imprecision can be interpreted similarly to a higher degree of information asymmetry about the investment level. For an optimal degree of accounting imprecision, over- and underinvestment incentives, resulting from information asymmetry about the investment profitability and level, can perfectly balance each other. In contrast, for a decision between a safe and a risky investment, first best can only result if the market price response is positive. The intuition is as follows: For a positive market price response, information asymmetry about the risky investment profitability induces overinvestment incentives, and information asymmetry about the risky investment level induces underinvestment incentives. Together both can perfectly balance each other. As the underinvestment incentives depend on the degree of information asymmetry about the investment level, an optimal degree of information asymmetry induces first best investment. However, if the market price response is negative, both types of information asymmetry induce overinvestment incentives. Hence, independent of the degree of information asymmetry, first best can never result.

These results neglect the concept of materiality. Considering materiality, i.e., disclosures and, thus, more information are more likely for a higher investment level, a direct and an indirect effect influence the firm's investment decision. Materiality increases the probability of additional disclosures and, thus, decreases the information asymmetry about the investment level. A decreasing information asymmetry decreases under- or overinvestment (direct effect). The probability of qualifying as material, i.e., the probability of additional disclosures, increases in the risky investment level. In the case of disclosure, the market prices the firm with perfect information. If the market price with perfect information is higher than without perfect information, disclosure is desirable. Consequently, materiality increases investment incentives if the disclosure is desirable and decreases investment incentives otherwise (indirect effect).

Taking both effects together, two main insights result:

1. Without materiality, an optimal degree of information asymmetry exists, inducing first best investment for a positive market price response. The direct effect of materiality increases investment incentives and, thereby, reduces underinvestment. Nevertheless, if disclosure is desirable, the indirect effect further increases investment incentives. With materiality, investment incentives can increase so that the firm always overinvests and first best never results.

2. Without materiality, for a negative market price response, the firm never invests first best. The direct effect of materiality decreases investment incentives and, thereby, reduces overinvestment. If disclosure is non-desirable, the indirect effect further decreases investment incentives. Together, both can result in first best investment.

Thus, materiality increases or decreases investment efficiency depending on the market price response and the desirability of disclosure.

This paper extends the literature about the real effects of information asymmetry. Kanodia (1980) develops a real effects framework, showing that disclosure of information affects asset prices and, thus, real corporate decisions. Prior theoretical models show that managers might underinvest, i.e., behave myopically or overinvest in the presence of information asymmetry. Stein (1989) shows that managers behave myopically by boosting current earnings and, thereby, forgo longer-term benefits. In equilibrium, the market is not deceived, but the possibility of deception leads managers to behave myopically.

Spence (1973) shows that information asymmetry about productivity results in a signaling equilibrium. In a job market, individuals overinvest in their education to signal higher productivity. Bebchuk and Stole (1993) examine investment decisions in the presence of information asymmetry and myopic managerial objectives. They show that managers underinvest in the presence of information asymmetry about the investment level and overinvest in the presence of information asymmetry about the investment profitability. The underinvestment equilibrium results as the managers ignore the market price. Without information about the investment level, the firm's market price is based on perceptions, and the actual investment decision does not influence the market price. The overinvestment equilibrium results as the managers want to signal higher profitability.
However, the precision of accounting reports influences the information asymmetry and, thereby, managers' investment behavior. Kanodia and Mukherji (1996) show that if accounting reports aggregate cash flows and do not measure periodic performance, firms' equilibrium investments are distorted. The market price, which results with aggregate cash flows, induces an additional informational cost to investment and, thereby, decreases investment incentives. An imprecise accounting measure that provides a noisy signal can decrease these informational costs and shift the economy to first best investments. Kanodia et al. (2005) further analyze the presence of information asymmetry about both – the investment level and the investment profitability, where an imprecise accounting report measures the investment level. The results suggest that accounting imprecision can be value enhancing. Information asymmetry about the investment level induces underinvestment while information asymmetry about the investment profitability induces overinvestment. Depending on the accounting precision, both effects can perfectly balance each other and induce first best investment. In these prior models, the accounting precision or information asymmetry is exogenously given. I contribute to this stream of literature by analyzing the effect of materiality on investment behavior. The manager, thereby, influences the information asymmetry, which in turn influences managerial investment incentives.
Liang and Wen (2007) investigate input- and output-based accounting measures and show that input-based accounting measures can induce more efficient investment decisions than output-based measures if both measures are noisy. Zhang (2013) examine the quality of accounting standards and how they affect investment decisions and welfare. They show that accounting standards matter as the information quality influences risk premia on projects and the investment level. Dutta and Nezlobin (2017) study how disclosures in accounting reports affect investment efficiency and investor welfare. The firm makes sequential investments to adjust the capital stock over time. Disclosures can either entail information about the firm's future capital stock or its future operating cash flows. Without information about the firm's future capital stock underinvestment results, more precise disclosure mitigates this underinvestment incentive and increases investment efficiency. However,

more precise information about future cash flows either results in under- or overinvestment depending on the precision of accounting measurement and the expected growth in demand.

Voluntary disclosures also influence the information asymmetry and, thereby, investment incentives. Beyer and Guttman (2012) study a model where both the disclosure and the investment decision are endogenous. In contrast to prior voluntary disclosure literature, the model predicts that two distinct nondisclosure intervals can characterize managers' disclosure strategy and that managers with intermediate information sometimes forgo profitable investment opportunities. Their results show the importance of examining both firm's disclosure and investment decisions. In contrast to them, I do not consider voluntary disclosure. Disclosure is legally required with a given probability. However, with materiality, the investment level influences the mandatory disclosure probability.

Voluntary disclosure and an investment decision differ from materiality and mandatory disclosure in one significant way: The manager decides about both the voluntary disclosure and the investment decision separately. With materiality and mandatory disclosure, the firm only decides about the investment and, thereby, indirectly influences the mandatory disclosure. Thus, disclosure is not a direct choice but incorporated in the investment decision.

The paper also extends to the literature about the concept of materiality, which is often analyzed only from an auditor perspective (Christensen et al., 2020; Patterson and Smith, 2003). Doxey et al. (2020) find in an experimental study that investors' materiality judgment is different for good and bad news. Chung et al. (2021) analyze quantitative characteristics of actual observable material thresholds by analyzing the materiality thresholds used in mandatory *change in accounting estimate* disclosures. However, an analysis of the interdependencies of information asymmetry, materiality and firms' investment decisions is missing.

The remainder of the paper is organized as follows. In Section 4.2, I describe the model descriptions and assumptions. Section 4.3 derives the three benchmark cases (perfect information, information asymmetry about the risky investment level, and information asymmetry about the risky investment profitability). In Section 4.4, I analyze the firm's investment decision in the presence of both types of information asymmetry. Section 4.5 studies how materiality influences the firm's investment decision. Section 4.6 concludes.

4.2 Model Setup

Consider a firm having investment capital K. The firm can invest the capital in either a safe or risky project. Similar to Bebchuk and Stole (1993), I assume that the capital K is exogenously given, common knowledge, and the firm always invests the total amount. As a result, the firm's decision reduces to finding the optimal risky investment level depicted by x. The firm's utility comprises the cash flows from safe and risky investment and the firm's market price.

Risky investment of x yields a return of $\theta_r x - c(x)$, where $c(x)$ depicts the costs of investment with $c'(x) > 0$ and $c''(x) > 0$ (strictly convex). The probability of success is depicted by $\theta_r \in [\underline{\theta_r}, \overline{\theta_r}]$. Risky investment, consequently, yields a positive return in case of success, θ_r, and a loss in case of failure, $(1-\theta_r)$. Contrary to this, safe investment of $K - c(x)$ yields a certain positive return $(\theta_s - 1)(K - c(x))$ with $\theta_s > 1$. The parameter θ_s can be interpreted as a risk-free interest rate.

The firm's market price is described by $v(x, \theta_r)$ (exogenously given).[3] Assumption 2 characterizes the market price.

Assumption 2. *The market price $v(x, \theta_r)$ is*

1. *increasing in the risky investment profitability $v_{\theta_r}(x, \theta_r) > 0$,*
2. *and increasing or decreasing in the risky investment level $v_x(x, \theta_r) \gtrless 0$.*

Kanodia et al. (2005) assume that the market price is always increasing in the investment level, i.e., $v_x(x, \theta_r) > 0$. However, they consider a single investment decision, whereas this model analyzes the choice between a safe and risky investment. Consequently, investing in the risky project entails opportunity costs in the form of forgoing safe returns. Moreover, the firm's and market's preferences regarding safe and risky investments might not coincide. For different weighting factors for safe and risky projects, the market price can increase or decrease for higher risky investment level, x, depending on these weighting factors. Similar to Kanodia et al. (2005), consider, for example, a market price in the form of

$$\gamma \theta_s (K - c(x)) + \delta \theta_r x + h(\theta_r^2 + \theta_s^2). \tag{4.1}$$

The first two terms capture the pricing of the expected returns from safe and risky investment with γ and δ as the weighting factors of safe and risky investment. The third term captures the effect of the current profitability on the expected returns from anticipated future investments. Differetiating with respect to x yields

$$-c'(x)\gamma\theta_s + \delta\theta_r \gtrless 0 \implies c'(x) \gtrless \frac{\delta\theta_r}{\gamma\theta_s}. \tag{4.2}$$

[3] Kanodia (1980) derives an endogenously market pricing rule resulting in an intertemporal equilibrium. Assuming investment opportunities in every period and the current profitability and investment affecting future profitability and cash flows, the market pricing rule is a function of current investment and current profitability. As described in Kanodia et al. (2005), the assumptions characterizing the exogenously given market pricing rule would likely be true for an endogenously derived market pricing rule.

Depending on the weighting factors γ and δ and the risky investment level x, the market price decreases or increases for higher levels of x. The weighting factor for the safe investment γ can be higher if the market, for example, prices the effect of the investment on future periods higher. Investment in a safe project generates a certain positive cash flow, i.e., ensures steady economic growth. Investment in a risky project can generate a loss, leaving the firm with no capital for future investments. A firm's manager making the investment decision might be more myopic, thereby weighting the safe and risky investment differently.

To analyze the effect of materiality on a firm's investment decision in the presence of information asymmetry, the model considers two types of information asymmetry, which can occur either separately or combined. The firm exerts effort into seeking investment opportunities and, thus, firms are better informed about the investment's profitability, θ_r. The investment costs $c(x)$ can be depicted in the financial statement. However, the investment costs are not always perfectly depicted depending on the accounting measures. Therefore, I assume that the accounting measure perfectly depicts $c(x)$, and, thus, x, with probability p and does not depict $c(x)$ otherwise. Safe and risky investment costs can, for example, be shown in separated accounts with probability p so that risky investment is perfectly observable. With probability $(1-p)$, both are shown in aggregated accounts so that the market cannot distinguish between safe and risky investment without additional information.

In addition, accounting measures and disclosures are influenced by the concept of materiality. For a material investment, the probability of mandatory additional disclosures increases. As a result, an additional signal regarding the investment costs $c(x)$ is observed with probability $m(x)$ with $m'(x) > 0$. The higher the risky investment level x, the higher the costs $c(x)$, which are the basis of the accounting measure. The higher the costs $c(x)$ compared to the financial statement as a whole, the higher the probability of qualifying as material and, thus, additional disclosures are mandatory (quantitative characteristic of materiality).

In their annual report 2020, Volkswagen AG, for example, disclosed information about material transactions in 2020. One of them is an investment in a company developing a system for autonomous driving. They also disclosed the investment amount of one billion dollars over the following years. Moreover, they contribute one of their consolidated subsidiary (Volkswagen AG, 2020). Volkswagen AG would not have disclosed this information if the transaction is immaterial. The disclosure informs the financial statement users about the investment type, e.g., is it risky or safe, and about the investment level. This example shows that there is a higher probability of disclosure for material investments and, therefore, a higher probability that no information asymmetry about the investment level exists.

4.3 Benchmark Investment Decisions

Similar to Kanodia et al. (2005), I analyze three benchmark cases: perfect information/ first best (benchmark 1), information asymmetry about the investment level (benchmark 2), information asymmetry about the investment profitability (benchmark 3). The second and third benchmark cases are also similar to the analysis of Bebchuk and Stole (1993) considering two types of information asymmetry separately by analyzing long- and short-term investments.

4.3.1 Benchmark 1 - Perfect Information

The market has perfect information about the investment level x and profitability θ_r. The firm maximizes its expected utility given by

$$\mathbb{E}[U(x)] = (\theta_s - 1)(K - c(x)) + \theta_r x - c(x) + v(x, \theta_r). \tag{4.3}$$

The first two terms capture the cash flows from safe and risky investment. The third term captures the market price with perfect information about x and θ_r. The first-order condition describes the first best risky investment schedule:

$$c'(x) = \frac{\theta_r + v_x(x, \theta_r)}{\theta_s}, \tag{4.4}$$

with x^{FB} being the solution to Equation (4.4). In equilibrium, the firm invests until the marginal costs of the risky investment equal the marginal return of the risky investment. The investments profitability, θ_r, and a positive market price response, $v_x(x, \theta_r) > 0$, increase investment incentives. A higher return from safe investment, θ_s, or a negative market price response, $v_x(x, \theta_r) < 0$, decrease investment incentives. Both reflect the opportunity costs of risky investment. For higher investment level x, the firm forgoes safe investment with a positive return of θ_s. These opportunity costs of a risky investment are also incorporated in the market price and can result in a negative market price response.[4]

4.3.2 Benchmark 2 - Information Asymmetry about the Investment Level

As a second benchmark, I consider information asymmetry about the investment level x. The accounting report perfectly measures the costs $c(x)$ and, thereby, discloses the investment level x, with measurement probability p and does not disclose the investment level with probability $(1-p)$. The investment's profitability θ_r is common knowledge.

With probability p, the market price is depicted by $v(x, \theta_r)$, as the market has perfect information. With probability $(1-p)$, the market has no information about x and infers the risky investment level from the profitability θ_r. The inferences result in a pricing rule

[4] Parameter values exist to ensure $v_x(x, \theta_r) \gtrless 0$ is possible for all equilibria.

depicted by $\Phi(\theta_r)$. The firm's expected utility is given by

$$\mathbb{E}[U(x)] = (\theta_s - 1)(K - c(x)) + \theta_r x - c(x) + pv(x, \theta_r) + (1-p)\Phi(\theta_r). \tag{4.5}$$

The first two terms capture the cash flows from safe and risky investment. The third and fourth terms capture the market prices with and without perfect information about x. Knowing the firm's expected utility, the market can derive the firm's investment schedule as a function of the investment profitability θ_r. As θ_r is common knowledge, the market forms perfect beliefs about the risky investment schedule $x(\theta_r)$ without directly observing it from the accounting report, implying that

$$\Phi(\theta_r) = v(\hat{x}(\theta_r), \theta_r). \tag{4.6}$$

Inserting $\Phi(\theta_r)$ derived in Equation (4.6) in the firm's expected utility from Equation (4.5) yields the firm's investment problem given by

$$\max_x (\theta_s - 1)(K - c(x)) + \theta_r x - c(x) + pv(x, \theta_r) + (1-p)v(\hat{x}(\theta_r), \theta_r). \tag{4.7}$$

The first-order condition to the firm's investment problem in Equation (4.7) is given by

$$c'(x) = \frac{\theta_r + pv_x(x, \theta_r)}{\theta_s}, \tag{4.8}$$

with x^{B2} being the solution to Equation (4.8).
Proposition 4.1 compares the firm's optimal investment schedule for the second benchmark with first best (benchmark 1).

Proposition 4.1. *In the presence of information asymmetry about the investment level:*

1. *The firm underinvests if the market price response is positive* ($x^{B2} < x^{FB}$).
2. *The firm overinvests if the market price response is negative* ($x^{B2} > x^{FB}$).

Proof. See appendix. □

Bebchuk and Stole (1993) and Kanodia et al. (2005) show that in the presence of information asymmetry about the investment level underinvestment results. The market even ignores a noisy signal as it forms expectations about the investment level solely based on the investment profitability. The actual investment level does not affect the market price. This results in a myopic investment decision, where the firm only maximizes short-term returns, i.e., expected cash flows and underinvests.
In contrast to prior literature, considering the decision between safe and risky investment, information asymmetry about the investment level can induce under- or overinvestment. Part (1) of Proposition 4.1 states that underinvestment results if the market price response

is positive. A positive market price response, i.e., $v_x(x,\theta_r) > 0$, increases investment incentives. With probability $(1-p)$, the manager ignores the market price, as it is based on perceptions and not on the actual investment level. Thus, investment incentives resulting from the market price response are lower compared to first best and underinvestment results. Part (2) of Proposition 4.1 states that overinvestment results if the market price response is negative. A negative market price response, i.e., $v_x(x,\theta_r) < 0$, decreases investment incentives. With probability $(1-p)$, the manager ignores the market price and, thus, investment incentives are higher compared to first best, resulting in overinvestment.

4.3.3 Benchmark 3 - Information Asymmetry about the Investment Profitability

As a third benchmark, I consider the case of information asymmetry about the investment profitability θ_r. The investment profitability θ_r is the firm's private information and cannot be credibly disclosed. The risky investment level x is depicted in the accounting report through $c(x)$, i.e., $p = 1$. The market infers θ_r from the perfectly observable investment level x, resulting in a market pricing schedule depicted by $\Phi(x)$. As the investment level x is perfectly observable, a fully revealing signaling equilibrium with perfect market inferences can exist (Spence, 1974).

Definition 1. *A fully revealing signaling equilibrium consists of a risky investment schedule $x(\theta_r)$, a market pricing schedule $\Phi(x)$, and the market's inferences on θ_r depicted by $I(x)$, which satisfiy:*

1. $x(\theta_r) = \arg\max_x (\theta_s - 1)(K - c(x)) + \theta_r x - c(x) + \Phi(x)$,
2. $\Phi(x) = v(x, I(x))$, *and*
3. $I(x(\theta_r)) = \theta_r \forall \theta_r$.

For a fully revealing signaling equilibrium, the equilibrium investment schedule maximizes the firm's expected utility (condition 1), for every investment level x the market price is consistent with the market's inferences of the investment profitability $I(x)$ (condition 2), and the market infers the true value of θ_r for every θ_r given the observable risky investment level x (condition 3).
Lemma 4.1 summarizes the conditions for a fully revealing signaling equilibrium resulting from Definition 1.

Lemma 4.1. *A fully revealing signaling equilibrium must satisfy the monotonicity condition $x'(\theta_r) > 0$ and $x(\theta_r) = V_{\theta_r}$ with $V(\theta_r) = (\theta_s - 1)(K - c(x(\theta_r))) + \theta_r x(\theta_r) - c(x(\theta_r)) + v(x(\theta_r), \theta_r)$.*

Proof. See appendix. □

Proposition 4.2 summarizes the resulting firm's optimal investment schedule.

Proposition 4.2. *In the presence of information asymmetry about the investment profitability, any fully revealing equilibrium must satisfy the first-order differential equation given by*

$$x'(\theta_r)\left(c'(x)\theta_s - \theta_r - v_x(x,\theta_r)\right) = v_{\theta_r}(x,\theta_r), \tag{4.9}$$

with x^{B3} *being the solution to Equation (4.9), resulting in overinvestment for every* $\theta_r > \underline{\theta_r}$.

Proof. See appendix. □

Proposition 4.2 is a standard result in adverse selection settings with continuous types (Kanodia and Lee, 1998). From Assumption 2 follows $v_{\theta_r}(x,\theta_r) > 0$, i.e., the right term of Equation (4.9) is positive. Following Lemma 4.1, $x'(\theta_r) > 0$ must be satisfied and, thus, for a fully revealing signaling equilibrium

$$c'(x) > \frac{\theta_r + v_x(x,\theta_r)}{\theta_s} = c'(x^{FB}). \tag{4.10}$$

From Equation (4.10) follows that for every fully revealing signaling equilibrium the firm overinvests, $x^{B3} > x^{FB}$. This result replicates findings of Bebchuk and Stole (1993) and Kanodia et al. (2005). The intuition of the overinvestment equilibrium is as follows: The market price increases in the investment profitability, $v_{\theta_r}(x,\theta_r) > 0$. Therefore, for $\tilde{\theta_r} > \theta_r$ a firm of type θ_r has incentives to invest $x(\tilde{\theta_r})$ instead of $x(\theta_r)$ to signal a higher profitability to the market. If the market anticipates first best investment schedule, the firm's overinvestment would deceive the market. However, as the market knows the firm's investment problem, the market anticipates the possibility of deception. As a result, the market forms beliefs about the investment schedule that matches the true investment schedule. Although the firm never deceives the market, the possibility of deception leads to a market pricing schedule, incorporating the firm's overinvestment incentives. Consequently, the firm signals the true risky investment profitability by overinvesting in the risky project. Overinvestment occurs independent of the market price response $v_x(x,\theta_r)$. Figure 4.1 graphically depicts Proposition 4.1 and 4.2.[5] Figure 4.1 and all following figures are depicted for $c(x) = \frac{cx^2}{2}$ and

$$v(x,\theta_r) = \gamma\theta_s(K - c(x)) + \delta\theta_r x + h(\theta_r^2 + \theta_s^2). \tag{4.11}$$

The market value is similar to an example of Kanodia et al. (2005). The first two terms depict the current pricing of the safe and risky investment with the weighting factors γ and δ. The third term depicts the effect of the profitability on future investments, assuming that the firm has the same investment decisions in future periods.

[5] It can be checked that for the numerical example (also used in all following figures) for every fully revealing equilibria $x'(\theta_r) > 0$ is satisfied.

For $\delta < \gamma$ the market price response is negative, i.e., $v_x(x, \theta_r) < 0$ and, thus, both types of information asymmetry induce overinvestment ($x^{B2} > x^{FB}$ and $x^{B3} > x^{FB}$). For $\delta > \gamma$ the market price response is positive, i.e., $v_x(x, \theta_r) > 0$ and information asymmetry about the investment level induces underinvestment ($x^{B2} < x^{FB}$) while information asymmetry about the investment profitability induces overinvestment ($x^{B3} > x^{FB}$).

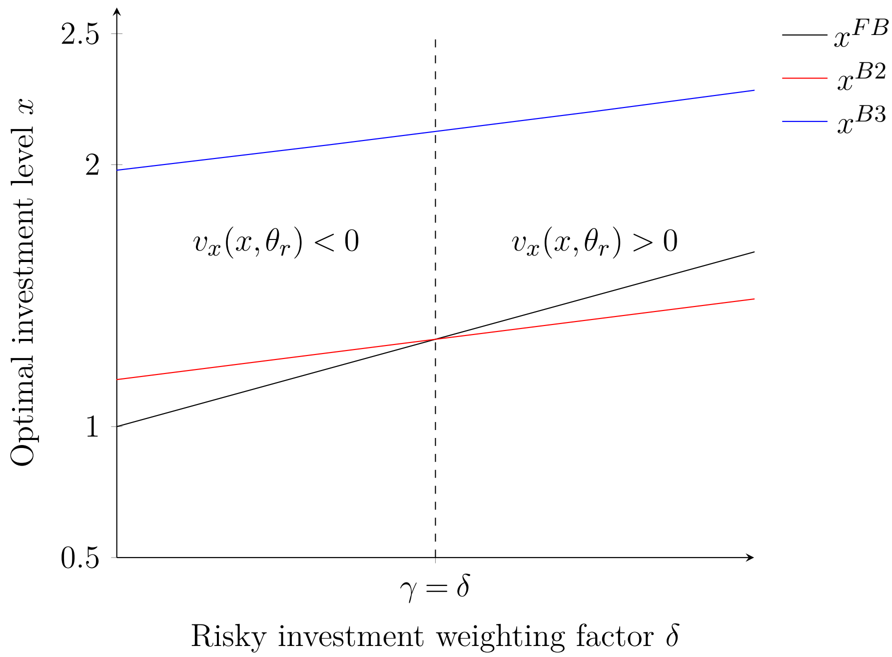

Figure 4.1: Benchmark cases plotted for $\theta_r = 0.8, \theta_s = 1.2, \gamma = 1, c = 0.5, K = 2.5, h = 1$, and $p = 0.3$.

4.4 Interaction of Both Types of Information Asymmetry

In the following, I consider the case where information asymmetry about the investment level and profitability exists. Firms often have more information about the investment profitability, and the accounting report does not perfectly measure the investment level at the same time.

With probability p, the accounting report perfectly discloses the investment level x through perfectly measuring investment costs $c(x)$ and the investment profitability θ_r is the firm's private information. However, the market infers θ_r using the perfectly observable investment level x. Thus, a fully revealing signaling equilibrium can exist where the market's inferences $\Phi(x)$ are perfect. With probability $(1-p)$, the market can neither observe the investment level x nor the investment profitability θ_r. The market forms expectations about the expected profitability $E[\theta_r]$ and, knowing the firm's investment problem, expectations about the resulting investment level for the expected profitability $\hat{x}(E[\theta_r])$. The market pricing rule is depicted by $\Phi(\hat{x}(E[\theta_r]), E[\theta_r])$. The fully revealing signaling equilibrium is defined in the following.

Definition 2. *A fully revealing signaling equilibrium consists of a risky investment schedule $x(\theta_r)$, a market pricing schedule $\Phi(x)$ and the market's inferences on θ_r depicted by $I(x)$, which satisfy:*

1. $x(\theta_r) = \arg\max_x (\theta_s - 1)(K - c(x)) + \theta_r x - c(x) + p\Phi(x) + (1-p)\Phi(\hat{x}(E[\theta_r]), E[\theta_r])$,
2. $\Phi(x) = v(x, I(x))$, *and*
3. $I(x(\theta_r)) = \theta_r \forall \theta_r$.

Lemma 4.2 summarizes the firm's optimal investment schedule resulting from Definition 2.

Lemma 4.2. *In the presence of both types of information asymmetry any fully revealing equilibrium must satisfy $x'(\theta_r) > 0$ and the first-order differential equation is given by*

$$x'(\theta_r)\left(c'(x)\theta_s - \theta_r - pv_x(x,\theta_r)\right) = pv_{\theta_r}(x,\theta_r), \tag{4.12}$$

with $x^\dagger$ being the solution to Equation (4.12).

Proof. See appendix. □

From Assumption 2 follows that the market price is always increasing in the risky investment profitability ($v_{\theta_r}(x,\theta_r) > 0$), i.e., the right term of Equation (4.12) is always positive. Following Lemma 4.2 $x'(\theta_r) > 0$ must be satisfied and, thus, for every fully revealing signaling equilibrium follows from Equation (4.12)

$$c'(x) > \frac{\theta_r + pv_x(x,\theta_r)}{\theta_s} = c'(x^{B2}). \tag{4.13}$$

Rearranging (4.12) yields

$$c'(x) = \frac{\theta_r + pv_x(x,\theta_r) + p\frac{v_{\theta_r}(x,\theta_r)}{x'(\theta_r)}}{\theta_s}, \tag{4.14}$$

with the investment schedule $x^\dagger$ being the solution to Equation (4.14). The market price response to higher profitability ($v_{\theta_r}(x,\theta_r)$) increases the investment incentives. Proposition 4.3 summarizes the comparison of the firm's optimal investment schedule in the presence of both types of information asymmetry and first best.

Proposition 4.3. *In the presence of both types of information asymmetry:*

1. *A negative market price response always induces overinvestment ($x^\dagger > x^{FB}$).*
2. *A positive market price response induces*
   (a) *Overinvestment ($x^\dagger > x^{FB}$) if $p > p^{FB}$,*

(b) Underinvestment ($x^{\dagger} < x^{FB}$) if $p < p^{FB}$,

(c) First best investment ($x^{\dagger} = x^{FB}$) if $p = p^{FB}$.

Proof. See appendix. □

Kanodia et al. (2005) show that it can be optimal if information asymmetry about the investment level and profitability exist, with an imprecise accounting measure depicting the investment level. Information asymmetry about the investment level (profitability) induces underinvestment (overinvestment). In the presence of both types of information asymmetry, over- and underinvestment incentives can perfectly balance each other. As underinvestment incentives increase in the degree of accounting precision, an optimal degree of accounting precision exists, inducing first best investment.

However, Proposition 4.3 shows that considering a decision between a safe and risky investment, information asymmetry is sometimes never value enhancing independent of the measurement probability p, i.e., the degree of information asymmetry. The accounting precision in Kanodia et al. (2005) influences the information asymmetry about the investment level similar to the measurement probability p. The higher the accounting precision, the lower the information asymmetry and, thus, the lower the underinvestment incentives.

Part (1) of Proposition 4.3 shows that the firm always overinvests, if the market price response is negative, $v_x(x, \theta_r) < 0$. From Proposition 4.1 and 4.2 follows that both types of information asymmetry separately induce overinvestment. Thus, for both types of information asymmetry combined, the firm also always overinvests. Information asymmetry is never value enhancing for a negative market price response.

Part (2) of Proposition 4.3 shows that the first best investment can result if the market price response is positive. The intuition is similar to the results of Kanodia et al. (2005). From Proposition 4.1 and 4.2 follows that information asymmetry about the investment profitability induces overinvestment and information asymmetry about the investment level induces underinvestment. Underinvestment incentives are higher if the degree of information asymmetry about the investment level is high, i.e., p is low. Depending on p, over- and underinvestment incentives can perfectly balance each other, resulting in the first best investment schedule. Thus, information asymmetry can be optimal only if the market price response is positive.

Figure 4.2 graphically depicts Proposition 4.3. A fully revealing signaling equilibrium must satisfy Equation (4.13), i.e. $x^{\dagger} > x^{B2}$. Thus, if the market price response is negative, $v_x(x, \theta_r) < 0$, first best investment can never result, independent of the measurement probability p. If the market price response is positive, $v_x(x, \theta_r) > 0$, first best investment can result. Proposition 4.3 shows that for an optimal measurement probability, p^{FB}, first best investment results, with $p^{FB} = 0.3$ for $\delta = 1.26$. Figure 4.2 shows that for $\delta = 1.26$ the optimal investment schedule $x^{\dagger}$, depicted for $p = 0.3$, equals the first best investment schedule x^{FB}. The optimal measurement probability p^{FB} is increasing in δ for this numerical example. Consequently, for $\delta < 1.26$, $p = 0.3 > p^{FB}$ and the firm overinvests. For $\delta > 1.26$, $p = 0.3 < p^{FB}$ and the firm underinvests.

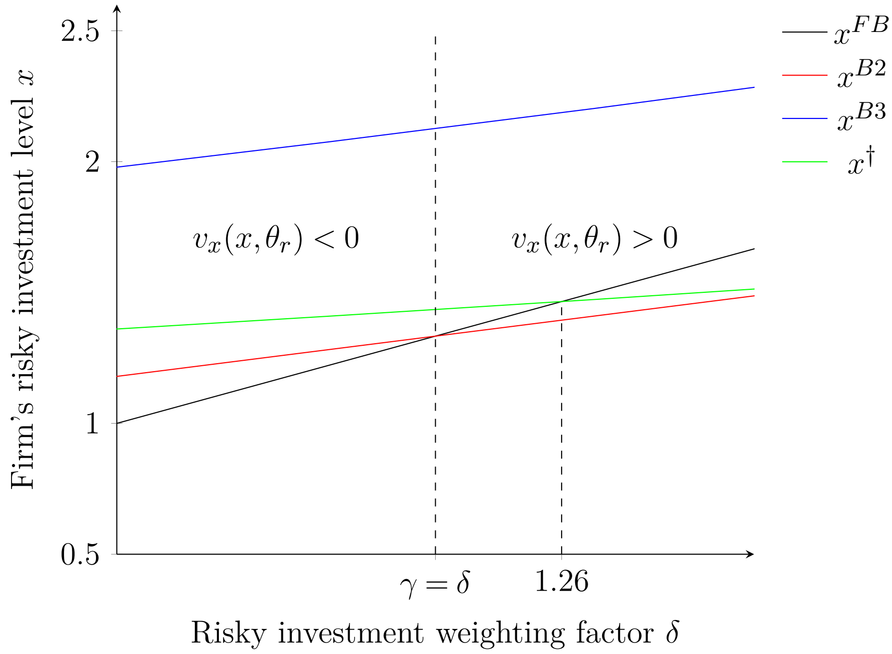

Figure 4.2: Investment decision in the presence of information asymmetry plotted for $\theta_r = 0.8, \theta_s = 1.2, \gamma = 1, c = 0.5, K = 2.5, h = 1$, and $p = 0.3$.

4.5 Interaction of Materiality and Information Asymmetry

Materiality influences the information disclosed in the accounting report and, thus, the information asymmetry between a firm and the financial statement users. Whether a transaction qualifies as material or not depends on both quantitative and qualitative characteristics. The higher the investment level compared to the total assets, the more material it is (quantitative characteristics). The probability $m(x)$ with $m'(x) > 0$, therefore, depicts the probability that the investment is material. Whenever the measurement of an investment qualifies as material, additional disclosures are required. Consequently, with probability $m(x)$, the accounting report discloses the risky investment level.

To analyze the effects of materiality on both types of information asymmetry, I derive the firm's investment schedule for both types of information asymmetry separately and combined. For information asymmetry about the investment profitability, the results with and without materiality are identical. Given that the investment level x is perfectly observable, a fully revealing signaling equilibrium, where the market perfectly infers θ_r can exist. As the risky investment level is already perfectly observable, i.e., $p = 1$, additional disclosures never disclose new information about the investment level x. Thus, the firm's investment schedule is identical to the firm's investment schedule in the presence of information asymmetry about the investment profitability depicted by x^{B3}. Materiality, thus, does not affect the firm's investment decision if there only exists information asymmetry about the investment profitability. Lemma 4.3 summarizes this result.

Lemma 4.3. *In the presence of information asymmetry about the investment profitability, materiality does not affect the firm's investment decision.*

4.5.1 Materiality and Information Asymmetry about the Investment Level

With materiality and information asymmetry about the investment level, the accounting report depicts the investment level x with probability $(p+(1-p)m(x))$ and the profitability θ_r is common knowledge. Whenever the accounting report discloses the investment level x, the market has perfect information, and the market price is depicted by $v(x,\theta_r)$. With probability $(1-p)(1-m(x))$ the market only observes investment profitability θ_r and does not observe the investment level x. Given the investment profitability θ_r, the market infers the risky investment level resulting in a pricing rule $\Phi(\theta_r)$. As θ_r is common knowledge, the market forms perfect beliefs about the firm's investment without directly observing it, so that

$$\Phi(\theta_r) = v(\hat{x}(\theta_r),\theta_r). \tag{4.15}$$

The firm's expected utility is given by

$$(\theta_s-1)(K-c(x))+\theta_r x-c(x)+(p+(1-p)m(x))v(x,\theta_r)+(1-p)(1-m(x))v(\hat{x}(\theta_r),\theta_r). \tag{4.16}$$

The first-order condition to the firm's investment problem of Equation (4.16) is given by

$$\begin{aligned} c'(x) &= \frac{\theta_r+(p+(1-p)m(x))v_x(x,\theta_r)+\overbrace{m'(x)(1-p)(v(x,\theta_r)-v(\hat{x}(\theta_r),\theta_r))}^{=0}}{\theta_s} \\ \implies c'(x) &= \frac{\theta_r+(p+(1-p)m(x))v_x(x,\theta_r)}{\theta_s}. \end{aligned} \tag{4.17}$$

with x^M being the solution to Equation (4.17). In equilibrium the market forms perfect beliefs about the firm's investment and, consequently, $v(x,\theta_r)=v(\hat{x}(\theta_r),\theta_r))$. Comparing the firm's investment schedule with and without materiality reveals

$$c'(x^M) \gtrless c'(x^{B2}) \implies (1-p)m(x)v_x(x,\theta_r) \gtrless 0. \tag{4.18}$$

Materiality increases the probability of disclosure and thereby decreases the information asymmetry about the investment level. Proposition 4.1 shows that information asymmetry about the investment level induces inefficient investment behavior, as the market price response only affects the firm's investment decision with probability p. Whenever the market price is based on perceptions and not on the actual investment level, the firm ignores the resulting market price. For a positive market price response, underinvestment results, and for a negative market price response, overinvestment results. The inefficient investment behavior decreases for an increasing probability of disclosure, as the market price response affects the firm's investment decision with a higher probability. In concrete terms, the probability increases by $(1-p)m(x)$. As a result, materiality can enhance the firm's investment decision by decreasing inefficient investment behavior resulting from information asymmetry about the investment level. Proposition 4.4 summarizes this result.

Proposition 4.4. *In the presence of information asymmetry about the investment level, materiality enhances the firm's investment decision by decreasing inefficient investment decisions (direct effect of materiality).*

Figure 4.3 graphically depicts Proposition 4.4 for $m(x) = \frac{x}{\tilde{x}}$. For $\delta < \gamma$ the market price response is negative. In the presence of information asymmetry about the investment level, overinvestment results ($x^{B2} > x^{FB}$). However, materiality decreases the information asymmetry and, thus, overinvestment ($x^{B2} > x^M > x^{FB}$). For $\delta > \gamma$ the market price response is positive. In the presence of information asymmetry about the investment level, underinvestment results ($x^{B2} < x^{FB}$). Materiality, then, decreases underinvestment ($x^{B2} < x^M < x^{FB}$). In the presence of information asymmetry about the investment profitability, overinvestment always results independent of the market price response and materiality ($x^{B3} > x^{FB}$).

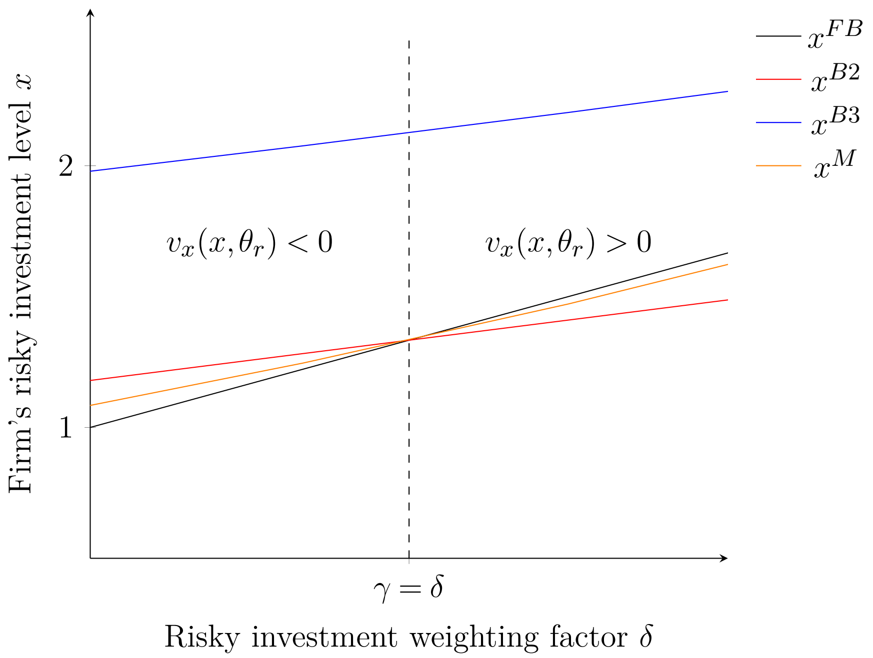

Figure 4.3: Investment decision with materiality in the presence of information asymmetry plotted for $\theta_r = 0.8, \theta_s = 1.2, \gamma = 1, c = 0.5, K = 2.5, h = 1, p = 0.3$, and $\tilde{x} = 2.5$.

4.5.2 Materiality and Both Types of Information Asymmetry

The market observes the investment level and infers the investment profitability θ_r with probability $(p+(1-p)m(x))$. As a result, a fully revealing signaling equilibrium with perfect inferences can exist. With probability $(1-p)(1-m(x))$ the investment level is unobservable. Given the known distribution of θ_r, the market's pricing schedule is based on the expected investment profitability $\Phi(\hat{x}(E[\theta_r]),E[\theta_r])$. The market does not observe the true profitability, θ_r, and forms expectations about the expected profitability $E[\theta_r]$. Knowing the firm's investment problem, the market also forms expectations about the resulting investment level in case of $\theta_r = E[\theta_r]$, i.e., $\hat{x}(E[\theta_r])$. However, as the market does not observe the true profitability, θ_r, the market's expectations, i.e., the market price without perfect information, $\Phi(\hat{x}(E[\theta_r]),E[\theta_r])$, only matches the market pricing schedule with perfect information, $v(x,\theta_r)$, if $\theta_r = E[\theta_r]$. Both market prices differ for all other realizations of θ_r.
The fully revealing signaling equilibrium is defined in the following.

Definition 3. *A fully revealing signaling equilibrium consists of an risky investment schedule $x(\theta_r)$, a market pricing schedule $\Phi(x)$ and the market's inferences on θ_r depicted by $I(x)$, which satisfy:*

1. $x(\theta_r) = \arg\max_x(\theta_s-1)(K-c(x))+\theta_r x - c(x) +$
   $(p+(1-p)m(x))\Phi(x)+(1-p)(1-m(x))\Phi(\hat{x}(E[\theta_r]),E[\theta_r])$,
2. $\Phi(x) = v(x,I(x))$, *and*
3. $I(x(\theta_r)) = \theta_r \forall \theta_r$.

Lemma 4.4 summarizes the firm's optimal investment schedule resulting from Definition 3.

Lemma 4.4. *With materiality and in the presence of both types of information asymmetry any fully revealing must satisfiy $x'(\theta_r) > 0$ and the first-order differential equation is given by*

$$x'(\theta_r)\Big(c'(x)\theta_s-\theta_r-v_x(x,\theta_r)(p+(1-p)m(x))-m'(x)(v(x,\theta_r)-\Phi(\hat{x}(E[\theta_r]),E[\theta_r]))\Big) = v_{\theta_r}(x,\theta_r)(p+(1-p)m(x)), \quad (4.19)$$

with x^* being the solution to Equation (4.19).

Proof. See appendix. □

From Assumption 2 follows that the right term of Equation (4.19) is positive, $v_{\theta_r}(x,\theta_r) > 0$. The condition for a fully revealing signaling equilibrium $x'(\theta_r) > 0$ is satisfied if

$$c'(x) > \frac{\theta_r + v_x(x,\theta_r)(p+(1-p)m(x)) + m'(x)(v(x,\theta_r) - \Phi(\hat{x}(E[\theta_r]),E[\theta_r]))}{\theta_s}. \tag{4.20}$$

Rearranging Equation (4.19) yields

$$c'(x^*) = \frac{\theta_r + \left(v_x(x,\theta_r) + \frac{v_{\theta_r}(x,\theta_r)}{x'(\theta_r)}\right)(p+(1-p)m(x)) + m'(x)(v(x,\theta_r) - \Phi(\hat{x}(E[\theta_r]),E[\theta_r]))}{\theta_s}. \tag{4.21}$$

Comparison to the investment schedule without materiality, $x^\dagger$, reveals two effects influencing the firm's risky investment decision:

$$c'(x^*) - c'(x^\dagger) = \overbrace{(1-p)m(x)\left(v_x(x,\theta_r) + \frac{v_{\theta_r}(x,\theta_r)}{x'(\theta_r)}\right)}^{\text{Direct Effect}} + \underbrace{m'(x)(v(x,\theta_r) - \Phi(\hat{x}(E[\theta_r]),E[\theta_r]))}_{\text{Indirect Effect}}. \tag{4.22}$$

The direct effect emerges due to the higher probability of disclosure. The direct effect comprises two parts. First is the decrease in inefficient investment behavior in the presence of information asymmetry about the investment level. With materiality, the effect of the market price response increases, which decreases inefficient investment behavior in the form of over- or underinvestment (see Proposition 4.4; $(1-p)m(x)(v_x(x,\theta_r))$). Second is the increase in overinvestment incentives in the presence of information asymmetry about the investment profitability $\left((1-p)m(x)(\frac{v_{\theta_r}(x,\theta_r)}{x'(\theta_r)})\right)$. Overinvestment incentives increase, as the probability that a fully revealing signaling equilibrium results increase. Thus, the incentives to signal a high probability increase in case of more disclosures.
The indirect effect occurs as the probability of qualifying as material and thereby the probability of disclosures increases in the investment level, $m'(x) > 0$. Consequently, the higher the investment level, the higher the probability that the market prices the firm with perfect information, i.e., $v(x,\theta_r)$, and not with imperfect information, i.e., $\Phi(\hat{x}(E[\theta_r]),E[\theta_r])$.

Definition 4. *Define $D[v,\Phi] := v(x,\theta_r) - \Phi(\hat{x}(E[\theta_r]),E[\theta_r])$ as the desirability of disclosure. For $D[v,\Phi] > 0$ disclosure is desirable and for $D[v,\Phi] < 0$ disclosure is not desirable.*

If the market price with perfect information is higher than with imperfect information, disclosure is desirable. As a result, investment incentives increase, as higher investment increases the probability of disclosure. Investment incentives decrease if the market price with imperfect information is higher than with perfect information, i.e., disclosure is not desirable. Lemma 4.5 summarizes this result.

Lemma 4.5. *Materiality increases (decreases) investment incentives, if disclosure is desirable (not desirable).*

Depending on the market price response (direct effect), $v_x(x, \theta_r)$, and the desirability of disclosure, $D[v, \Phi]$ (indirect effect), materiality can further increase or decrease inefficient investment behavior. The direct and the indirect effect of materiality, thus, yield a variety of possible outcomes. Proposition 4.5 summarizes the two main insights.[6]

Proposition 4.5. *Materiality can increase or decrease investment efficiency:*

1. *For a positive market price response, the firm always overinvests and never invests first best, if disclosure is sufficiently desirable. The concept of materiality, then, decreases investment efficiency.*

2. *For a negative market price response, the firm can invest first best, if disclosure is sufficiently non-desirable. The concept of materiality, then, increases investment efficiency.*

Proof. See appendix. □

Part (1) of Proposition 4.5 states that materiality can decrease investment efficiency. The intuition is as follows: For a positive market price response, i.e., $v_x(x, \theta_r) > 0$, without materiality, the firm invests first best for an optimal measurement probability p^{FB}. With materiality, on the one hand, underinvestment incentives decrease (direct effect). On the other hand, if disclosure is desirable, investment incentives can further increase (indirect effect). If disclosure is *sufficiently* desirable, investment incentives can be so high that overinvestment results. Moreover, the market price response to higher investment profitability ($v_{\theta_r}(x, \theta_r)$) also always induces overinvestment incentives. Consequently, the firm never invests first best, independent of the measurement probability p, i.e., the degree of information asymmetry. Materiality, then, decreases investment efficiency.

Part (2) of Proposition 4.5 states that materiality can increase investment efficiency. The intuition is as follows: For a negative market price response, i.e., $v_x(x, \theta_r) < 0$, without materiality, the firm never invests first best. With materiality, on the one hand, overinvestment incentives decrease (direct effect). On the other hand, if disclosure is not desirable, investment incentives can further decrease (indirect effect). Together both can result in underinvestment incentives. The market price response to higher investment profitability ($v_{\theta_r}(x, \theta_r)$) always induces overinvestment incentives. Thus, both under- and overinvestment incentives can perfectly balance each other in equilibrium. Materiality, then, increases investment efficiency.

[6] All other possible outcomes are stated in the appendix.

4.6 Conclusion

In this paper, I analyze the effect of materiality on firms' investment decisions. Prior literature suggests that information asymmetry can result in under- or overinvestment (Bebchuk and Stole, 1993; Kanodia et al., 2005). In the presence of information asymmetry about the investment level, the firm ignores the market price and underinvests. In the presence of information asymmetry about the investment profitability, the firm overinvests to signal high profitability to the market. Together both can be value enhancing as over-, and underinvestment incentives can perfectly balance each other. First best investment results dependent on the degree of information asymmetry or the precision of the accounting measure, depicting the investment level (Kanodia et al., 2005). However, these results neglect, on the one hand, possible opportunity costs of investments and, on the other hand, the concept of materiality, which is crucial for mandatory disclosures.

Considering a decision between two investment opportunities, for example, between a safe and risky investment, information asymmetry about the investment level not always induces underinvestment as implied by prior literature. As investment in a risky project always entails opportunity costs in the form of forgoing safe returns, the market price response to risky investment can be positive or negative. With information asymmetry about the investment level, the market price is ignored, and the effect of the market price response does not affect the firm's investment decision resulting in lower investment incentives (positive market price response) or higher investment incentives (negative market price response). As a result, information asymmetry always induces underinvestment (overinvestment) if the market price response is positive (negative).

Thus, for a positive market price response, first best investment can result. Underinvestment incentives, resulting from information asymmetry about the investment level, and overinvestment incentives, resulting from information asymmetry about the investment profitability, can perfectly balance each other, depending on the degree of information asymmetry. Information asymmetry, then, is value enhancing by inducing first best investment. Nevertheless, for a negative market price response, both types of information asymmetry induce overinvestment incentives. Independent of the degree of information asymmetry, overinvestment always results, and the firm never invests first best. Information asymmetry, then, is never value enhancing.

Moreover, prior literature neglects the concept of materiality. Accounting precision or mandatory disclosure is often assumed to be exogenously given. However, due to materiality, the probability of mandatory disclosure and, thus, the degree of information asymmetry depends on the investment level. The higher the investment level compared to the total assets, the higher the probability that the investment is material. Consequently, the firm discloses further descriptions or disaggregations in the notes, which decreases the information asymmetry about the investment level. A higher investment level influences the resulting market price directly and indirectly. The market price increases or decreases (direct effect). The probability that the market prices the firm with perfect information increases (indirect effect). If disclosure, i.e., the market price with perfect information, is desirable, the indirect effect increases investment incentives and decreases investment incentives otherwise.

Overall, two main insights result:

1. If the market price response is positive, neglecting the concept of materiality, first best investment can result, and information asymmetry can be value enhancing. Considering the concept of materiality shows, if disclosure is *sufficiently* desirable, investment incentives increase so that overinvestment incentives outweigh. Consequently, the firm never invests first best, and materiality decreases investment efficiency.

2. If the market price response is negative, neglecting the concept of materiality, first best investment can never result. However, with materiality, if disclosure is *sufficiently* non-desirable, the indirect effect can induce underinvestment incentives. The resulting underinvestment incentives from information asymmetry about the investment level and the overinvestment incentives from information asymmetry about the investment profitability can perfectly balance each other. Materiality, then, increases investment efficiency.

Thus, materiality can be value enhancing by inducing first best investment. Nevertheless, materiality can also deteriorate investment incentives. Whether materiality increases or decreases investment efficiency depends on the market price response and the desirability of disclosure. When analyzing the real effects of information asymmetry, it is crucial to consider the effect of materiality.

4.7 Appendix

4.7.1 Proof of Proposition 4.1

Proof. The optimal investment schedule can be characterized by

$$c'(x) = \frac{\theta_r + pv_x(x,\theta_r)}{\theta_s} \tag{4.23}$$

with x^{B2} being the solution to Equation (4.23). Comparison with the first best investment schedule reveals

$$c'(x^{B2}) = \frac{\theta_r + pv_x(x,\theta_r)}{\theta_s} \gtrless c'(x^{FB}) = \frac{\theta_r + v_x(x,\theta_r)}{\theta_s} \implies 0 \gtrless (1-p)v_x(x,\theta_r). \tag{4.24}$$

Equation (4.24) shows that the investment schedule x^{B2} is higher than first best, if the market price response is negative, i.e., $0 > (1-p)v_x(x,\theta_r)$, and lower, if the market price response is positive, i.e., $0 < (1-p)v_x(x,\theta_r)$. Consequently, for a negative market price response, overinvestment results ($x^{B2} > x^{FB}$) and for a positive market price response, underinvestment results ($x^{B2} < x^{FB}$). □

4.7.2 Proof of Lemma 4.1

Proof. Necessary Condition: For a fully revealing signaling equilibrium the equilibrium risky investment schedule must be incentive compatible (IC) (Kanodia and Lee, 1998). Consequently, a necessary condition for a fully revealing signaling equalibrium is

$$\begin{aligned}(\theta_s - 1)(K - c(x(\theta_r))) + \theta_r x(\theta_r) - c(x(\theta_r)) + v(x(\theta_r),\theta_r) \geq \\ (\theta_s - 1)(K - c(x(\tilde{\theta}_r))) + \theta_r x(\tilde{\theta}_r) - c(x(\tilde{\theta}_r)) + v(x(\tilde{\theta}_r),\tilde{\theta}_r) \forall \theta_r, \tilde{\theta}_r.\end{aligned} \tag{4.25}$$

Define for type θ_r:

$$V(\theta_r) := (\theta_s - 1)(K - c(x(\theta_r))) + \theta_r x(\theta_r) - c(x(\theta_r)) + v(x(\theta_r),\theta_r), \tag{4.26}$$

and for type $\tilde{\theta}_r$:

$$V(\tilde{\theta}_r) := (\theta_s - 1)(K - c(x(\tilde{\theta}_r))) + \tilde{\theta}_r x(\tilde{\theta}_r) - c(x(\tilde{\theta}_r)) + v(x(\tilde{\theta}_r),\tilde{\theta}_r). \tag{4.27}$$

From Equation (4.25) follows for type θ_r

$$V(\theta_r) \geq V(\tilde{\theta}_r) - x(\tilde{\theta}_r)(\tilde{\theta}_r - \theta_r) \implies x(\tilde{\theta}_r)(\tilde{\theta}_r - \theta_r) \geq V(\tilde{\theta}_r) - V(\theta_r). \tag{4.28}$$

The IC constraint for type $\tilde{\theta_r}$ can be written as

$$V(\tilde{\theta_r}) \geq V(\theta_r) - x(\theta_r)(\theta_r - \tilde{\theta_r}) \implies x(\theta_r)(\tilde{\theta_r} - \theta_r) \leq V(\tilde{\theta_r}) - V(\theta_r). \tag{4.29}$$

From the IC constraints in Equations (4.28) and (4.29) follows

$$x(\theta_r)(\tilde{\theta_r} - \theta_r) \leq V(\tilde{\theta_r}) - V(\theta_r) \leq x(\tilde{\theta_r})(\tilde{\theta_r} - \theta_r), \tag{4.30}$$

divide by $(\tilde{\theta_r} - \theta_r)$ and take the limit as θ_r approaches $\tilde{\theta_r}$ yields

$$x(\theta_r) = \frac{dV(\theta_r)}{d\theta_r} = V_{\theta_r}(\theta_r). \tag{Necessary Condition}$$

Sufficient Condition: Integrating the necessary condition yields

$$V(\theta_r) = V(\underline{\theta_r}) + \int_{\underline{\theta_r}}^{\theta_r} x(t)dt. \tag{4.31}$$

From the incentive compatibility of the fully revealing signaling equilibrium (Equation (4.28)) we know

$$V(\theta_r, x(\theta_r)) \geq V(\theta_r, x(\tilde{\theta_r})) \implies V(\theta_r, x(\theta_r)) \geq V(\tilde{\theta_r}, x(\tilde{\theta_r})) - x(\tilde{\theta_r})(\tilde{\theta_r} - \theta_r) \tag{4.32}$$

Inserting this in Equation (4.31) yields

$$\begin{aligned} V(\underline{\theta_r}) + \int_{\underline{\theta_r}}^{\theta_r} x(t)dt &\geq V(\underline{\theta_r}) + \int_{\underline{\theta_r}}^{\tilde{\theta_r}} x(t)dt - x(\tilde{\theta_r})(\tilde{\theta_r} - \theta_r) \\ \implies \int_{\tilde{\theta_r}}^{\theta_r} x(t)dt - x(\tilde{\theta_r})(\tilde{\theta_r} - \theta_r) &\geq 0 \\ \implies \int_{\tilde{\theta_r}}^{\theta_r} (x(t) - x(\tilde{\theta_r}))dt &\geq 0 \end{aligned} \tag{4.33}$$

which is non-negative, if $x(t) > x(\tilde{\theta_r})$ for each $t > \tilde{\theta_r}$.
For $\tilde{\theta_r} > \theta_r$

$$\int_{\theta_r}^{\tilde{\theta_r}} (x(\tilde{\theta_r}) - x(t))dt \geq 0 \tag{4.34}$$

which is non-negative if $x(t) < x(\theta_r)$ for each $t < \theta_r$. Thus, $x(\theta_r)$ is increasing in θ_r, i.e. $x'(\theta_r) > 0$ (Sufficient Condition). □

4.7.3 Proof of Proposition 4.2

Proof. From Lemma 4.1 follows

$$V_{\theta_r}(\theta_r) = x(\theta_r) \implies v_{\theta_r}(x(\theta_r), \theta_r) = x'(\theta_r)\left(\theta_s c'(x(\theta_r)) - \theta_r - v_x(x(\theta_r), \theta_r)\right). \tag{4.35}$$

From Assumption 2 follows that the term on the left is always positive, $v_{\theta_r}(x,\theta_r) > 0$. From Lemma 4.1 follows $x'(\theta_r) > 0$ as a sufficient condition for a fully revealing signaling equilibrium. Thus, for every fully revelaing signaling equilibrium

$$\theta_s c'(x(\theta_r)) - \theta_r - v_x(x(\theta_r),\theta_r) > 0 \implies c'(x) > c'(x^{FB}) = \frac{\theta_r + v_x(x,\theta_r)}{\theta_s}. \tag{4.36}$$

From Equation (4.36) follows $x^{B3} > x^{FB}$ (overinvestment). □

4.7.4 Proof of Lemma 4.2

For a fully revealing signaling equilibrium the equilibrium risky investment schedule must be incentive compatible. From Lemma 4.1 follows $x'(\theta_r) > 0$ and $x(\theta_r) = V_{\theta_r}$ as conditions for a fully revealing signaling equilibrium in the presence of information asymmetry about the investment profitability. The same conditions must be satisfied for a fully revealing signaling equilibrium in the presence of information asymmetry about the investment profitability and level.

Proof. Necessary Condition:
Define:

$$\begin{aligned} V(\theta_r) :=& (\theta_s - 1)(K - c(x(\theta_r))) + \theta_r x(\theta_r) - c(x(\theta_r)) + \\ & pv(x(\theta_r),\theta_r) + (1-p)\Phi(\hat{x}(E[\theta_r]), E[\theta_r]), \end{aligned} \tag{4.37}$$

and

$$\begin{aligned} V(\tilde{\theta_r}) :=& (\theta_s - 1)(K - c(x(\tilde{\theta_r}))) + \tilde{\theta_r} x(\tilde{\theta_r}) - c(x(\tilde{\theta_r})) + \\ & pv(x(\tilde{\theta_r}),\tilde{\theta_r}) + (1-p)\Phi(\hat{x}(E[\theta_r]), E[\theta_r]). \end{aligned} \tag{4.38}$$

The incentive compatibility constraint for type θ_r is given by

$$V(\theta_r) \geq V(\tilde{\theta_r}) - x(\tilde{\theta_r})(\tilde{\theta_r} - \theta_r), \tag{4.39}$$

and the incentive compatibility constraint for type $\tilde{\theta_r}$ is given by

$$V(\tilde{\theta_r}) \geq V(\theta_r) - x(\theta_r)(\theta_r \tilde{\theta_r}). \tag{4.40}$$

From the IC constraints in Equations (4.39) and (4.40) follows

$$x(\theta_r)(\tilde{\theta_r} - \theta_r) \leq V(\tilde{\theta_r}) - V(\theta_r) \leq x(\tilde{\theta_r})(\tilde{\theta_r} - \theta_r), \tag{4.41}$$

which is equal to Equation (4.30) in the Proof of Lemma 4.1. The proof of $x'(\theta_r) > 0$ and $x(\theta_r) = V_{\theta_r}$ as conditions for a fully revealing signaling equilibrium in the presence

of information asymmetry about both the investment profitability and level, thus, follows the proof of Lemma 4.1.
From Lemma 4.1 follows

$$V_{\theta_r}(\theta_r) = x(\theta_r) \implies x'(\theta_r)\left(c'(x)\theta_s - \theta_r - pv_x(x,\theta_r)\right) = pv_{\theta_r}(x,\theta_r). \tag{4.42}$$

From Assumption 2 follows that the term on the right is always positive, $v_{\theta_r}(x,\theta_r) > 0$. From Lemma 4.1 follows $x'(\theta_r) > 0$ as a sufficient condition for a fully revealing signaling equilibrium. Thus, for every fully revealing equilibrium

$$c'(x)\theta_s - \theta_r - pv_x(x,\theta_r) > 0 \implies c'(x) > c'(x^{B2}) = \frac{\theta_r + pv_x(x,\theta_r)}{\theta_s}. \tag{4.43}$$

Let $x^{\dagger}$ depict the firm's equilibrium investment schedule in the presence of both types of information asymmetry. □

4.7.5 Proof of Proposition 4.3

Proof. From Equation (4.43) follows that $x^{\dagger} > x^{B2}$ and, thus, the firm always invests more in the presence of both types of information asymmetry than in the presence of information asymmetry about the investment level. From Proposition 4.1 follows that the firm always overinvests in the presence of information asymmetry about the investment level if the market price response is negative ($x^{B2} > x^{FB}$). Taking the results of Proposition 4.1 and Equation (4.43) together proves

$$x^{\dagger} > x^{B2} > x^{FB}, \tag{4.44}$$

if the market price response is negative, $v_x(x,\theta_r) < 0$.
If the market price response is positive, $v_x(x,\theta_r) > 0$, the firm either overinvests more, underinvests, or invests first best dependent on p. Rearranging Equation (4.42) yields

$$c'(x) = \frac{p\frac{v_{\theta_r}(x,\theta_r)}{x'(\theta_r)} + \theta_r + pv_x(x,\theta_r)}{\theta_s}. \tag{4.45}$$

Taking the derivative with respect to p yields

$$c_{px}(x) = \frac{1}{\theta_s}\left(x'(\theta_r)v_{\theta_r}(x,\theta_r) + v_x(x,\theta_r)\right) > 0, \tag{4.46}$$

which is always positive for a positive market price response. Thus, the higher measurement probability p, the higher the optimal investment level.

Comparison with the first best investment schedule yields

$$\begin{aligned} & c'(x^{FB}) > c'(x^{\dagger}) \\ \implies \frac{\theta_r + v_x(x,\theta_r)}{\theta_s} > & \frac{p\frac{v_{\theta_r}(x,\theta_r)}{x'(\theta_r)} + \theta_r + p v_x(x,\theta_r)}{\theta_s} \\ \implies & (1-p) v_x(x,\theta_r) x'(\theta_r) > p v_{\theta_r}(x,\theta_r) \\ \implies p < p^{FB} = & \frac{x'(\theta_r) v_x(x,\theta_r)}{v_{\theta_r}(x,\theta_r) + x'(\theta_r) v_x(x,\theta_r)}. \end{aligned} \tag{4.47}$$

If the measurement probability p is *sufficiently* low (high), i.e., $p < p^{FB}$ ($p > p^{FB}$), the firm underinvests (overinvests). If the measurement probability is equal to the critical threshold p^{FB}, i.e., $p = p^{FB}$, the firm invests first best. □

4.7.6 Proof of Lemma 4.4

For a fully revealing signaling equilibrium the equilibrium risky investment schedule must be incentive compatible. From Lemma 4.1 follows $x'(\theta_r) > 0$ and $x(\theta_r) = V_{\theta_r}$ as conditions for a fully revealing signaling equilibrium in the presence of information asymmetry about the investment profitability. The same conditions must be satisfied for a fully revealing signaling equilibrium with materiality and in the presence of information asymmetry about both the investment profitability and level.

Proof. Necessary Condition:
Define:

$$\begin{aligned} V(\theta_r) := & (\theta_s - 1)(K - c(x(\theta_r))) + \theta_r x(\theta_r) - c(x(\theta_r)) + \\ & (p + (1-p)m(x)) v(x(\theta_r), \theta_r) + (1-p)(1-m(x)) \Phi(\hat{x}(E[\theta_r]), E[\theta_r]), \end{aligned} \tag{4.48}$$

and

$$\begin{aligned} V(\tilde{\theta_r}) := & (\theta_s - 1)(K - c(x(\tilde{\theta_r}))) + \theta_r x(\tilde{\theta_r}) - c(x(\tilde{\theta_r})) + \\ & (p + (1-p)m(x)) v(x(\tilde{\theta_r}), \tilde{\theta_r}) + (1-p)(1-m(x)) \Phi(\hat{x}(E[\theta_r]), E[\theta_r]). \end{aligned} \tag{4.49}$$

The incentive compatibility constraint for type θ_r is given by

$$V(\theta_r) \geq V(\tilde{\theta_r}) - x(\tilde{\theta_r})(\tilde{\theta_r} - \theta_r), \tag{4.50}$$

and the incentive compatibility constraint for type $\tilde{\theta_r}$ is given by

$$V(\tilde{\theta_r}) \geq V(\theta_r) - x(\theta_r)(\theta_r \tilde{\theta_r}). \tag{4.51}$$

From the IC constraints in Equations (4.50) and (4.51) follows

$$x(\theta_r)(\tilde{\theta_r}-\theta_r) \leq V(\tilde{\theta_r}) - V(\theta_r) \leq x(\tilde{\theta_r})(\tilde{\theta_r}-\theta_r), \tag{4.52}$$

which is equal to Equation (4.30) in the Proof of Lemma 4.1. The proof of $x'(\theta_r) > 0$ and $x(\theta_r) = V_{\theta_r}$ as conditions for a fully revealing signaling equilibrium in the presence of information asymmetry about the investment profitability and level, thus, follows the proof of Lemma 4.1.
From Lemma 4.1 follows

$$\begin{aligned} V_{\theta_r}(\theta_r) &= x(\theta_r) \\ \implies x'(\theta_r)(c'(x)\theta_s - \theta_r - v_x(x,\theta_r)(p+(1-p)m(x)) &- m'(x)(v(x,\theta_r) - \Phi(\hat{x}(E[\theta_r]),E[\theta_r]))) \\ &= v_{\theta_r}(p+(1-p)m(x)). \end{aligned} \tag{4.53}$$

From Assumption 2 follows that the right term is always positive, $v_{\theta_r}(x,\theta_r) > 0$. From Lemma 4.1 follows $x'(\theta_r) > 0$ as a sufficient condition for a fully revealing signaling equilibrium. Thus, for every fully revealing signaling equilibrium

$$\begin{aligned} &c'(x)\theta_s - \theta_r - v_x(x,\theta_r)(p+(1-p)m(x)) - m'(x)(v(x,\theta_r) - \Phi(\hat{x}(E[\theta_r]),E[\theta_r])) > 0 \\ &\implies c'(x) > \frac{\theta_r + v_x(x,\theta_r)(p+(1-p)m(x)) + m'(x)(v(x,\theta_r) - \Phi(\hat{x}(E[\theta_r]),E[\theta_r]))}{\theta_s}. \end{aligned} \tag{4.54}$$

Rearranging Equation (4.53) yields

$$c'(x) = \frac{\theta_r + \left(v_x(x,\theta_r) + \frac{v_{\theta_r}(x,\theta_r)}{x'(\theta_r)}\right)(p+(1-p)m(x)) + m'(x)(v(x,\theta_r) - \Phi(\hat{x}(E[\theta_r]),E[\theta_r]))}{\theta_s}. \tag{4.55}$$

Let x^* depict the firm's equilibrium investment schedule with materiality in the presence of both types of information asymmetry and, therefore, x^* is the solution to Equation (4.55). □

4.7.7 Proof of Proposition 4.5

Proof. Comparison of Equation 4.55 with the first best investment schedule reveals

$$
\begin{aligned}
& c'(x^*) \gtrless c'(x^{FB}) \\
\implies & \frac{\theta_r + \left(v_x(x,\theta_r) + \frac{v_{\theta_r}(x,\theta_r)}{x'(\theta_r)}\right)(p+(1-p)m(x)) + m'(x)(v(x,\theta_r) - \Phi(\hat{x}(E[\theta_r]), E[\theta_r]))}{\theta_s} \\
\gtrless & \frac{\theta_r + v_x(x,\theta_r)}{\theta_s} \\
\implies & \frac{v_{\theta_r}(x,\theta_r)}{x'(\theta_r)}(p+(1-p)m(x)) \\
& - v_x(x,\theta_r)(1-p)(1-m(x)) + m'(x)(v(x,\theta_r) - \Phi(\hat{x}(E[\theta_r]), E[\theta_r]) \gtrless 0 \qquad (4.56)
\end{aligned}
$$

Recall that by assumption $m'(x) > 0$ and $\frac{v_{\theta_r}(x,\theta_r)}{x'(\theta_r)}(p+(1-p)m(x)) > 0$ follows from Assumption 2 and the sufficient condition for a fully revealing signaling equilibrium. From Equation (4.56) follows that overinvestment results, i.e., $c'(x^*) > c'(x^{FB})$, if

1. Disclosure is desirable $(v(x,\theta_r) > \Phi(\hat{x}(E[\theta_r]), E[\theta_r]))$ and the market price response is negative $(-v_x(x,\theta_r) > 0)$,
2. Disclosure is desirable $(v(x,\theta_r) > \Phi(\hat{x}(E[\theta_r]), E[\theta_r]))$ and the market price response is positive $(-v_x(x,\theta_r) < 0)$, and the effect of desirable disclosure outweighs the effect of the positive market price response, $(m'(x)(v(x,\theta_r) - \Phi(\hat{x}(E[\theta_r]), E[\theta_r])) - v_x(x,\theta_r)(1-p)(1-m(x)) > 0)$,
3. Disclosure is not desirable $(v(x,\theta_r) < \Phi(\hat{x}(E[\theta_r]), E[\theta_r]))$ and the market price response is negative $(-v_x(x,\theta_r) > 0)$, and the effect of the negative market price response outweighs the effect of the non-desirability of disclosure, $(m'(x)(v(x,\theta_r) - \Phi(\hat{x}(E[\theta_r]), E[\theta_r])) - v_x(x,\theta_r)(1-p)(1-m(x)) > 0)$.

Underinvestment incentives result if

1. Disclosure is not desirable $(v(x,\theta_r) < \Phi(\hat{x}(E[\theta_r]), E[\theta_r]))$ and the market price response is positive $(-v_x(x,\theta_r) < 0)$,
2. Disclosure is not desirable $(v(x,\theta_r) < \Phi(\hat{x}(E[\theta_r]), E[\theta_r]))$ and the market price response is negative $(-v_x(x,\theta_r) > 0)$, and the effect of the non-desirable disclosure outweighs the effect of the negative market price response,

   $(m'(x)(v(x,\theta_r) - \Phi(\hat{x}(E[\theta_r]), E[\theta_r])) - v_x(x,\theta_r)(1-p)(1-m(x)) < 0)$,
3. Disclosure is desirable $(v(x,\theta_r) > \Phi(\hat{x}(E[\theta_r]), E[\theta_r]))$, the market price response is positive $(-v_x(x,\theta_r) < 0)$ and the effect of the positive market price response outweighs the effect of the desirability of disclosure, $(m'(x)(v(x,\theta_r) - \Phi(\hat{x}(E[\theta_r]), E[\theta_r])) - v_x(x,\theta_r)(1-p)(1-m(x)) < 0)$.

These incentives result in underinvestment, i.e., $c'(x^*) < c'(x^{FB})$, if the above listed underinvestment incentives outweigh overinvestment incentives of $\frac{v_{\theta_r}(x,\theta_r)}{x'(\theta_r)}(p+(1-p)m(x)) > 0$. If underinvestment incentives perfectly balance the overinvestment incentives, i.e., $\frac{v_{\theta_r}(x,\theta_r)}{x'(\theta_r)}(p+(1-p)m(x)) = (v_x(x,\theta_r)(1-p)(1-m(x)) - m'(x)(v(x,\theta_r) - \Phi(\hat{x}(E[\theta_r]), E[\theta_r]))$, first best results, i.e., $c'(x^*) = c'(x^{FB})$. $\square$

Chapter 5

The Impact of Book-Tax Conformity on Reporting and Investment Behavior*

Abstract

Mandatory book-tax conformity affects firms' behavior in various ways. High book-tax conformity reduces the firms' reporting discretion and, thereby, decreases tax-aggressive reporting. However, real effects occur because taxes influence firms' investment behavior. In a game-theoretic model, we study how book-tax conformity influences firms' investment and subsequent reporting decisions when the financial statement provides a noisy signal to the tax authority in a tax inspection game. The firm decides on an investment amount and considers subsequent reporting consequences, which the tax authority may audit. We show that an increasing mandatory book-tax conformity can increase or decrease the firms' and tax authority's expected payoff. High book-tax conformity increases the cost of investment in the form of higher taxes and thereby deteriorates investment incentives. As a result, depending on the baseline level of book-tax conformity, a further increase can lead to more or less understated tax reports resulting in a lower or higher expected tax liability. Thus, our results indicate that the effect of a tighter regulation regarding book-tax conformity is ambiguous and highlight challenges governments face while designing book-tax conformity regulation.

* This chapter is joint work with Michelle Peters (Hochschule Weserbergland) and Rebecca Reineke (Leibniz Universität Hannover).

5.1 Introduction

In the wake of accounting scandals and misreporting cases, regulators discuss the alignment of the financial statement and the tax report to curb accounting manipulation and fraud. An alignment of the financial accounting rules and tax law leads to a high mandatory book-tax conformity.[1] Higher book-tax conformity reduces the reporting discretion in simultaneously managing the financial statement and the tax report, which is expected to decrease the probability of accounting scandals (Watts, 2003; Hanlon and Shevlin, 2005). However, book-tax conformity is a double-edged sword. Besides the advantage of reducing firms' reporting discretion, tax regulations also influence firms' real decisions. Financial accounting rules, settled in the generally accepted accounting principles (GAAP), are typically based on conservatism and matching principles. In contrast to that, a tax system is designed to raise the government's tax revenues, providing economic incentives or disincentives to engage in certain activities and rewarding particular constituencies (Atwood et al., 2010). Increasing the book-tax conformity to increase the tax revenue might be myopic. In particular, high book-tax conformity can impair investment incentives. Since profitable investments build the foundation of long-term economic growth and are essential for the economy's welfare, the deterioration of investment incentives can be particularly harmful. This highlights the necessity to investigate the effects of regulation regarding book-tax conformity on investment behavior and related reporting.

In this study, we examine the impact of mandatory book-tax conformity on a firm's investment and tax reporting decisions in a standard tax inspection game where the correct financial statement provides a noisy signal to the tax authority. We investigate whether an increasing book-tax conformity leads to less understated tax reports and, accordingly, to higher tax revenues for the tax authority. We are particularly interested in the following research questions: What are the consequences of a high mandatory book-tax conformity on a firm's investment decision considering that tax reporting is the outcome of a strategic interaction between the firm and the tax authority? Does a high book-tax conformity lead to a high tax revenue for the tax authority?

We study the raised research questions in a game-theoretic model. Specifically, we consider a setting where a firm decides on an investment in an existing project and determines corresponding tax reporting. Both the financial statement and the tax report depict the project outcome. The correct treatment of the project outcome for financial statement and tax purposes are positively correlated. Consequently, the publicly observable financial statement is informative about the correct tax treatment.

Initially, the firm has an existing project and decides on an investment amount to increase the expected outcome. The project's outcome can be high if the investment is successful

[1] Book-tax conformity is jointly determined by financial accounting setters and tax regulators. Compliance with the financial accounting rules and tax law is mandatory. Therefore, we use the terms book-tax conformity and mandatory book-tax conformity interchangeably throughout the paper.

or low if the investment fails. The project outcome is realized before the firm issues its reports. We consider public firms and, therefore, assume that the financial statement is correct and publicly observable. In contrast, the firm can bias the tax report to reduce its tax liability. The tax authority observes both the financial statement and the tax report and decides whether to conduct an audit or not.

Consistent with prior theoretical and empirical work, we show that an increasing book-tax conformity induces less understated non-conforming tax reports, i.e., an understated tax report that creates a book-tax difference (Atwood et al., 2012; Blaufus et al., 2017; Chen and Gavious, 2017; Niggemann, 2020). This supports the hypothesis of Chan et al. (2013) that an increasing book-tax conformity is likely to induce increasing tax payments for firms with sufficiently high financial reporting incentives. However, the above argument ignores that an increasing book-tax conformity facilitates conforming understated tax reports, i.e., an understated tax report when the financial statement is low, and therefore can also decrease the revenue of the tax authority.

An increasing book-tax conformity increases the marginal investment costs due to less beneficial tax treatment of the investment, which decreases the optimal investment amount. This, in turn, leads to a decrease of the expected tax base. Therefore, an increasing book-tax conformity can either increase or decrease the expected income of the tax authority. The outcome depends on the baseline level of book-tax conformity and the tax independent investment incentives like the investment costs. For a low baseline level of book-tax conformity, the expected tax revenue increases with an increasing book-tax conformity by inducing less understated tax reports. The deterioration of the investment incentives is not severe, so that the benefits of less understated tax reports outweigh the decreasing investment amount. However, suppose the baseline level of book-tax conformity is high. In that case, a further increase of the mandatory book-tax conformity leads to a decrease in the tax authority's expected income. In this case, the investment is expensive due to the unfavorable tax treatment and, thus, the investment incentives are low. The marginal costs of the investment increase with an increasing book-tax conformity, and therefore the firm forgoes expected pre-tax profits. As a result, the probability for a low project and a concomitant financial statement is high, which leads to a high probability for a correct low tax report, thereby reducing the expected tax liability. However, the probability for understated conforming tax reports also increases because a firm facing a low project outcome and a high correct tax report can better mimic a low tax report type.

Taken together, our results indicate that the effect of tightening regulation regarding book-tax conformity is ambiguous. This highlights problems regulators face while designing book-tax legislation. Governments are interested in collecting their owing taxes. Thus, countermeasures are introduced to prevent firms from tax-aggressive reporting behavior. We show that the outcome of this type of regulation is unclear and depends on various variables like the baseline level of book-tax conformity, which is inherent to current tax law and GAAP. Moreover, several potentially unobservable parameters like the firm's preferences or the investment costs influence the outcome. Hence, our results show that implementing book-tax regulations is a complex task.

We address calls of Hanlon and Heitzman (2010) and Graham et al. (2012) for research that leads to a better understanding of how tax incentives influence firms' real investments. Therefore, we contribute to findings of Schwab and Todtenhaupt (2017), De Simone et al. (2021), and Reineke and Weiskirchner-Merten (2021) investigating the impact of tax regulations on firms' real decisions. Moreover, we add to the literature by endogenizing an investment decision in a tax inspection game. Instead of considering only reporting behavior, we investigate the impact of book-tax conformity on the reporting and the investment behavior simultaneously.

The rest of the paper proceeds as follows. First, the related literature is discussed in Section 5.2. Then, the model is presented in Section 5.3. Afterwards, Section 5.4 provides the analysis and discussion of the equilibrium strategies of both players. This is followed by comparative statics in Section 5.5. Section 5.6 concludes the paper.

5.2 Literature Review

In this section, we provide an overview of theoretical and empirical work closely related to our research. It is well known that book-tax differences may be a valuable tool to convey information to shareholders without incurring corresponding tax consequences. Mills and Newberry (2001) have shown that firms with positive income account for positive book-tax differences while loss-making firms tend to have negative book-tax differences.

Prior research has shown that book-tax differences affect tax auditors' behavior. Sansing (1993) examines how different information influences taxpayers' and tax auditors' behavior whereas Mills (1998) shows a positive association between book-tax differences and proposed Internal Revenue Service (IRS) audit adjustments. The results indicate that book-tax differences serve as red flags for tax auditors. This finding is in line with work of Badertscher et al. (2009), Mills (1996), Mills and Sansing (2000), and Chen and Gavious (2017) showing that positions with high book-tax differences are more likely to be scrutinized within a tax audit.

Niggemann (2020) finds that a departure from a high book-tax conformity increases the tax non-compliance. In line with empirical evidence of Ayers et al. (2010), Chan et al. (2010), and Hanlon et al. (2008), this indicates that a high book-tax conformity might mitigate understated tax reports. Nevertheless, Atwood et al. (2010) also document that this can come at the cost of reduced accuracy of the financial statement. They state that an increasing book-tax conformity may reduce the earnings quality. In contrast, Desai (2005), Evers et al. (2016), and Lev and Nissim (2004) argue that one set of books, i.e., a financial statement and a tax report which coincide, would offer less discretion for opportunistic reporting behavior and, therefore, induces a higher earnings quality. However, the information required by tax authorities differs substantially from the information needed by investors who are one of the primary recipients of financial accounting information (Atwood et al., 2010). Thus, an increasing book-tax conformity necessarily exacerbates the trade-off between the different information requirements. Ali and Hwang (2000) show that earnings are less value relevant when the book-tax conformity is high. This suggests that in such cases, less information is transmitted to the financial statement users.

Despite the potentially harmful effect on the earnings quality, the findings of Lang et al. (2012), Tang (2015), and Watrin et al. (2014) indicate that managers will less often engage in earnings management when book-tax conformity is low because the incentive to smooth the taxable income carries over to smoother accounting earnings for high book-tax conformity. Contrary, Blaylock et al. (2017) find that a higher book-tax conformity increases the cost of equity, whereas the cost of debt does not change. They conclude that high book-tax conformity is associated with more earnings management.

Although the effect of an increasing book-tax conformity on earnings management for financial statement purposes appears equivocal, the results regarding tax evasion tend to be less ambiguous. The findings of Atwood et al. (2012) and Chen and Gavious (2017) suggest that an increasing book-tax conformity is associated with less tax evasion. Blaufus et al. (2017) have shown that an increasing book-tax conformity can lead to more or less understated tax reports. We contribute to their findings showing that a reduced reporting discretion results in lower investment amounts when real effects are considered. Accordingly, an increasing book-tax conformity may lead to decreasing expected tax revenues for the tax authority. A high book-tax conformity deteriorates investment incentives. Thus, governments face a trade-off while designing regulations regarding book-tax conformity.

The studies of Blaufus et al. (2017), Mills and Sansing (2000), and Mills et al. (2010) are closely related to our work. These papers analyze different information environments and the resulting inferences from book-tax differences. Mills and Sansing (2000) consider the use of financial statement information in a tax audit. Blaufus et al. (2017) include a strategic statutory auditor in the aforementioned setting. While these papers are mainly concerned with the signaling effect of book-tax differences, we investigate the impact of book-tax conformity on a firm's investment decision while acknowledging that the financial statement alters the tax authority's beliefs regarding the correct tax treatment of the project outcome.

5.3 Model Setup

We consider a game-theoretic model comprising two risk-neutral players: A firm and a tax authority. Initially, the firm has an existing project with a low project outcome. The firm can further invest in this existing project to achieve a high project outcome. The firm releases a financial statement and a tax report. Both depict the project outcome. Due to GAAP and tax law particularities, the treatment of the project outcome for the financial statement and the tax report can differ. For example, corporate tax shelters may induce favorable tax treatment of investments. Alternatively, the firm could decide whether an expenditure must be expensed or capitalized in the financial statement and the tax report (see Mills and Sansing, 2000). Subsequently, the tax authority decides whether to conduct a tax audit or not.

In particular, the firm decides on an investment amount a to maximize its expected after-tax income, considering potential tax audits. After the investment the project outcome b can either be low ($\underline{b}$) or high ($\bar{b}$). The investment is costly $\frac{za^2}{2}$, where $z > 0$ denotes the unit costs of investment.[2] The investment amount a determines the probability of obtaining a high project outcome, i.e., $P(\bar{b}) = a$ and $P(\underline{b}) = (1-a)$, respectively.[3] Thus, the higher the investment, the higher the probability of a high project outcome.

After the project outcome is realized, the firm releases a financial statement and a tax report. Since we are not interested in strategic interdependencies with a statutory auditor, we assume that the project outcome and the corresponding financial statement coincide. In addition, the firm has no incentives to bias the financial statement because the financial statement of public firms is always audited and publicly observable. Presuming a perfect audit technology, a statutory auditor always detects and corrects false reports. Hence, the disclosed financial statement displays the correct financial accounting treatment of the project outcome. Correspondingly, the project outcome and the concomitant financial statement are $b \in \{\underline{b}, \bar{b}\}$, with $\bar{b} > \underline{b}$.

Considering the tax report, the correct treatment of the project outcome can also be high or low, i.e., $t \in \{\underline{t}, \bar{t}\}$, with $\bar{t} > \underline{t}$. When the tax report , depicted by $\hat{t}$, and the financial statement b differ, a book-tax difference arises. As the correct tax treatment of the project outcome is private information to the firm, the firm can either issue a correct tax report or bias the tax report. As a result, book-tax differences can arise if differences between GAAP and tax law exist or if the firm biases the tax report. In line with prior work of Blaufus et al. (2017) we refer to the true valuation of the project outcome (b,t) as the firm's type. Hence, the firm can be of four types: $\{(\underline{b}, \underline{t}), (\bar{b}, \underline{t}), (\bar{b}, \bar{t}), (\underline{b}, \bar{t})\}$.

Since both the tax report and the financial statement describe the same underlying economics, similarities between the financial accounting rules and the tax law lead to a positive but imperfect correlation between the tax report and the financial statement. This correlation is captured by the level of mandatory book-tax conformity c, where c is exogenously and jointly determined by tax regulators and financial statement standard setters. To ensure a positive correlation between the financial statement and the tax report, we assume $\frac{1}{2} < c < 1$. Therefore, the conditional probabilities are $P(\bar{t}|\bar{b}) = P(\underline{t}|\underline{b}) = c$ and $P(\bar{t}|\underline{b}) = P(\underline{t}|\bar{b}) = (1-c)$. Thus, a high level of mandatory book-tax conformity in-

[2] We assume that z is sufficiently large to ensure that $a \leq 1$ holds.

[3] For example, an investment in equipment could induce higher productivity. Consequently, the probability of high outcomes increases.

creases the probability of conforming reports, i.e., the financial statement and the tax report are either high or low. A low level of book-tax conformity increases the probability of non-conforming reports, i.e., a book-tax difference arises when the financial statement is high, and the tax report is low or vice versa.
The tax authority observes the firm's tax report $\hat{t}$ and the financial statement b. Based on both reports the tax authority decides whether to conduct an audit with audit costs of k.[4] We capture the tax authority's decision whether to conduct an audit or not using a binary variable:

$$x_{TA} = \begin{cases} 1 & \text{if an audit takes place, and} \\ 0 & \text{if no audit takes place.} \end{cases}$$

We assume perfect audit technology. In case of an audit the tax authority always observes the correct tax treatment and detects biased tax reports. The tax authority updates its beliefs regarding a correct high or low tax report depending on the level of book-tax conformity c and the observed financial statement, which perfectly informs about the project outcome. If the tax authority detects a biased tax report, the firm corrects the tax report and pays an additional penalty δ.
Figure 5.1 depicts the timing of the game.

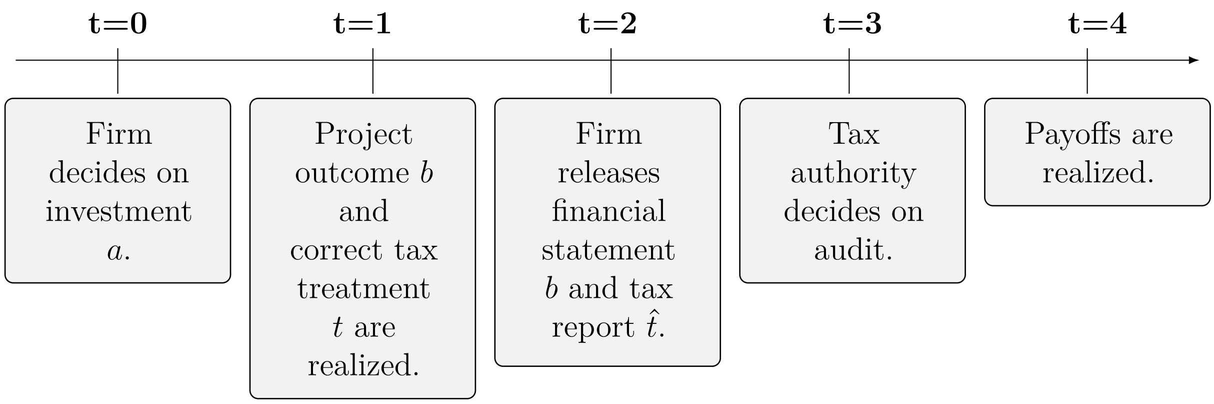

Figure 5.1: Timing of the game.

The tax authority is interested in a high tax revenue comprising the firm's tax liability and potential penalties. Thus, the tax authority's decision problem can be written as

$$\max_{x_{TA} \in \{0,1\}} \mathbb{E}[\Pi_{TA}(x_{TA})] = \hat{t} + x_{TA} \left(max\left\{t - \hat{t}, 0\right\} \frac{t - \hat{t} + \delta}{t - \hat{t}} - k \right). \tag{5.1}$$

[4] Throughout the analysis, we assume that the audit costs are not prohibitively high to ensure the tax authority's audit incentives.

Reporting/ Audit Decision	$x_{TA} = 1$	$x_{TA} = 0$
$\bar{t}$, $\hat{t} = \underline{t}$	$\bar{t} + \delta$	$\underline{t}$
$\underline{t}$, $\hat{t} = \bar{t}$	$\underline{t}$	$\bar{t}$

Table 5.1: Firm's tax liability depending on the audit and reporting decisions.

Considering potential penalties due to a detected understated tax report the firm maximizes

$$\max_{a,\hat{t}} \mathbb{E}[\Pi_F(a)] = a(\mu\bar{b} - \omega T_{\bar{b}} - P_{\bar{b}}) + (1-a)(\mu\underline{b} - \omega T_{\underline{b}} - P_{\underline{b}}) - \frac{za^2}{2} \tag{5.2}$$

with μ and ω as positive weighting factors indicating the firm's preferences regarding the financial statement and the tax report. These preferences are common knowledge to all players. We consider the case of $\mu > \omega$, implying that the firm is more sensitive to the financial statement. This is representative for large firms where investment and reporting decisions are typically delegated to managers whose variable compensation is commonly based on the financial statement (Blaufus et al., 2017). $T_{\bar{b}}$ and $T_{\underline{b}}$ denote the expected tax liability and $P_{\bar{b}}$ and $P_{\underline{b}}$ denote the expected penalty in case of an understated report for a high or low financial statement, respectively. Therefore, the expected tax liability and the expected penalty depend on the firm's tax reporting decision and the tax authority's auditing decision. Releasing a correct tax report, the firm's tax liability is equal to the tax report, and there is no additional penalty. However, understating the report, the expected tax liability and the expected penalty depend on the tax authority's audit decision. Table 5.1 depicts the resulting tax liabilities, including penalties in case of an understated tax report.

5.4 Equilibrium Analysis

After the firm releases the financial statement and the tax report, the tax authority decides whether to conduct an audit or not. However, the tax authority only observes the outcome of the firm's tax reporting strategy. The firm's strategy itself, i.e., whether the tax report is correct or biased, is not observable. Therefore, the reporting decision of the firm and the audit decision of the tax authority can be seen as strategically simultaneous (Crawford and Sobel, 1982). The model is solved using backward induction. First, the firm's reporting and the tax authority's auditing strategy are determined. Then, anticipating the subsequent tax inspection game, the firm decides on an investment amount in an existing project to maximize its expected after-tax income.

5.4.1 Dominated Strategies

The firm is interested in a high project outcome, a concomitant high financial statement, and a low tax report resulting in a low tax liability. The firm never benefits from biasing a low correct tax treatment $\underline{t}$ upwards. In contrast, the tax authority is interested in maximizing the tax revenue comprising the firm's tax liability and the potential penalty due to a detected understated tax report. Therefore, the tax authority will never audit a high tax report, i.e., $\bar{t}$, as an audit is costly and no additional tax revenue can be generated.
Lemma 5.1 summarizes the dominated strategies.

Lemma 5.1. *The following actions will not occur in equilibrium:*

1. *The firm will never bias a correct tax treatment $t = \underline{t}$.*
2. *The tax authority will never audit a tax report $\hat{t} = \bar{t}$.*

The game tree, depicted in Figure 5.2, displays those strategies which are not dominated.

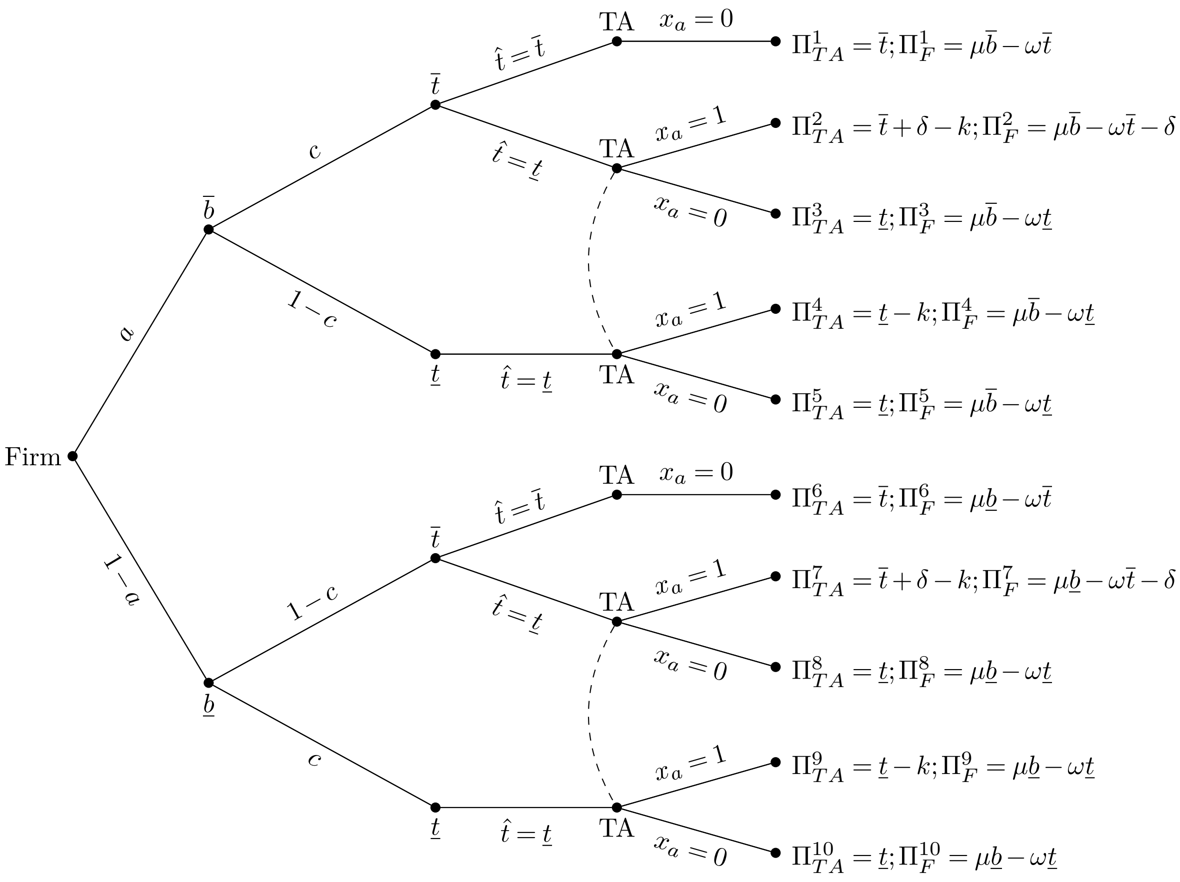

Figure 5.2: Game tree without dominated strategies.

5.4.2 Equilibrium Strategies

We assume throughout the analysis that $k < \bar{t} - \underline{t} + \delta$, to focus on realistic mixed-strategy equilibria. Considering extremely high or low tax audit costs causes pure-strategy equilibria. In a mixed-strategy equilibrium, the firm randomizes between understating or truthfully reporting a correct high tax treatment $\bar{t}$. The tax authority randomizes between auditing or not auditing $\hat{t} = \underline{t}$. Proposition 5.1 summarizes the resulting equilibrium strategies.

Proposition 5.1. *The equilibrium strategies of the tax authority and the firm are as follows:*

1. *The tax authority audits a tax report* $\hat{t} = \underline{t}$ *with probability* $\gamma = \frac{\omega(\bar{t}-\underline{t})}{\omega(\bar{t}-\underline{t})+\delta}$.
2. *The firm of type* $(\bar{b}, \bar{t})$ *understates the tax report with probability* $\phi = \frac{(1-c)k}{c(\bar{t}-\underline{t}+\delta-k)}$.
3. *The firm of type* $(\underline{b}, \bar{t})$ *understates the tax report with probability* $\eta = \frac{ck}{(1-c)(\bar{t}-\underline{t}+\delta-k)}$.
4. *The misreporting probability is higher in terms of conforming reports, i.e.,* $\phi < \eta$.

Proof. See appendix. □

The equilibrium strategies are in line with prior theoretical work. Proposition 5.1 replicates equilibrium behavior in a standard tax inspection game (e.g., Mills and Sansing, 2000; Blaufus et al., 2017). The tax authority's audit incentives and the firm's reporting incentives are reflected in the respective equilibrium strategy. An understated tax report seems especially worthwhile if the preferences of the firm regarding the tax report ω or the tax savings in case of an understated report $(\bar{t} - \underline{t})$ are high. However, higher incentives to understate the tax report, in turn, are incorporated in the tax authority's audit probability. High penalties in the case of a detected understated tax report lead to a low probability of an understated tax report. Anticipating this, the tax authority audits low tax reports less frequently when the penalty is high.
Furthermore, Proposition 5.1 shows that the firm's tax reporting strategies also depend on the level of mandatory book-tax conformity, i.e., the correlation between GAAP and tax law. The firm's tax reporting strategy depends on the project outcome, i.e., whether the investment in the existing project was a success or a failure. The firm considers that the financial statement is informative regarding the correct tax treatment of the project outcome. Therefore, the expected tax consequences depend on the expected project outcome and the book-tax conformity. Observing a low financial statement indicates that a tax report $\hat{t} = \underline{t}$ might be correct with a high probability. Consequently, a firm with negative book-tax differences, i.e., type $(\underline{b}, \bar{t})$, can better mimic a low-conforming type, i.e. $(\underline{b}, \underline{t})$, than a high non-conforming type, i.e., type $(\bar{b}, \bar{t})$, can mimic a firm with positive

book-tax differences, i.e., $(\bar{b}, \underline{t})$. This is reflected by a higher probability of a conforming understated tax report than a non-conforming understated tax report, i.e., $\phi < \eta$.
The probability of an understated tax report can either increase or decrease for a high level of mandatory book-tax conformity depending on the project outcome. The tax authority updates its beliefs regarding the true type of the firm dependent on the observed financial statement. That is, observing a high financial statement $\bar{b}$ the tax authority anticipates that a high tax report is more likely for a high book-tax conformity c. Consequently, a report $\hat{t} = \underline{t}$ is audited with a high probability. Therefore, the firm understates its tax report less frequently. For a financial statement $\underline{b}$, the probability of a low correct tax report increases with increasing mandatory book-tax conformity. Therefore, the tax audit incentives decrease, and the firm of type $(\underline{b}, \bar{t})$ can better mimic a low conforming type. Corollary 5.1 summarizes the effect of book-tax conformity on the equilibrium strategies.

Corollary 5.1. *An increasing mandatory book-tax conformity leads to less understated non-conforming tax reports, i.e., the probability of a report $(\bar{b}, \hat{t} = \underline{t})$ decreases (ϕ), while the probability of conforming understated tax reports, i.e., $(\underline{b}, \hat{t} = \underline{t})$, increases ($\eta$).*

Proof. See appendix. □

5.4.3 The Effect of Book-Tax Conformity Neglecting Real Effects

Prior theoretical work has focused on the effects of book-tax conformity on firms' reporting behavior. Empirical work concludes the impact of an increasing book-tax conformity on firms' tax payments (Chan et al., 2013). To provide a theoretical foundation for empirical research regarding book-tax conformity, we analyze both reporting and real effects. First, we investigate the effect of book-tax-conformity neglecting real effects, i.e., without endogenizing the firm's investment decision, to draw inferences regarding firms' reporting behavior. In contrast to prior research, we consider the possibility that the probability of a high or low project outcome and a concomitant high or low financial statement are not equally likely. We, thereby, acknowledge that the probability of a high financial statement depends on the underlying project.
Empirical findings of Atwood et al. (2012) and Chen and Gavious (2017) indicate that a high book-tax conformity induces less tax evasion, which can increase the tax revenue. Therefore, prior research hypothesizes that an increasing book-tax conformity is beneficial for the tax authority. In terms of an inspection game and in line with prior work of Blaufus et al. (2017), we interpret the ex-ante probability of an understated tax report as a measure for tax evasion:

$$P(\hat{t} = \underline{t} | t = \bar{t}) = acP(\bar{b}, \hat{t} = \underline{t}) \mid (\bar{b}, t = \bar{t})) + (1-a)(1-c)P((\underline{b}, \hat{t} = \underline{t}) \mid (\underline{b}, \bar{t})). \tag{5.3}$$

Whether the firm's tax reporting strategy leads to more or less understated tax reports, i.e., more or less tax evasion, depends on the project outcome. A high book-tax conformity induces more truthful tax reporting for a high conforming type, i.e., $(\bar{b}, \bar{t})$, whereas a high book-tax conformity induces less truthful reporting for a low non-conforming type, i.e., $(\underline{b}, \bar{t})$. In line with empirical findings of Atwood et al. (2012) and Chen and Gavious (2017), this result suggests that a high book-tax conformity can induce less tax evasion. Nevertheless, the effect of book-tax conformity is ambiguous and depends on the probability of success or failure of the firm's project. Thus, increasing the mandatory book-tax conformity can increase or decrease the tax authority's expected tax revenue. Lemma 5.2 summarizes this result.

Lemma 5.2. *The probability for a correct high tax report and the expected tax revenue are increasing (decreasing) with an increasing book-tax conformity if a high project outcome and a concomitant high financial statement occurs with a high (low) probability, i.e., for* $a > \frac{1}{2}$ *(for* $a < \frac{1}{2}$*).*

Proof. See appendix. □

In the case of a high financial statement, an increasing book-tax conformity eliminates uncertainty regarding the correct tax report. Therefore, an increasing mandatory book-tax conformity limits the firm's reporting discretion in case of a high financial statement. In case of a low financial statement, an increasing book-tax conformity leads to decreasing expected tax revenues of the tax authority. This result occurs because the probability of a correct low tax report is increasing in the book-tax conformity for a low financial statement. Consequently, firms of type $(\underline{b}, \bar{t})$ can better mimic $(\underline{b}, \underline{t})$.
Figure 5.3 depicts the expected tax revenue and the probability of an understated tax report depending on the book-tax conformity.

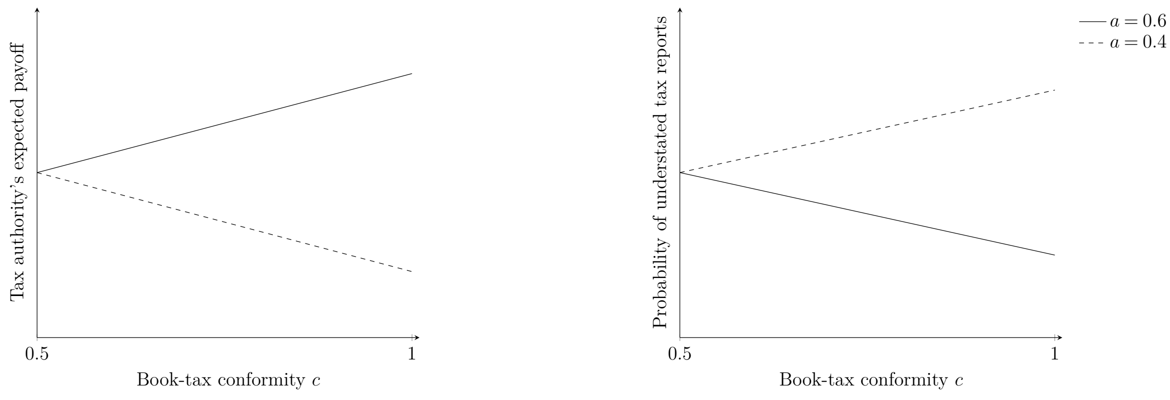

Figure 5.3: Expected tax revenue and the probability of an understated tax report depending on c plotted for $(\bar{t} - \underline{t}) = (2 - 1)$, $\delta = 1.25$, and $k = 0.75$.

5.4.4 Optimal Investment Decision

Deciding on the investment amount, the firm considers investment costs and subsequent tax reporting consequences to achieve a high project outcome and a concomitant high financial statement. An investment in an existing project can typically influence the project outcome because additional capital or personally costly effort will increase the probability of success. Assuming a perfect correlation between the financial statement and the project outcome, the probability of a high financial statement increases with an increasing investment amount.

In equilibrium both the tax authority and the firm are indifferent whether to conduct an audit or not and whether to report the taxable income truthfully or biased. Therefore, the firm's expected payoff with a truthful tax report equals its expected payoff with a biased tax report. The firm's ex ante expected payoff incorporating equilibrium behavior is given by

$$\mathbb{E}[\Pi_F(a)] = a\left(\mu\bar{b} - \omega(c\bar{t} + (1-c)\underline{t})\right) + (1-a)\left(\mu\underline{b} - \omega(c\underline{t} + (1-c)\bar{t})\right) - \frac{za^2}{2}. \tag{5.4}$$

Thus, the firm maximizes its expected payoff by investing

$$\begin{aligned} \frac{\partial\mathbb{E}[\Pi_F(a)]}{\partial a} &= \mu(\bar{b} - \underline{b}) - c\omega\bar{t} - (1-c)\omega\underline{t} + (1-c)\omega\bar{t} + c\omega\underline{t} - za = 0 \\ \implies a^* &= \frac{\mu(\bar{b} - \underline{b}) + (1-2c)\omega(\bar{t} - \underline{t})}{z} \geq 0. \end{aligned} \tag{5.5}$$

The firm always invests a positive amount a if the firm is more sensitive to the financial statement, i.e., $\mu(\bar{b} - \underline{b}) \geq \omega(\bar{t} - \underline{t})$. Proposition 5.2 summarizes this result.

Proposition 5.2. *The firm maximizes its after-tax profit choosing an optimal investment amount a^*.*

Proof. See appendix. □

The investment amount decreases if the investment becomes costlier. Investment costs include direct costs, z, and indirect costs, e.g., tax payments. A high mandatory book-tax conformity decreases investment incentives as it increases the expected tax liability (indirect costs). Corollary 5.2 summarizes this result.

Corollary 5.2. *Investment incentives are deteriorated by a high level of mandatory book-tax conformity.*

Proof. See appendix. □

By accepting a high probability of a low project outcome, the firm forgoes potential pre-tax profits if a high tax liability devours the benefit of a high investment. Consequently, the firm achieves a low tax liability due to two different effects. First, the firm can use tax reporting discretion and minimize the tax liability by issuing an understated tax report. Second, the firm can choose a low investment amount, resulting in a higher probability of a lower project outcome and a higher probability of a low tax liability. Both effects are crucial to evaluate the consequences of a varying mandatory book-tax conformity.

5.5 Comparative Statics

In the following, we analyze the impact of the mandatory book-tax conformity on the firm's and the tax authority's expected payoff. The firm's expected payoff given optimal investment amount a^* is given by

$$\mathbb{E}[\Pi_F(a^*)] = a^*\mu\bar{b} + (1-a^*)\mu\underline{b} - \frac{za^{*2}}{2} - \omega(a^*(c\bar{t} + (1-c)\underline{t}) + (1-a^*)(c\underline{t} + (1-c)\bar{t}). \tag{5.6}$$

The expected payoff can be separated into the expected pre-tax profits and the expected tax liability:

$$\begin{aligned}\mathbb{E}[\Pi_F(a^*)] = & \underbrace{\frac{1}{2z}\left(2z\mu\underline{b} + \mu^2(\bar{b}-\underline{b})^2 - (1-2c)^2\omega^2(\bar{t}-\underline{t})^2\right)}_{\text{Exp. Pre-tax Profit}(\Pi_F^{pre-tax})} - \\ & \underbrace{\frac{\omega}{z}\left(z(c\underline{t} + (1-c)\bar{t}) - (1-2c)(\bar{t}-\underline{t})(\mu(\bar{b}-\underline{b}) - (1-2c)\omega(\bar{t}-\underline{t}))\right)}_{\text{Exp. Tax Liability}(\Pi_F^{tax})}.\end{aligned} \tag{5.7}$$

The effect of an increasing mandatory book-tax conformity on the firm's expected payoff, therefore, depends on the effect on the firm's expected pre-tax profits and the firm's expected tax liability. An increasing book-tax conformity leads to decreasing expected pre-tax profits of the firm:

$$\frac{\partial \Pi_F^{pre-tax}}{\partial c} = \frac{1}{2z}\left(-(8c-4)\omega^2(\bar{t}-\underline{t})^2\right) < 0. \tag{5.8}$$

Decreasing expected pre-tax profits result because the investment amount, a^*, is based on the investment's profits. With a high book-tax conformity, investment is costlier due to less favorable tax treatment. For higher marginal cost of investment, the optimal investment amount decreases. Therefore, the probability of a high project outcome, i.e., a high pre-tax profit, is low.

The effect on the expected tax liability is ambiguous:

$$\frac{\partial \Pi_F^{tax}}{\partial c} = \frac{\omega}{z}\left(-z(\bar{t}-\underline{t}) + 2\mu(\bar{b}-\underline{b})(\bar{t}-\underline{t}) - (8c-4)\omega(\bar{t}-\underline{t})^2\right). \tag{5.9}$$

Whether the expected tax liability increases or decreases in the book-tax conformity depends on the baseline level of mandatory book-tax conformity. That is,

$$\frac{\partial \Pi_F^{tax}}{\partial c}\begin{cases} > 0 & \text{if } c < \bar{c}_{TA} = \frac{2\mu(\bar{b}-\underline{b}) + 4\omega(\bar{t}-\underline{t}) - z}{8\omega(\bar{t}-\underline{t})} \text{ and} \\ < 0 & \text{otherwise.}\end{cases} \tag{5.10}$$

The intuition is as follows:

1. For a low baseline level of book-tax conformity, i.e., $c < \overline{c}_{TA}$, the tax-based investment incentives are high. For a high project outcome ($\overline{b}$), a preferential tax treatment ($\underline{t}$) occurs with high probability. The marginal costs of investment are relatively low. Consequently, the firm chooses a high optimal investment amount, and a correct high tax report is understated with positive probability. For a marginal increase of the book-tax conformity, the investment incentives are still sufficient to induce an investment amount, leading to a high probability of a high project outcome and a concomitant high financial statement. However, an increasing book-tax conformity increases the probability of a correct high tax report. Thus, the tax authority's audit incentives increase. Anticipating higher audit incentives, the firm understates the tax report less frequently. The expected tax liability, thereby, increases in case of an increasing book-tax conformity.

2. For a high baseline level of book-tax conformity, i.e., $c > \overline{c}_{TA}$, the tax-based investment incentives are low. For a high project outcome ($\overline{b}$), a preferential tax treatment ($\underline{t}$) occurs with low probability. The marginal costs of investment are relatively high, and the firm chooses a low optimal investment amount. A marginal increase of the mandatory book-tax conformity additionally harms the investment incentives. A low optimal investment amount results, which results in a low project outcome and a concomitant low financial statement with high probability. As a consequence, a low correct tax report is more likely, and the audit incentives decrease. Anticipating lower audit incentives, the firm understates the tax report more frequently. The expected tax liability, thereby, decreases in case of an increasing book-tax conformity.[5]

With an ambiguous effect on the expected tax liability, the overall effect of an increasing book-tax conformity on the firm's expected payoff depends on the baseline level of the mandatory book-tax conformity:

$$\frac{\partial \mathbb{E}[\Pi_F(a^*)]}{\partial c} > 0 \text{ for } c > \overline{c}_F = \frac{2\mu(\overline{b} - \underline{b}) + 2\omega(\overline{t} - \underline{t}) - z}{4\omega(\overline{t} - \underline{t})}. \tag{5.11}$$

For a low baseline level of book-tax conformity, i.e., $c < \overline{c}_F$, the firm's expected payoff is decreasing, which can result for two different reasons. First, the firm's expected pre-tax profit is always decreasing in c independent of the level of the baseline book-tax conformity (investment effect). Second, the expected tax liability can increase or decrease in the book-

[5] Depending on the firm's investment incentives like the investment costs z and the preferences about the financial statement μ, it is feasible that the expected tax liability is always increasing or decreasing in the book-tax conformity. That is, for high investment costs or low preferences about the financial statement, investment incentives are so low that the firm always chooses a low investment amount, and an increasing book-tax conformity always decreases the expected tax liability ($\overline{c}_{TA} < 0.5 < c$). For low investment costs or high preferences about the financial statement, investment incentives are high. Consequently, deteriorated investment incentives due to an increasing book-tax conformity can be neglected, and the expected tax liability always increases ($c < 1 < \overline{c}_{TA}$).

tax conformity depending on the baseline level of book-tax conformity ($\overline{c}_{TA}$) (tax effect). Thus, for a low baseline level of book-tax conformity, both effects (investment and tax effect) lead to a decreasing expected payoff, or the marginal benefit from a decreasing expected tax liability (tax effect) cannot outweigh the marginal loss from a decreasing expected pre-tax profit (investment effect). The expected payoff of the firm decreases for both cases.

For a high baseline level of book-tax conformity, i.e., $c > \overline{c}_F$, the firm's expected payoff is increasing with an increasing book-tax conformity. A decreasing expected tax liability (tax effect) outweighs the decreasing expected pre-tax profits (investment effect).

The effect on the tax authority's expected payoff depends on the threshold $\overline{c}_{TA}$. The tax authority is only interested in maximizing the expected tax liability. When the baseline level of book-tax conformity is sufficiently low, i.e., $c < \overline{c}_{TA}$, the firm's expected tax liability increases and, consequently, the tax authority's expected payoff increases and vice versa. Lemma 5.3 summarizes the effects of an increasing book-tax conformity on the firm's and the tax authority's expected payoff.

Lemma 5.3.

1. *For a low (high) baseline level of book-tax conformity, i.e.,* $c < \overline{c}_F$ $(c > \overline{c}_F)$ *the firm's expected payoff is decreasing (increasing) with an increasing book-tax conformity.*

2. *For a low (high) baseline level of book-tax conformity, i.e.,* $c < \overline{c}_{TA}$ $(c > \overline{c}_{TA})$ *the tax authority's expected payoff is increasing (decreasing) with an increasing book-tax conformity.*

Proof. See appendix. □

The threshold values of the firm and the tax authority ($\overline{c}_F, \overline{c}_{TA}$) do not coincide. Consequently, a decreasing tax liability, i.e., decreasing payoff for the tax authority, is not necessarily associated with an increasing expected payoff of the firm as the firm also faces decreasing expected pre-tax profits. Moreover, an increasing expected payoff for the tax authority is not necessarily associated with a decreasing expected payoff of the firm. The difference between the threshold values is given by

$$\overline{c}_F - \overline{c}_{TA} = \frac{2\mu(\overline{b} - \underline{b}) - z}{8\omega(\overline{t} - \underline{t})}. \tag{5.12}$$

This shows that the threshold $\overline{c}_{TA}$ is always greater than $\overline{c}_F$ for high investment costs, i.e., $z > 2\mu(\overline{b} - \underline{b})$. Nevertheless, for high investment costs both thresholds are always smaller than 0.5, i.e., $\overline{c}_F < \overline{c}_{TA} < 0.5 < c$. Thus, the expected tax liability is decreasing with an increasing book-tax conformity. This effect outweighs the effect of decreasing expected pre-tax profits. As a result, the tax authority's expected payoff decreases while the firm's expected payoff increases.

Contrary, with low investment costs, i.e., $z < 2\mu(\overline{b} - \underline{b})$, $0.5 < \overline{c}_{TA} < \overline{c}_F < 1$ results. Figure 5.4 depicts the effect of a varying book-tax conformity in case of low investment costs.

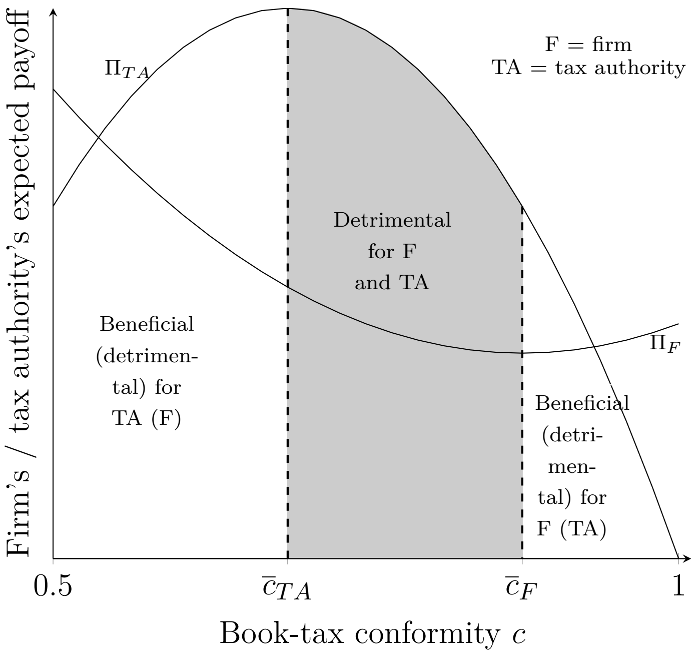

Figure 5.4: Expected tax revenue and expected firm payoff depending on book-tax conformity c plotted for $\mu = 2$, $\omega = 1$, $(\overline{b} - \underline{b}) = (\overline{t} - \underline{t}) = (2 - 1)$, $z = 2.5$, $\delta = 1.25$, and $k = 0.75$.

With a sufficiently low (high) baseline level of book-tax conformity, an increasing (decreasing) tax authority's expected payoff is always associated with a decreasing (increasing) firm's expected payoff. For an intermediate baseline level of book-tax conformity, the tax authority's and the firm's expected payoff decrease with an increasing book-tax conformity. Due to the less favorable tax treatment, the firm chooses a low investment amount, thereby reducing the expected tax liability. However, the effect of decreasing expected pre-tax profits outweighs the effect of a decreasing expected tax liability resulting in a decreasing firm's expected payoff. Proposition 5.3 summarizes this results.

Proposition 5.3. *An increasing mandatory book-tax conformity*

1. *increases (decreases) the tax authority's (firm's) expected payoff for $z < z_{TA}$ or $z \in [z_{TA}, \overline{z}]$ and $c < \overline{c}_{TA}$,*

2. *decreases both the tax authority's and the firm's expected payoff for $z \in [z_{TA}, z_F]$ and $c > \overline{c}_{TA}$ or $z \in [z_F, \overline{z}]$ and $c \in [\overline{c}_{TA}, \overline{c}_F]$ and*

3. *decreases (increases) the tax authority's (firm's) expected payoff for $z \in [z_F, \overline{z}]$ and $c > \overline{c}_F$ or $z > \overline{z}$.*[6]

Proof. See appendix. □

[6] The thresholds for z can be found in the appendix.

5.6 Conclusion

Allowing firms to reveal relevant information to investors without facing monetary consequences like a higher tax liability is the primary benefit of book-tax-differences (Atwood et al., 2010). Moreover, tax authorities can influence firm behavior in their favor, for instance, by tax exemptions and tax deductibility. These measures necessarily lead to book-tax differences because GAAP reporting aims at providing relevant information to investors instead of inducing particular behavior. However, governments and supranational organizations are concerned with large book-tax differences because book-tax differences also provide large reporting discretion. In particular, a low mandatory book-tax conformity can foster opportunistic reporting behavior of taxpayers. Specifically, firms can bias their taxable income downwards while engaging in upwards earnings manipulation. Accordingly, regulators consider opportunities to align financial statements and tax reports to curtail tax evasion through book-tax differences. Nevertheless, reducing book-tax differences counteracts the possibility to incentivize specific investment behavior. In particular, high book-tax conformity does not allow for regulation affecting only taxpayers' behavior without considering the consequences resulting from the investors' reaction to altered information provided by GAAP reporting. Moreover, whether a financial statement driven by accounting standards intended to induce specific behavior provides information meeting the criteria of decision usefulness and relevance is at least questionable and needs careful consideration. Due to the aforementioned countervailing effects, a prosperous debate regarding the minimization of book-tax differences is prevalent. However, the consequences of tightening regulation regarding the allowance of book-tax differences are widely underexplored.

We argue that prior research regarding book-tax differences neglects effects on firms' decision making beyond pure reporting decisions. In contrast, we study firms' investment behavior considering that the tax report and the financial statement are affected. An increasing book-tax conformity is detrimental for investment decisions by providing less incentives due to less preferential tax treatment. If only reporting behavior is considered, prior work of Niggemann (2020), Atwood et al. (2012) and Chen and Gavious (2017) suggest that an increasing mandatory book-tax conformity induces less tax-aggressive reporting. Therefore, the authors conclude that high book-tax conformity might be beneficial. In line with prior research, we show that high book-tax conformity leads to less understated non-conforming tax reports. Nevertheless, our results indicate that investigating only reporting behavior in the context of book-tax differences seems to be myopic. In particular, the joint consideration of reporting and investment behavior shows that an increasing book-tax conformity can increase or decrease tax authority's expected tax revenue depending on the baseline level of book-tax conformity. Firms might be willing to forgo pre-tax profits and therefore decrease the expected tax liability to maximize the expected after-tax profits. Thus, the effect of an increasing book-tax conformity depends on the tax-independent investment incentives and the level of baseline book-tax conformity because an increasing mandatory book-tax conformity affects both the firm's investment decision and the corresponding expected tax liability. Interestingly, for an intermediate baseline level of book-tax conformity, an increasing book-tax conformity is detrimental for the firm's and the tax authority's expected payoff.

Recently, governments and tax authorities seek to curtail book-tax differences. Our analysis demonstrates that the consequences of an increasing book-tax conformity depend on several potentially unobservable parameters. This emphasizes the complexity that legislators, tax authorities, and supranational organizations like the European Union need to consider when designing regulations regarding book-tax conformity. Regulators should bear in mind the trade-off between providing investment incentives and inducing less tax-aggressive reporting. Thus, the real effects of an increasing mandatory book-tax conformity should be considered instead of solely focusing on reporting behavior.

5.7 Appendix

5.7.1 Proof of Proposition 5.1

Proof. Never auditing report $\hat{t} = \overline{t}$ and never overstating a true report $\hat{t} = \underline{t}$ simply follows from the tax authority's and firm's preferences.
The tax authority's equilibrium audit probability for report $\hat{t} = \underline{t}$ can be derived from the indifference of the firm between truthful and biased reporting. The firm of type $(b, \overline{t})$ is indifferent between truthful and biased reports for

$$\mu b - \gamma(\omega \overline{t} + \delta) - (1-\gamma)\omega \underline{t} = \mu b + \omega \overline{t}$$
$$\implies \gamma = \frac{\omega(\overline{t} - \underline{t})}{\omega(\overline{t} - \underline{t}) + \delta}. \tag{5.13}$$

The firm's equilibrium reporting probability can be derived from the indifference of the tax authority between auditing and not auditing report $\hat{t} = \underline{t}$. This is given for a high financial statement $(\overline{b})$ for

$$c\phi(\overline{t} + \delta - k) + c(1-\phi)\overline{t} + (1-c)(\underline{t} - k) = (c\phi + (1-c))\underline{t} + c(1-\phi)\overline{t}$$
$$\implies \phi = \frac{(1-c)k}{c((\overline{t} - \underline{t}) + \delta - k)}. \tag{5.14}$$

The tax authority is indifferent between auditing and not auditing the report $\hat{t} = \underline{t}$ given $\underline{b}$ for

$$c(\overline{t} - k) + (1-c)\eta(\overline{t} + \delta - k) + (1-c)(1-\eta)\overline{t} = (1-c)(1-\eta)\overline{t} + (c + (1-c)\eta)\overline{t}$$
$$\implies \eta = \frac{ck}{(1-c)((\overline{t} - \underline{t}) + \delta - k)}. \tag{5.15}$$

The firm of type $\underline{b}$ understates more often. Proof:

$$\phi = \frac{(1-c)k}{c((\overline{t} - \underline{t}) + \delta - k)} < \eta = \frac{ck}{(1-c)((\overline{t} - \underline{t}) + \delta - k)} \implies (1-c) < c.$$

□

5.7.2 Proof of Corollary 5.1

Proof. The firm of type $\overline{b}$ understates $\overline{t}$ with probability ϕ. Differentiating the probability ϕ with respect to c shows that the probability of an understatement decreases with higher book-tax-conformity:

$$\frac{\partial \phi}{\partial c} = \frac{-k}{c^2(\overline{t} - \underline{t} + \delta - k)} < 0. \tag{5.16}$$

The firm of type $\underline{b}$, instead, understates $\overline{t}$ with probability η. Differentiating with respect to c reveals that the probability of an understatement increases with higher book-tax conformity:

$$\frac{\partial \eta}{\partial c} = \frac{k}{(1-c)^2(\overline{t} - \underline{t} + \delta - k)} > 0. \tag{5.17}$$

□

5.7.3 Proof of Lemma 5.2

Proof. In mixed-strategies the expected tax revenue can be written as

$$\begin{aligned}\mathbb{E}[\Pi_{TA}(a)] = &(ac\phi + (1-a)(1-c)\eta + a(1-c) + (1-a)c) + \underline{t} \\ &(ac(1-\phi) + (1-a)(1-c)(1-\eta))\,\overline{t}.\end{aligned} \tag{5.18}$$

Inserting the equilibrium probabilities ϕ and η and differentiate with respect to c yields

$$\frac{\partial \mathbb{E}[\Pi_{TA}(a)]}{\partial c} = (a-(1-a))\left(1+\frac{k}{(\overline{t}-\underline{t}+\delta-k)}\right)(\overline{t}-\underline{t}) \tag{5.19}$$

with

$$\frac{\partial \mathbb{E}[\Pi_{TA}(a)]}{\partial c}\begin{cases} <0 & \text{if } a<0.5, \\ =0 & \text{if } a=0.5 \text{ and} \\ >0 & \text{if } a>0.5. \end{cases} \tag{5.20}$$

The expected probability of misreporting and the probability of low tax reports can be written as

$$P(\hat{t}=\underline{t}|t=\overline{t}) = ac\phi + (1-a)(1-c)\eta \tag{5.21}$$

$$\text{and } P(\underline{t}) = ac\phi + (1-a)(1-c)\eta + a(1-c) + (1-a)c. \tag{5.22}$$

Given the equilibrium probabilities ϕ and η and differentiate with respect to c yields

$$\frac{\partial P(\hat{t}=\underline{t}|t=\overline{t})}{\partial c} = ((1-a)-a)\frac{k}{(\overline{t}-\underline{t}+\delta-k)} \tag{5.23}$$

$$\text{and } \frac{\partial P(\underline{t})}{\partial c} = ((1-a)-a)\frac{\overline{t}-\underline{t}+\delta}{(\overline{t}-\underline{t}+\delta-k)} \tag{5.24}$$

with

$$\frac{\partial P(\hat{t}=\underline{t}|t=\overline{t})}{\partial c}, \frac{\partial P(\underline{t})}{\partial c}\begin{cases} <0 & \text{if } a>0.5, \\ =0 & \text{if } a=0.5 \text{ and} \\ >0 & \text{if } a<0.5. \end{cases} \tag{5.25}$$

□

5.7.4 Proof of Proposition 5.2

Proof. The firm maximizes the expected after-tax payoff given by

$$\mathbb{E}[\Pi_F(a)] = a\left(\mu\overline{b} - \omega(c\overline{t} + (1-c)\underline{t})\right) + (1-a)\left(\mu\underline{b} - \omega(c\underline{t} + (1-c)\overline{t}\right) - \frac{za^2}{2}. \tag{5.26}$$

Firm chooses investment amount to maximize after-tax profit. The FOC is given by

$$\mu(\overline{b}-\underline{b}) - c\omega\overline{t} - (1-c)\omega\underline{t} + (1-c)\omega\overline{t} + c\omega\underline{t} - za = 0. \tag{5.27}$$

The SOC is given by

$$-z < 0 \tag{5.28}$$

which is negative so that a determines a local maximum. Therefore, the optimal investment level is

$$a^* = \frac{\mu(\bar{b} - \underline{b}) + (1-2c)\omega(\bar{t} - \underline{t})}{z}. \tag{5.29}$$

□

5.7.5 Proof of Corollary 5.2

Proof. Differentiating the optimal investment level a^* with respect to c yields

$$\frac{\partial a^*}{\partial c} = \frac{-2\omega(\bar{t} - \underline{t})}{z} < 0. \tag{5.30}$$

The tax valuation $\bar{t}$ always exceeds the valuation $\underline{t}$ so that higher book-tax-conformity always leads to less investment expenditure. □

5.7.6 Proof of Lemma 5.3

Proof. In equilibrium, inserting the optimal investment amount a^* in the firm's expected payoff can be written as

$$\begin{aligned}\mathbb{E}[\Pi_F(a^*)] = & \underbrace{\frac{1}{2z}\left(2z\mu\underline{b} + \mu^2(\bar{b} - \underline{b})^2 - (1-2c)^2\omega^2(\bar{t} - \underline{t})^2\right)}_{\text{Exp. Pre-tax Profit}(\Pi_F^{pre-tax})} - \\ & \underbrace{\frac{\omega}{z}\left(z(c\underline{t} + (1-c)\bar{t}) - (1-2c)(\bar{t} - \underline{t})(\mu(\bar{b} - \underline{b}) - (1-2c)\omega(\bar{t} - \underline{t}))\right)}_{\text{Exp. Tax Liability}(\Pi_F^{tax})}. \end{aligned} \tag{5.31}$$

Differentiating the expected pre-tax profit with respect to c reveals

$$\frac{\partial \Pi_F^{pre-tax}}{\partial c} = \frac{1}{2z}\left(-(8c-4)\omega^2(\bar{t} - \underline{t})^2\right) < 0. \tag{5.32}$$

The expected tax liability is increasing or decreasing in the book-tax conformity depending on the baseline level of book-tax conformity:

$$\frac{\partial \Pi_F^{tax}}{\partial c} = \frac{\omega}{z}\left(-z(\bar{t} - \underline{t}) + 2\mu(\bar{b} - \underline{b})(\bar{t} - \underline{t}) - (8c-4)\omega(\bar{t} - \underline{t})^2\right) \tag{5.33}$$

with

$$\frac{\partial \Pi_F^{tax}}{\partial c} \begin{cases} > 0 & \text{if } c < \bar{c}_{TA} = \frac{2\mu(\bar{b} - \underline{b}) + 4\omega(\bar{t} - \underline{t}) - z}{8\omega(\bar{t} - \underline{t})}, \\ < 0 & \text{if } c > \bar{c}_{TA} = \frac{2\mu(\bar{b} - \underline{b}) + 4\omega(\bar{t} - \underline{t}) - z}{8\omega(\bar{t} - \underline{t})}. \end{cases} \tag{5.34}$$

Differentiating the firm's expected payoff with respect to c reveals that the effect of decreasing expected tax-liability outweighs the effect of decreasing pre-tax profits whenever the baseline level of book-tax conformity exceeds a critical threshold $\overline{c}_F$:

$$\frac{\partial \mathbb{E}[\Pi_F(a^*)]}{\partial c}\begin{cases} > 0 & \text{if } c > \overline{c}_F = \frac{2\mu(\overline{b}-\underline{b})+2\omega(\overline{t}-\underline{t})-z}{4\omega(\overline{t}-\underline{t})}, \\ < 0 & \text{if } c < \overline{c}_F = \frac{2\mu(\overline{b}-\underline{b})+2\omega(\overline{t}-\underline{t})-z}{4\omega(\overline{t}-\underline{t})}. \end{cases} \tag{5.35}$$

In equilibrium, the tax authority's expected payoff can be written as

$$\begin{aligned}\mathbb{E}[\Pi_{TA}(a)] =& \underbrace{(ac\phi + (1-a)(1-c)\eta)}_{P(\hat{t}=\overline{t})}\overline{t} + \\ & \underbrace{(a(1-c) + ac(1-\phi) + (1-a)c + (1-a)(1-c)(1-\eta))}_{P(\hat{t}=\underline{t})}\underline{t}.\end{aligned} \tag{5.36}$$

Inserting the optimal investment expenditure a^* as well as the equilibrium probabilities ϕ and η yields

$$\begin{aligned}\mathbb{E}[\Pi_{TA}(a=a^*)] =& \frac{1}{z}(z(\overline{t} - c(\overline{t}-\underline{t})(1+\frac{k}{\overline{t}-\underline{t}+\delta-k})) - \\ & (1-2c)(\overline{t}-\underline{t})(\mu(\overline{b}-\underline{b}) + (1-2c)\omega(\overline{t}-\underline{t}))(1+\frac{k}{\overline{t}-\underline{t}+\delta-k})).\end{aligned} \tag{5.37}$$

Differentating with respect to c reveals

$$\frac{\partial \mathbb{E}[\Pi_{TA}(a^*)]}{\partial c} = \frac{(\overline{t}-\underline{t})(\delta+\overline{t}-\underline{t})(2\mu(\overline{b}-\underline{b}) + 4\omega(\overline{t}-\underline{t})(1-2c) - z)}{(\overline{t}-\underline{t}+\delta-k)z}. \tag{5.38}$$

Rearranging yields

$$\frac{\partial \mathbb{E}[\Pi_{TA}(a^*)]}{\partial c}\begin{cases} > 0 & \text{if } c < \overline{c}_{TA} = \frac{2\mu(\overline{b}-\underline{b})+4\omega(\overline{t}-\underline{t})-z}{8\omega(\overline{t}-\underline{t})}, \\ < 0 & \text{if } c > \overline{c}_{TA} = \frac{2\mu(\overline{b}-\underline{b})+4\omega(\overline{t}-\underline{t})-z}{8\omega(\overline{t}-\underline{t})}. \end{cases} \tag{5.39}$$

□

5.7.7 Proof of Proposition 5.3

Proof. For comparison of the firm's and the tax authority's expected payoffs, the order of both critical thresholds is needed:

$$\overline{c}_F - \overline{c}_{TA} = \frac{2\mu(\overline{b}-\underline{b}) - z}{8\omega(\overline{t}-\underline{t})} \tag{5.40}$$

with

$$\overline{c}_F - \overline{c}_{TA}\begin{cases} < 0 & \text{if } z > 2\mu(\overline{b}-\underline{b}), \\ > 0 & \text{if } z < 2\mu(\overline{b}-\underline{b}). \end{cases} \tag{5.41}$$

Whenever the relevant thresholds ($\overline{c}_{TA}$, $\overline{c}_F$) fall out of the feasible region for the book-tax conformity ($c \in (0.5, 1)$) the baseline level of book-tax conformity exceeds or falls below the critical threshold. Depending on the investment costs z the following holds:

$$\bar{c}_{TA} = \frac{2\mu(\bar{b}-\underline{b})+4\omega(\bar{t}-\underline{t})-z}{8\omega(\bar{t}-\underline{t})} \begin{cases} \leq 0.5 & \text{if } z \geq \bar{z} = 2\mu(\bar{b}-\underline{b}), \\ \in (0.5,1) & \text{if } z \in (z_{TA} = 2\mu(\bar{b}-\underline{b})-4\omega(\bar{t}-\underline{t}), \bar{z}), \\ \geq 1 & \text{if } z \leq z_{TA}. \end{cases} \tag{5.42}$$

$$\bar{c}_{F} = \frac{2\mu(\bar{b}-\underline{b})+2\omega(\bar{t}-\underline{t})-z}{4\omega(\bar{t}-\underline{t})} \begin{cases} \leq 0.5 & \text{if } z \geq \bar{z} = 2\mu(\bar{b}-\underline{b}), \\ \in (0.5,1) & \text{if } z \in (z_{F} = 2\mu(\bar{b}-\underline{b})-2\omega(\bar{t}-\underline{t}), \bar{z}), \\ \geq 1 & \text{if } z \leq z_{F}. \end{cases} \tag{5.43}$$

Comparison of the thresholds for z reveals that

$$z_{TA} < z_F < \bar{z}. \tag{5.44}$$

Consequently, the following cases can be summarized:

1. $z < z_{TA}$ so that with increasing book-tax conformity the tax authority's expected payoff increases and the firm's expected payoff decreases,
2. $z_{TA} < z < z_F$ with
   (a) $c < \bar{c}_{TA}$ so that with increasing book-tax conformity the tax authority's expected payoff increases and the firm's expected payoff decreases, or
   (b) $\bar{c}_{TA} < c$ so that with increasing book-tax conformity the tax authority's expected payoff decreases and the firm's expected payoff decreases,
3. $z_F < z < \bar{z}$ with
   (a) $c < \bar{c}_{TA}$ so that with increasing book-tax conformity the tax authority's expected payoff increases and the firm's expected payoff decreases, or
   (b) $\bar{c}_{TA} < c < \bar{c}_F$ so that with increasing book-tax conformity the tax authority's expected payoff decreases and the firm's expected payoff decreases,
   (c) $\bar{c}_F < c$ so that with increasing book-tax conformity the tax authority's expected payoff decreases and the firm's expected payoff increases and
4. $\bar{z} < z$ so that with increasing book-tax conformity the tax authority's expected payoff decreases and the firm's expected payoff increases.

□

Bibliography

Ali, A. and Hwang, L.-S. (2000). Country-specific factors related to financial reporting and the value relevance of accounting data. *Journal of Accounting Research*, 38(1):1 – 21.

Almulla, M. and Bradbury, M. E. (2019). Auditor, client, and investor consequences of the enhanced auditor's report. *Available at SSRN 3165267*.

Aoyagi, M. (2010). Information feedback in a dynamic tournament. *Games and Economic Behavior*, 70(2):242–260.

Asbhar, K. and Ruhnke, K. (2019). Real effects of reporting key audit matters on auditors' judgment and choice of action. *International Journal of Auditing*, 23(2):165 – 180.

Atwood, T., Drake, M. S., Myers, J. N., and Myers, L. A. (2012). Home country tax system characteristics and corporate tax avoidance: International evidence. *The Accounting Review*, 87(6):1831 – 1860.

Atwood, T. J., Drake, M. S., and Myers, L. A. (2010). Book-tax conformity, earnings persistence and the association between earnings and future cash flows. *Journal of Accounting and Economics*, 50(1):111 – 125.

Autrey, R. L., Dikolli, S. S., and Newman, D. P. (2010). Performance measure aggregation, career incentives, and explicit incentives. *Journal of Management Accounting Research*, 22(1):115–131.

Ayers, B. C., Laplante, S. K., and McGuire, S. T. (2010). Credit ratings and taxes: The effect of book-tax differences on ratings changes. *Contemporary Accounting Research*, 27(2):359 – 402.

Backof, A. G., Bowlin, K., and Goodson, B. (2019). The importance of clarification of auditors' responsibilities under the new audit reporting standards. *Available at SSRN 2446057*.

Badertscher, B. A., Phillips, J. D., Pincus, M., and Rego, S. O. (2009). Earnings management strategies and the trade-off between tax benefits and detection risk: To conform or not to conform? *The Accounting Review*, 84(1):63–97.

Beaudry, P. (1994). Why an informed principal may leave rents to an agent. *International Economic Review*, 35(4):821–832.

Bebchuk, L. A. and Stole, L. A. (1993). Do short-term objectives lead to under- or overinvestment in long-term projects? *The Journal of Finance*, 48(2):719–729.

Beer, M. (1987). Performance appraisal. In Lorsch, J. W., editor, *Handbook of organizational behavior*. Englewood Cliffs, NJ: Prentice Hall.

Benabou, R. and Tirole, J. (2003). Intrinsic and extrinsic motivation. *The review of economic studies*, 70(3):489–520.

Bentley, J. W., Lambert, T. A., and Wang, E. (2021). The effect of increased audit disclosure on managers' real operating decisions: Evidence from disclosing critical audit matters. *The Accounting Review*, 96(1):23–40.

Beyer, A. and Guttman, I. (2012). Voluntary disclosure, manipulation, and real effects. *Journal of Accounting Research*, 50(5):1141–1177.

Blaufus, K., Schöndube, J. R., and Wielenberg, S. (2017). The audit of deferred taxes as a signal for tax auditors: Tax compliance implications for private and public firms. *Available at SSRN 3141267*.

Blaylock, B., Gaertner, F. B., and Shevlin, T. (2017). Book-tax conformity and capital structure. *Review of Accounting Studies*, 22(2):903–932.

Boolaky, P. K. and Quick, R. (2016). Bank directors' perceptions of expanded auditor's reports. *International Journal of Auditing*, 20(2):158 – 174.

Bournois, F. and Roussillon, S. (1992). The management of 'highflier' executives in france: The weight of the national culture. *Human Resource Management Journal*, 3(1):37–56.

Brasel, K., Doxey, M. M., Grenier, J. H., and Reffet, A. (2016). Risk disclosure preceding negative outcomes: The effects of reporting critical audit matters on judgments of auditor liability. *The Accounting Review*, 91(5):1345–1362.

Cade, N. L. and Hodge, F. D. (2014). The effect of expanding the audit report on managers' communication openness. *Available at SSRN 2433641*.

Carver, B. T. and Trinkle, B. S. (2017). Nonprofessional investors' reactions to the PCAOB's proposed changes to the standard audit report. *Available at SSRN 2930375*.

Chade, H. and Silvers, R. (2002). Informed principal, moral hazard, and the value of a more informative technology. *Economics Letters*, 74(3):291–300.

Chan, K. H., Lin, K. Z., and Mo, P. L. (2010). Will a departure from tax-based accounting encourage tax noncompliance? Archival evidence from a transition economy. *Journal of Accounting and Economics*, 50(1):58–73.

Chan, K. H., Lin, K. Z., and Tang, F. (2013). Tax effects of book-tax conformity, financial reporting incentives, and firm size. *Journal of International Accounting Research*, 12(2):1–25.

Chen, E. and Gavious, I. (2017). The roles of book-tax conformity and tax enforcement in regulating tax reporting behaviour following International Financial Reporting Standards adoption. *Accounting & Finance*, 57(3):681–699.

Chen, Q., Jiang, X., and Zhang, Y. (2019). The effects of audit quality disclosure on audit effort and investment efficiency. *The Accounting Review*, 94(4):189 – 214.

Christensen, B. E., Eilifsen, A., Glover, S. M., and Messier Jr., W. F. (2020). The effect of materiality disclosures on investors' decision making. *Accounting, Organizations and Society*, 87.

Christensen, B. E., Glover, S. M., and Wolfe, C. J. (2014). Do critical audit matter paragraphs in the audit report change nonprofessional investors' decision to invest? *Auditing: A Journal of Practice & Theory*, 33(4):71–93.

Christensen, J. (1981). Communication in agencies. *The Bell Journal of Economics*, 12(2):661–674.

Christensen, J. (1982). The determination of performance standards and participation. *Journal of Accounting Research*, 20(2):589–603.

Chung, P. K., Geiger, M. A., Paik, D. G., and Rabe, C. (2021). Materiality thresholds: Empirical evidence from change in accounting estimate disclosures. *Accounting Horizons*, 35(3):113–141.

Cianciaruso, D., Marinovic, I., and Smith, K. (2021). Information design in financial markets. *Available at SSRN 3686089*.

Crawford, V. P. and Sobel, J. (1982). Strategic information transmission. *Econometrica: Journal of the Econometric Society*, 50(6):1431–1451.

Crémer, J. (1995). Arm's length relationships. *The Quarterly Journal of Economics*, 110(2):275–295.

De Simone, L., Klassen, K. J., and Seidman, J. K. (2021). The effect of income-shifting aggressiveness on corporate investment. *Available at SSRN 3232036*.

Deng, M. and Wen, X. (2020). Less is more: Does audit risk disclosure improve financial reporting precision and the quality of audited financial reports? *Baruch College Zicklin School of Business Research Paper*, 2020-03.

Desai, M. A. (2005). The degradation of reported corporate profits. *Journal of Economic Perspectives*, 19(4):171–192.

Dewatripont, M., Jewitt, I., and Tirole, J. (1999). The economics of career concerns, part i: Comparing information structures. *The Review of Economic Studies*, 66(1):183–198.

Dialog Semiconductor (2018). Annual report 2018. https://www.dialog-semiconductor.com/sites/default/files/gb0059822006-ja-2018-eq-e-00.pdf.

Doxey, M. M., Hatfield, R. C., Rippy, J. A., and Peel, R. K. (2020). Asymmetric investor materiality and the effects of disclosure. *Auditing: A Journal of Practice & Theory*, 39(2):27–50.

Dries, N. and Pepermans, R. (2008). "Real" high-potential careers: An empirical study into the perspectives of organisations and high potentials. *Personnel Review*.

Dutta, S. and Gigler, F. (2002). The effect of earnings forecasts on earnings management. *Journal of Accounting Research*, 40(3):631–655.

Dutta, S. and Nezlobin, A. (2017). Dynamic effects of information disclosure on investment efficiency. *Journal of Accounting Research*, 55(2):329–369.

Dye, R. A. (1985). Disclosure of nonproprietary information. *Journal of Accounting Research*, 23(1):123–145.

Effron, M. and Ort, M. (2010). *One page talent management: Eliminating complexity, adding value*. Harvard Business Press.

Evers, M., Meier, I., and Nicolay, K. (2016). Book-tax conformity and reporting behavior–A quasi-experiment. *Proceedings. Annual Conference on Taxation and Minutes of the Annual Meeting of the National Tax Association*, 109:1–45.

FASB (2018). Amendments to concepts statement no. 8—conceptual framework for financial reporting chapter 3, qualitative characteristics of useful financial information. https://www.fasb.org/cs/Satellite?c=Document_C&cid=1176171111614&pagename=FASB%2FDocument_C%2FDocumentPage.

Friedman, H. L., Hughes, J. S., and Michaeli, B. (2021). A rationale for imperfect reporting standards. *Management Science*.

Gandossy, R. and Effron, M. (2004). *Leading the Way: Three Truths From the Top Companies for Leaders*. John Wiley & Sons.

Gershkov, A. and Perry, M. (2009). Tournaments with midterm reviews. *Games and Economic Behavior*, 66(1):162–190.

Gibbons, R. and Murphy, K. J. (1992). Optimal incentive contracts in the presence of career concerns: Theory and evidence. *Journal of Political Economy*, 100(3):468–505.

Gimbar, C., Hansen, B., and Ozlanski, M. E. (2016). The effects of critical audit matter paragraphs and accounting standard precision on auditor liability. *The Accounting Review*, 91(6):1629–1646.

Goex, R. F. and Wagenhofer, A. (2009). Optimal impairment rules. *Journal of Accounting and Economics*, 48(1):2–16.

Gold, A., Heilmann, M., Plott, C., and Rematzki, J. (2020). Do key audit matters impact financial reporting behavior? *International Journal of Auditing*, 24(2):232 – 244.

Goldman, E. and Slezak, S. L. (2006). An equilibrium model of incentive contracts in the presence of information manipulation. *Journal of Financial Economics*, 80(3):603–626.

Goltsman, M. and Mukherjee, A. (2011). Interim performance feedback in multistage tournaments: The optimality of partial disclosure. *Journal of Labor Economics*, 29(2):229–265.

Graham, J. R., Harvey, C. R., and Rajgopal, S. (2005). The economic implications of corporate financial reporting. *Journal of Accounting and Economics*, 40(1-3):3–73.

Graham, J. R., Raedy, J. S., and Shackelford, D. A. (2012). Research in accounting for income taxes. *Journal of Accounting and Economics*, 53(1-2):412–434.

Grossman, S. J. (1981). The informational role of warranties and private disclosure about product quality. *The Journal of Law and Economics*, 24(3):461–483.

Gutierrez, E., Minutti-Meza, M., Tatum, K. W., and Vulcheva, M. (2018). Consequences of adopting an expanded auditor's report in the United Kingdom. *Review of Accounting Studies*, 23(4):1543 – 1587.

Hamner, W. C. (1975). How to ruin motivation with pay. *Compensation Review*, 7(3):17–27.

Hanlon, M. and Heitzman, S. (2010). A review of tax research. *Journal of Accounting and Economics*, 50(2-3):127–178.

Hanlon, M., Maydew, E. L., and Shevlin, T. (2008). An unintended consequence of book-tax conformity: A loss of earnings informativeness. *Journal of Accounting and Economics*, 46(2-3):294–311.

Hanlon, M. and Shevlin, T. (2005). Book-tax conformity for corporate income: An introduction to the issues. *Tax Policy and the Economy*, 19:101–134.

Harris, M. and Raviv, A. (1990). Capital structure and the informational role of debt. *The Journal of Finance*, 45(2):321 – 349.

Hart, O. and Moore, J. (1994). Debt and seniority: An analysis of the role of hard claims in constraining management. *National Bureau of Economic Research*, No. 4886.

Heinle, M. S. and Verrecchia, R. E. (2016). Bias and the commitment to disclosure. *Management Science*, 62(10):2859–2870.

Hermalin, B. E. and Weisbach, M. S. (1998). Endogenously chosen boards of directors and their monitoring of the CEO. *American Economic Review*, 88(1):96–118.

Holmström, B. (1999). Managerial incentive problems: A dynamic perspective. *The Review of Economic Studies*, 66(1):169–182.

IAASB (2012). Improving the auditor's report - invitation to comment. www.ifac.org/system/files/publications/files/Auditor_Reporting_Invitation_to_Comment-final_0.pdf.

IAASB (2015). International standard on auditing 701: Communicating key audit matters in the independent auditor's report. https://www.iaasb.org/publications/international-standard-auditing-isa-701-new-communicating-key-audit-matters-independent-auditors-4.

IASB (2018). Amendment issued: IASB clarifies its definition of 'material'. https://www.ifrs.org/news-and-events/news/2018/10/iasb-clarifies-its-definition-of-material/.

Jensen, M. C. (1986). Agency costs of free cash flow, corporate finance, and takeovers. *The American Economic Review*, 76(2):323–329.

Kachelmeier, S. J., Rimkus, D., Schmidt, J. J., and Valentine, K. (2020). The forewarning effect of critical audit matter disclosures involing measurement uncertainty. *Contemporary Accounting Research*, 37(4):2186–2212.

Kamenica, E. and Gentzkow, M. (2011). Bayesian persuasion. *American Economic Review*, 101(6):2590–2615.

Kandel, E. and Lazear, E. P. (1992). Peer pressure and partnerships. *Journal of Political Economy*, 100(4):801–817.

Kanodia, C. (1980). Effects of shareholder information on corporate decisions and capital market equilibrium. *Econometrica: Journal of the Economic Society*, 48(4):923–953.

Kanodia, C. and Lee, D. (1998). Investment and disclosure: The disciplinary role of periodic performance reports. *Journal of Accounting Research*, 36(1):33–55.

Kanodia, C. and Mukherji, A. (1996). Real effects of separating investment and operating cash flows. *Review of Accounting Studies*, 1(1):51–71.

Kanodia, C., Singh, R., and Spero, A. E. (2005). Imprecision in accounting measurement: Can it be value enhancing? *Journal of Accounting Research*, 43(3):487–519.

Kelton, A. S. and Montague, N. R. (2018). The unintended consequences of uncertainty disclosures made by auditors and managers on nonprofessional investor judgments. *Accounting, Organizations and Society*, 65:44–55.

Köhler, A., Ratzinger-Sakel, N., and Theis, J. (2020). The effects of key audit matters on the auditor's report's communicative value: Experimental evidence from investment professionals and non-professionals investors. *Accounting in Europe*, 17(2):105–128.

Klevak, J., Livnat, J., Pei, D. S., and Suslava, K. (2020). Are critical audit matters informative? *Available at SSRN 3685369*.

Lang, M., Lins, K. V., and Maffett, M. (2012). Transparency, liquidity, and valuation: International evidence on when transparency matters most. *Journal of Accounting Research*, 50(3):729–774.

Laux, V. (2012). Stock option vesting conditions, CEO turnover, and myopic investment. *Journal of Financial Economics*, 106(3):513–526.

Laux, V. (2017). Supporting and assessing agents. *Journal of Accounting Research*, 55(4):995–1016.

Lawler, E. E. (1972). Secrecy and the need to know. *Managerial Motivation and Compensation*, pages 455–475.

Lazear, E. P. (1989). Pay equality and industrial politics. *Journal of Political Economy*, 97(3):561–580.

Lazear, E. P. and Rosen, S. (1981). Rank-order tournaments as optimum labor contracts. *Journal of Political Economy*, 89(5):841–864.

Leland, H. E. and Pyle, D. H. (1977). Informational asymmetries, financial structure, and financial intermediation. *The Journal of Finance*, 32(2):371–387.

Lev, B. and Nissim, D. (2004). Taxable income, future earnings, and equity values. *The Accounting Review*, 79(4):1039–1074.

Li, H., Hay, D., and Lau, D. (2019). Assessing the impact of the new auditor's report. *Pacific Accounting Review*, 31(1):110 – 132.

Liang, P. J. and Wen, X. (2007). Accounting measurement basis, market mispricing, and firm investment efficiency. *Journal of Accounting Research*, 45(1):155–197.

Libby, R., Rennekamp, K. M., and Seybert, N. (2015). Regulation and the interdependent roles of managers, auditors, and directors in earnings management and accounting choice. *Accounting, Organizations and Society*, 47:25 – 42.

Lizzeri, A., Meyer, M. A., and Persico, N. (2002). The incentive effects of interim performance evaluations. Penn CARESS Working Papers, Penn Economics Department.

Michaeli, B. (2017). Divide and inform: Rationing information to facilitate persuasion. *The Accounting Review*, 92(5):167–199.

Mills, L. F. (1996). Corporate tax compliance and financial reporting. *National Tax Journal*, 49(3):421–435.

Mills, L. F. (1998). Book-tax differences and internal revenue service adjustments. *Journal of Accounting Research*, 36(2):343–356.

Mills, L. F. and Newberry, K. J. (2001). The influence of tax and nontax costs on book–tax reporting differences: Public and private firms. *The Journal of the American Taxation Association*, 23(1):1–19.

Mills, L. F., Robinson, L. A., and Sansing, R. C. (2010). Fin 48 and tax compliance. *The Accounting Review*, 85(5):1721–17426.

Mills, L. F. and Sansing, R. C. (2000). Strategic tax and financial reporting decisions: Theory and evidence. *Contemporary Accounting Research*, 17(1):85–106.

Narayanan, M. P. (1985). Managerial incentives for short-term results. *The Journal of Finance*, 40(5):1469 – 1484.

Niggemann, F. (2020). Mandatory book tax conformity and its effects on strategic reporting and auditing. *Available at SSRN 3215367*.

Patterson, E. R. and Smith, R. (2003). Materiality and uncertainty and earnings misstatement. *The Accounting Review*, 78(3):819–846.

PCAOB (2017). The auditor's report on an audit of financial statements when the auditor expresses an unqualified opinion; and related amendments to PCAOB standards; PCAOB Release No. 2017-001, Washington, DC: PCAOB. https://pcaobus.org/Rulemaking/Docket034/2017-001-auditors-report-final-rule.pdf.

Penno, M. (1984). Asymmetry of pre-decision information and managerial accounting. *Journal of Accounting Research*, 22(1):177–191.

Penno, M. (2021). A theory of assurance: Balancing costly formal control with tone at the top. *Management Science*.

Prendergast, C. (1992). Career development and specific human capital collection. *Journal of the Japanese and International Economies*, 6(3):207–227.

Prendergast, C. (1993). The role of promotion in inducing specific human capital acquisition. *The Quarterly Journal of Economics*, 108(2):523–534.

Ready, D. A., Conger, J. A., and Hill, L. A. (2010). Are you a high potential. *Harvard Business Review*, 88(6):78–84.

Reid, L. C., Carcello, J. V., Li, C., and Neal, T. L. (2019). Impact of auditor report changes on financial reporting quality and audit costs: Evidence from the united kingdom. *Contemporary Accounting Research*, 36(3):1501 – 1539.

Reineke, R. and Weiskirchner-Merten, K. (2021). Transfer pricing and location choice of intangibles - Spillover and tax avoidance through profit shifting. *Journal of Management Accounting Research*, 33(1):129–148.

Sansing, R. C. (1993). Information acquisition in a tax compliance game. *The Accounting Review*, 68(4):874–884.

Schwab, T. and Todtenhaupt, M. (2017). Spillover from the haven: Cross-border externalities of patent box regimes within multinational firms. *IEB Working Paper 2017/15*.

Silzer, R. and Church, A. H. (2010). Identifying and assessing high-potential talent. *Strategy-driven talent management: A leadership imperative*, 28:213–280.

Sirois, L.-P., Bédard, J., and Bera, P. (2018). The informational value of key audit matters in the auditor's report: Evidence from an eye-tracking study. *Accounting Horizons*, 32(2):141–162.

Song, F. and Thakor, A. V. (2006). Information control, career concerns, and corporate governance. *The Journal of Finance*, 61(4):1845–1896.

Spence, M. (1973). Job market signaling. *The Quarterly Journal of Economics*, 87(3):355–374.

Spence, M. (1974). Competitive optimal responses to signals: An analysis of efficiency and distribution. *Journal of Economic Theory*, 7(3):296 – 332.

Stein, J. C. (1989). Efficient capital markets, inefficient firms: A model of myopic corporate behavior. *The Quarterly Journal of Economics*, 104(4):655–669.

Stulz, R. M. and Johnson, H. (1985). An analysis of secured debt. *Journal of Financial Economics*, 14(4):501 – 521.

Tang, T. Y. (2015). Does book-tax conformity deter opportunistic book and tax reporting? an international analysis. *European Accounting Review*, 24(3):441–469.

Tirole, J. (2010). *The Theory of Corporate Finance*. Princeton University Press.

Vinson, J. M., Robertson, J. C., and Cockrell, R. C. (2019). The effects of critical audit matter removal and duration on jurors' assessments of auditor negligence. *Auditing: A Journal of Practice and Theory*, 38(3):183 – 202.

Volkswagen AG (2020). Annual report 2020. https://www.volkswagenag.com/presence/investorrelation/publications/annual-reports/2021/volkswagen/Y_2020_d.pdf.

Watrin, C., Ebert, N., and Thomsen, M. (2014). Book-tax conformity and earnings management: Insights from european one-and two-book systems. *The Journal of the American Taxation Association*, 36(2):55–89.

Watts, R. L. (2003). Conservatism in accounting part I: Explanations and implications. *Accounting horizons*, 17(3):207–221.

Zhang, G. (2013). Accounting standards, cost of capital, resource allocation, and welfare in a large economy. *The Accounting Review*, 88(4):1459–1488.