Audit Quality, Litigation and Risk Aversion

- An Analytical Analysis of the Influence of Risk Aversion on Audit Quality

Julia Baldauf, Erich Pummerer, **Marcel Steller**[*)]

all Innsbruck University, Austria

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Abstract

In this paper, we analyze the influence of auditors' risk aversion on the quality of the audit. Our results suggest that risk-averse auditors choose a substantially higher optimal audit effort and that optimal audit effort is not related to the audit fee. Hence, they provide a higher audit quality by accepting substantially higher audit costs. We derive an explicit solution for the risk premium that risk-averse auditors require and a marginal audit fee that is relevant for market exit. We explain why the spread between the marginal audit fee and the optimized audit costs for risk-neutral auditors equals the expected loss; whereas for risk-averse auditors, the spread is determined mostly by the risk premium.

By changing the audit environment, the risk premium and the marginal fees are affected significantly. Hence, tightening the audit regulations without ensuring an increase of audit fees may cause a market exit of risk-averse auditors. Thus, the overall audit quality may decline even when, on an individual basis, an increase of quality is expected.

The major influence of risk-aversion on the audit quality suggests that selecting a risk-averse auditor is essential for a high audit quality. As the addressee of a financial statement is unable to assess the risk-aversion of an auditor, we suggest that standard setters should think about encouraging the responsibility of audit committees when mandating an auditor.

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*) Univ.-Ass. Dr. Marcel Steller
University of Innsbruck
Universitätsstraße 15
A-6020 Innsbruck
marcel.steller@uibk.ac.at

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Abstract

In this paper, we analyze the influence of risk aversion by an auditor on the quality of the audit. Our results suggest that risk-averse auditors choose a substantially higher optimal audit effort and that optimal audit effort is not related to the audit fee. Hence, they provide a higher audit quality by accepting substantially higher audit costs. We derive an explicit solution for the risk premium that risk-averse auditors require and a marginal audit fee that is relevant for market exit. We explain why the spread between the marginal audit fee and the optimized audit costs for risk-neutral auditors equals the expected loss; whereas for risk-averse auditors, the spread is determined mostly by the risk premium. By changing the audit environment, the risk premium and the marginal fees are affected significantly. Hence, tightening the audit regulations without ensuring an increase of audit fees may cause a market exit of risk-averse auditors. Thus, the overall audit quality may decline even when, on an individual basis, an increase of quality is expected. The major influence of risk-aversion on the audit quality suggests that selecting a risk-averse auditor is essential for a high audit quality. As the addressee of a financial statement is unable to assess the risk-aversion of an auditor, we suggest that standard setters should think about encouraging the responsibility of audit committees when mandating an auditor.

1 Introduction

With the regular occurrence of finance scandals and accounting misstatements, the role of the auditor and the quality of his work often comes into question. Especially considering the accounting scandals that occurred at the beginning of the millennium[1], where the companies in question had received an unqualified opinion from an auditor just prior to their collapse, numerous reform proposals[2] are now being implemented into legal norms with the aim of increasing the quality of the audits. In this context, measures such as increasing the liability of the auditor, implementing high-quality international auditing standards and others are discussed. The aim of these initiatives is to increase the diligence of the auditor who is carrying out his work. Another problem that is seen by the European Commission is that the Big 4 audit firms are too highly concentrated in the market, which in addition to a possible systemic risk bears the risk that price competition between the Big 4 firms may result in audit fees that are too low to ensure a satisfactory audit quality. [3,4]

The question then arises whether the measures mentioned above are sufficient to ensure high quality audits that are a result of a high level of diligence and effort on the part of the auditor.

There are a large number of empirical and analytical studies that explore audit quality. Within the empirical studies, various surrogates have been developed (such as earnings quality, going concern determinations in audit reports, etc.) to measure audit quality. Overall, the results of these studies are mixed, but they provide support for some characteristics to improve audit quality such as an increased audit effort. While the empirical studies are confronted with the problem of measuring the audit quality, the analytical contributions mostly define audit quality and investigate the impact of possible changes in the audit environment. With respect to the definition of audit quality, the analytical studies mostly refer to the likelihood of litigation or the probability of fault detection.

In general, various analytical studies have been carried out. The question of auditor liability is often investigated; in particular, the differing effects of limited and unlimited liability on the auditors' level of diligence (for analyses regarding unlimited liabilities see *Ewert* (1999)). *Dye* (1993 and 1995) examines the effects of limited liability on the effort of the auditor. An extension of this analysis can be seen in the work of *Bigus* (2007), who examines other aspects that are related to limited liability. In his article, he explores the question of whether limited liability decreases the effort of the auditor. Using a standard model, he analyzes different characteristics of the auditors' liability in cases of limited liability. *Bigus* concludes that limited liability, in general, decreases the effort of the auditor, but that there are particular characteristics of the auditor's liabilities that incite the auditor to choose an optimal level of effort from a financial statement addresses point of view. Moreover, he points out that in the case of unlimited liability, auditors could choose inefficiently high levels of effort therefore reducing the total welfare. Like most studies, *Bigus* did not consider the influences of complexity or of risk aversion on the optimal level of audit effort.

Further studies on auditor liability investigate strategic interdependencies between the auditors and the other stakeholders (such as the investors or the management).[5] These interdependencies are, in particular, the dependence of the audit effort on various factors such as performance-related fees, the type of liability regime, the influence of imprecise auditing standards[6] or the ability to settle out of court for cases of compensation payments. [7]

Previous discussions of these questions usually do not distinguish between the different risk dispositions of the auditors. Mostly, they assume that the auditors are risk-neutral. Therefore, the inclusion of (different levels of) risk-averse auditors can contribute to these discussions and can provide additional aspects for individual measures. Analyzing the impact of different levels of risk aversion on the optimal audit program (audit effort) and deriving conclusions to possible measures that ensure a high level of audit effort and quality are our priorities.

This paper contributes to the scientific discussion because we address the previously unasked question of how the risk disposition of the auditors and the complexity of an audit influence the quality of the audit. Audit quality is measured as the probability of detecting material misstatements in the financial statements.

Within our model, we exclude the possibility of the auditor insuring against potential liability payments. This is because the effects of the insurance may overlap the possible effects that are caused by different risk aversions and thus weakens the interesting issues that arise from the differences in risk dispositions. Rather, the results show that it might be appropriate to consider different risk aversions when designing insurance contracts, instead of providing a uniform insurance contract for all auditors. Our results reveal that auditors behave fundamentally differently depending on their risk disposition. Thus, the effects of different levels of risk aversion should be taken into account when implementing measures to increase the quality of the audit. For example, an increase in the liability of the auditor only contributes to a higher audit quality in cases of risk-averse auditors because such an auditor would invest significantly more effort into his/her audit. In contrast, the increase in audit effort of a risk-neutral auditor is much smaller.

This article is organized as follows: The next section describes the model that was used to examine the behavior of auditors with different risk aversions. Based on our model and the definitions of audit risk and audit quality, in the third section we examine the behaviors of risk-neutral and risk-averse auditors. First, we focus on the general impact of risk aversion on the determination of the optimal level of audit effort. Then, we analyze the effects of adjustments to liability limitations on the audit effort and on the quality of the audit as well as the effects of the increased liability on marginal fees. At the end of this section, implications are summarized and discussed in relation to the aim of ensuring high-quality audits. The final section contains a summary of our findings.

2 The Model

To analyze the impact of different levels of risk aversion, we use a standard model (see *Wagenhofer/Ewert* 2007 P. 442). We extend this model with a parameter that considers the complexity of the audit. Against the background of this model, we analyze the optimization behavior of a risk-neutral and a risk-averse auditor. The audit fee f is exogenous and predefined. Moreover, the auditors dispose of an initial wealth of w, which is not dependent on the audit result. Furthermore, we assume that the different auditors estimate the characteristics of a mandate equally. Thus, the auditors only differ in auditor-specific characteristics such as risk aversion (α) and initial wealth(w).

2.1 Audit Risk and Audit Complexity

The audit engagement includes an audit risk (r). Audit risk is defined as the probability that the financial statement contains a material misstatement and that the auditor issues an unqualified audit opinion. This misstatement can generally be detected by audit procedures. For the analytical approach, we assume that $r > 0$. If the misstatement is not discovered and reported, and the misstatement comes to light, a litigation case can be expected. According to the literature, both the audit risk and the audit environment are important with respect to the ability to detect misstatements.

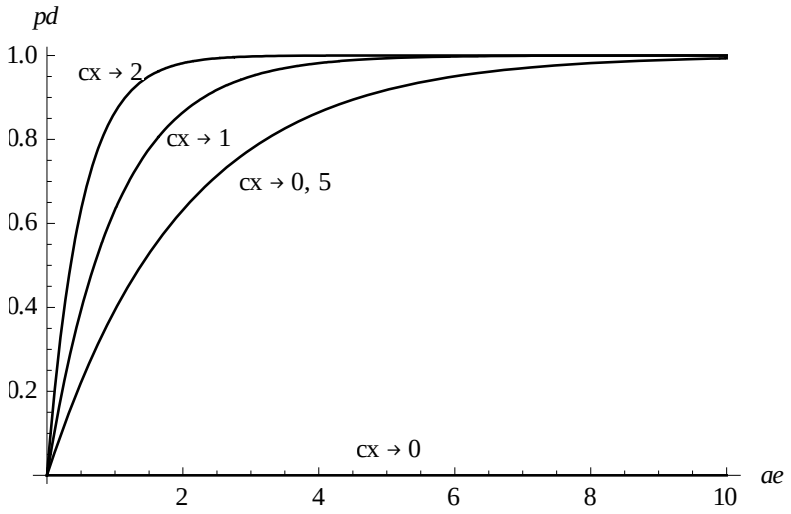
If the complexity of an audit is low, it is easy for the auditors to detect material misstatements and to report them. If the complexity of an audit is high, a significantly greater audit effort is required to detect misstatements. The complexity of the audit environment arises not only from the audit object itself, but also from the auditing standards and the judicature on liability cases. When successful auditors adhere to a few formalities to convince the judicature of a country that a liability case is not necessary because of less animosity towards lawsuits in the legal system, irrespective of the complexity of the audit environment, a low level of complexity can be assumed.

Numerous empirical studies have been performed to explain how the complexity affects the audit effort. Complexity is most often measured by the amount of subsidiaries (see *Simunic* 1980, *Francis* 1984). The auditor chooses an audit effort of ae by a given audit complexity of cx. To determine the probability of detecting a misstatement $\left(p_{det}\right)$, we use the model

$$p_{det} = 1 - e^{-cx \cdot ae}. \tag{1}$$

The relationship of the audit effort, the complexity of the audit environment and the probability of detecting a misstatement is illustrated in the figure below:

Figure I: The probability of detecting a misstatement as a function of the audit intensity and the audit complexity.



When the complexity of $cx = 0$, the audit environment is infinitely complex. Therefore, the probability of detecting a misstatement independent of the audit intensity is zero. Such a mandate cannot be audited because the probability of detecting a misstatement will not increase with an increased audit effort. With decreasing complexity (higher cx), it is easier for the auditor to detect material misstatements in the financial statements. Therefore, even a small amount of audit effort is sufficient to increase the probability of detecting a misstatement. In accord with (1), additional audit effort shows a diminishing marginal utility.

An increasing amount of audit effort increases the probability of detecting a material misstatement, resulting in a decreased probability that a misstatement will cause a liability payment (p_{lit}). Based on the audit effort, this amounts to

$$p_{lit} = r \cdot (1 - p_{det}) = r \cdot e^{-cx \cdot ae}. \quad (2)$$

The audit effort (ae) that is chosen by the auditor causes audit costs (ca) and is assumed to be positive. The costs are assumed to follow a linear cost function of fixed costs (cf) and variable costs (cv), as shown in the following equation:

$$ca = cf + cv \cdot ae. \quad (3)$$

In cases where there is no litigation, the auditor earns the audit fee (f) and bears the costs of the audit. In cases where there is litigation, a payment in the amount of *comp* is also payable by the auditor. We assume that this present value of compensation factors in the litigation payments and the other negative consequences of a liability case.

From the perspective of the auditor, the use of an optimal amount of audit effort can be viewed as insurance against a liability case. If the audit environment is complex, it is correspondingly more expensive to insure against the occurrence of a liability case. For lower complexity environments, however, a minor amount of audit effort helps to insure against a liability case.

2.2 Audit Quality

The concept of audit quality is not uniformly defined. The term quality is commonly based on the audit evidence and the audit result. *DeAngelo* (1981) takes the reporting of the auditor into account, whereas the definition of audit quality of *Niehus* (1994) and *Copley/Doucet* (1993) is based on the auditor's compliance to auditing standards. The original definition of audit quality is based on a fault detection and reporting component (*DeAngelo* 1981). According to

DeAngelo, the audit quality is defined as the probability that a misstatement in the accounts of the audited entity is discovered and reported by the auditor as assessed by the market. This definition considers the skills and abilities of the auditor as well as the auditor's independence. By empirical studies audit quality is often defined to make it measurable. Measures that describe earnings management or earnings-quality (like discretionary accruals) are often used as surrogates for audit quality. For example, *Francis* (2011) provides a comprehensive overview with respect to the different definitions and measurements of audit quality.

These definitions of audit quality result mainly from the question of how to measure audit quality, which is not the central point of our analytical analyses. For our purpose of analyzing the effects of different risk aversions on the audit effort, we use the definition of *DeAngelo*, which is the likelihood of a liability case p_{lit}. Accordingly, we define the audit quality as the reduced likelihood, due to the audit procedures, that a financial statement contains a material (decision relevant) misstatement (*DeAngelo* 1981 and *Carcello et al*. 2002). For the purpose of our analysis, we assume that the auditor reports a discovered misstatement. Because of the defined relationship between the audit effort and the probability of litigation in our model, it is assumed that a higher audit effort leads to a higher audit quality. According to (1), increasing the audit effort is characterized by a diminishing utility. Therefore, the costs accrued by a higher audit effort will increase disproportionately.

To discuss the differences in the behaviors of a risk-neutral and a risk-averse auditor, we define a relative audit quality raq. This normalizes the optimal probability of liability of a risk-averse auditor $\left(p^{*}_{lit,ra}\right)$ to that which will be accepted by a risk-neutral auditor who optimizes his audit effort $\left(p^{*}_{lit,rn}\right)$:

$$raq = \frac{p^{*}_{lit,ra}}{p^{*}_{lit,rn}}. \tag{4}$$

This relative audit quality shows the ratio of the probability of liability of a risk-averse auditor in comparison to a risk-neutral auditor. Thus, the probability of liability is a useable indicator for audit quality because the damage that is caused in cases of liability could have been avoided by an appropriate level of audit effort. Therefore, the damage can significantly exceed the liability compensation that the auditor faces (see *Bigus* 2007).

Against this background, we first discuss how risk-neutral auditors determine their optimal audit effort. Subsequently, we address the optimal audit effort that is chosen by a risk-averse auditor. To illustrate the formal presentation in the next sections, we make use of the following model parameters unless otherwise noted: $r = 0.2$, $cx = 1$, $cf = 1$; $cv = 0.5$; $comp = 50$; $f = 10$; $a = 0{,}2$.

3 Risk Aversion and the Optimal Audit Program

First, we focus on the behavior of a risk-neutral auditor with respect to the determination of the optimal audit effort and the respective audit quality. In addition, we look at the marginal fees in cases of risk neutrality. In section 3.2, the same is done for the risk-averse auditor.

3.1.1 Optimal Audit Intensity – Audit Quality

A risk-neutral auditor optimizes the audit program by maximizing the expected profit from the mandate. A necessary condition for accepting the mandate is that the optimized audit effort reveals an expected profit that is not negative. Otherwise, a risk-neutral auditor is not willing to accept the mandate. The expected profit is the expectation value of the liability-free condition and the condition in which a liability is caused:

$$E(\pi) = (1 - p_{lit}) \cdot (f - ca) + p_{lit} \cdot (f - ca - comp). \tag{5}$$

The two conditions only differ by the compensation payment, which has to be paid in cases of liability. The first derivative of the expected profit with respect to the audit effort is

$$\frac{\partial E(\pi)}{\partial ae} = -cv + comp \cdot cx \cdot e^{-cx \cdot ae} \cdot r \quad . \tag{6}$$

Setting this expression equal to zero and resolving for the audit effort leads to the following optimal solution from the perspective of a risk-neutral auditor:

$$\frac{\partial E(\pi)}{\partial ae} = 0 \Rightarrow ae^* \rightarrow -ln \cdot \left[\frac{cv}{comp \cdot cx \cdot r} \right] \cdot \frac{1}{cx} = 2,996 \quad .^{1} \tag{7}$$

The optimal audit program of a risk-neutral auditor is therefore determined by the variable cost of the audit, the payment in cases of liability and the audit risk, but not by the audit fee.

Substituting this optimal audit effort into the probability of detecting a misstatement (2) results in the optimal probability of a misstatement causing a liability payment:

$$p_{lit}^* = \frac{cv}{comp \cdot cx} = 0,01 \quad . \tag{8}$$

This relationship implies that the expected loss of a risk-neutral auditor in cases of optimal audit effort is equal to the relationship of variable costs and the complexity of the audit:

$$\Rightarrow E(loss) = p_{lit}^* \cdot comp = \frac{cv}{cx} = 0,5 \quad . \tag{9}$$

Thus, the expected loss is determined by the complexity and not by the level of compensation for litigation. For a risk-neutral auditor, the following optimal costs for the audit are attributable:

$$ca^* = cf + cv \cdot ae^* = 2,498 . \tag{10}$$

The maximized expected profit from the audit follows because of the assumptions made for a risk-neutral auditor with

[1] This function is only defined for $r > 0$. For $r = 0$, no optimal audit effort can be defined due to $cv \neq 0$. Without audit risk, no auditor would perform the audit evidence and would accept fixed costs.

$$E\left(\pi^{*}\right) = f - \left\{cf + cv \cdot ae^{*} + \frac{cv}{cx}\right\} = 7{,}002\,. \tag{11}$$

In cases where the audit risk is zero, the expected profit is the difference between the audit fee and the fixed costs. This limiting solution results from the non-negativity of the audit effort. Hence, a risk-neutral auditor investigates into audit effort in the presence of audit risk to reduce the risk of causing a liability payment.

3.1.2 The Marginal Audit Fee of Risk-Neutral Auditors

Thus far, we have optimized the audit effort assuming a (exogenously) given audit fee. The results illustrate that the optimal audit effort is not dependent on the audit fee. As part of the optimization process, risk-neutral auditors will chose the level of audit effort that results in an optimized expected profit. In addition to adjusting the audit effort, the auditor is also able to decide if he will participate in the market at all. If the expected profit is positive, a risk-neutral auditor would be willing to accept the mandate even for a lower audit fee than the previously assumed amount of ten. The minimum audit fee, for which a risk-neutral auditor is indifferent towards his market participation, is obtained when the expected profit is exactly zero.

When substituting the optimal audit effort into the equation of the expected profit, setting this equation to zero and solving for audit fees; after a few transformations the marginal fee from the perspective of a risk-neutral auditor can be written as follows:

$$f_{rn}^{min} = cf + ae^{*} \cdot cv + \frac{cv}{cx} = 2{,}998\,. \tag{12}$$

A risk-neutral auditor would accept the mandate with a significantly lower audit fee than the previously given amount of ten due to a lower audit effort. The minimum audit fee for the risk-neutral auditor is not only dependent on the fixed and variable costs and the complexity of the audit environment, but also on the risk of the audit object. Thus, even from the perspective of a risk-neutral auditor, the costs of insuring against the audit risk matter.

The spread, or the difference between the marginal fee and the optimized costs in this condition, is shown as the premium, which a risk-neutral auditor demands for the compensation of the expected loss.

$$f_{rn}^{min} - ca_{rn}^{*} = p_{lit,rn}^{*} \cdot comp = \frac{cv}{cx} = 0{,}5\,. \tag{13}$$

We use the results for a risk-neutral auditor as a reference point. Next, we determine the degree of an auditor's risk aversion on the audit quality. Below, we discuss the determination of the optimal audit effort of a risk-averse auditor. Subsequently, the implications for the audit quality can be derived depending on the auditors' degree of risk-aversion. As the results show, taking risk aversion into account has important implications for the question of how audit quality can be raised through institutional measures.

3.2 Risk-Averse Auditors

For a risk-averse auditor, we assume an exponential utility function in the form of

$$u = -e^{-a \cdot x}\,. \tag{14}$$

The assumption of an exponential utility function requires a constant absolute level of risk aversion (CARA). The risk aversion (α) is independent from the initial wealth, which is influenced by the result of a risky audit.

3.2.1 Optimal Audit Intensity – Audit Quality

Risk-averse auditors maximize the expected utility. This expected utility is calculated for the defined audit by

$$E(u) = (1 - p_{lit}) \cdot \left(-e^{-a \cdot (w + f - ca)}\right) + p_{lit} \cdot \left(-e^{-a \cdot (w + f - ca - comp)}\right). \tag{15}$$

The first derivative of the expected utility with respect to the audit effort (ae) is

$$\frac{\partial E(u)}{\partial ae} = e^{-ae \cdot cx + a \cdot (cf + ae \cdot cv - f - w)} \cdot \left[(cx - a \cdot cv) \cdot \left(e^{a \cdot comp} - 1\right) \cdot r - a \cdot cv \cdot e^{ae \cdot cx} \right]. \tag{16}$$

Maximizing (16) with respect to the audit effort results in the optimal audit effort of a risk-averse auditor:

$$\frac{\partial E(U)}{\partial ae} \overset{!}{=} 0 \Rightarrow ae_{ra}^{*} \rightarrow ln\left\{-\frac{r\left[\left(e^{a\cdot comp}-1\right)\cdot\left(a\cdot cv-cx\right)\right]}{a\cdot cv}\right\}\cdot\frac{1}{cx}=10,588 \quad . \tag{17}$$

It should be emphasized that the optimal audit effort of a risk-averse auditor, when compared with that of the risk-neutral auditor, depends on the individual's risk preference rate (α). Here, both the fee and the initial wealth (w) have no impact on the audit effort. Substituting the optimal audit effort from (17) into (1) and (2), the optimal probability of a misstatement causing a liability payment from the perspective of a risk-averse auditor follows:

$$p_{lit,ra}^{*} = -\frac{a\cdot cv}{(a\cdot cv-cx)\cdot(e^{a\cdot comp}-1)} = 5,045\cdot 10^{-6} \quad . \tag{18}$$

Therefore, the optimal audit costs of a risk-averse auditor are as follows:

$$ca_{ra}^{*} = cf + cv\cdot ae_{ra}^{*} = 6,294 \quad . \tag{19}$$

3.2.2 Risk Premiums in Cases of an Optimal Audit Program

After determining the optimal audit effort, we can achieve the expected utility by substituting the resulting audit costs into (15). Optimizing the audit effort and comparing the benefits of carrying out the audit with the initial situation, the certainty equivalent profit results from the inverse utility function[2] and can be written as:

$$cep_{ra}^{*} = -\frac{1}{a}ln\left\{\frac{cx\cdot \mathrm{e}^{a\cdot(cf-f)}\left[\frac{r}{p_{lit,ra}^{*}}\right]^{\frac{a\cdot cv}{cx}}}{cx-a\cdot cv}\right\} = 3,179 \quad . \tag{20}$$

[2] Due to the utility function $u=-e^{-a\cdot(x+w)}$ x results in $x=\frac{-ln(-u)}{a}-w$.

Even after optimizing the audit effort, a residual risk remains that the auditor has to bear. Risk-averse auditors require a risk premium (rp) for bearing risk in addition to the compensation for an expected loss (which is also required by risk-neutral auditors). This risk premium is the difference of the expected profit from the certainty equivalent profit in cases of optimized audit effort. The optimized expected profit can be written as follows:

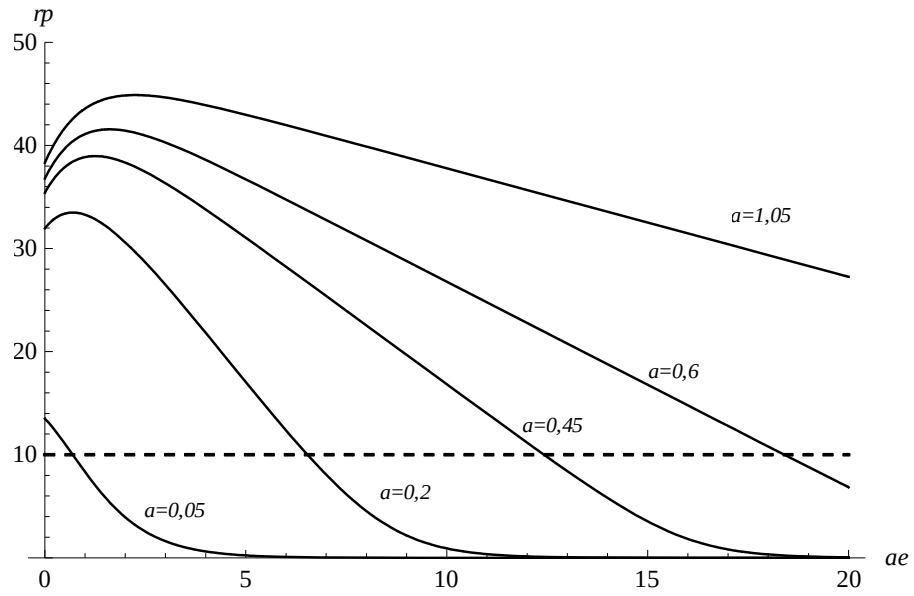
$$E\left(\pi_{ra}^{*}\right) = f - \underbrace{cf - \frac{cv}{cx} \cdot ln\left[\frac{r}{p_{lit,ra}^{*}}\right]}_{cost\ function} - \underbrace{p_{lit,ra}^{*} \cdot comp}_{expected\ damage} = 3,706 \tag{21}$$

Thus, the risk premium is determined as the difference between

$$rp^{*} = E\left(\pi_{ra}^{*}\right) - cep_{ra}^{*} = 0,527 \tag{22}$$

Figure II illustrates the risk premium as a function of the audit effort and the auditors' risk aversion.

Figure II: Risk premiums as a function of the audit effort.



The risk premium of a risk-neutral auditor is not dependent on the audit effort and is zero by definition. As shown in the figure, at a low level of audit effort, the required risk premium increases relatively quickly with increasing risk aversion. The auditor can reduce the risk premium by investing more in the audit effort. For less risk-averse auditors, however, a low

level of audit effort is able to reduce the risk of liability significantly, resulting in a small risk premium.

Furthermore, it can be easily derived from Figure II that risk premiums react relatively strongly with increasing risk aversion. For example, in cases where the risk aversion is equal to one, a very high audit effort is not sufficient to reduce the required risk premium below the necessary audit fee of ten. Even if this reduction were possible, such an auditor would not accept this mandate because this condition implies a very high level of audit effort, which results in higher variable costs.

3.2.3 The Marginal Audit Fee of Risk-Averse Auditors

Even after optimizing the audit effort, the auditor has to bear risk. This bearing of risk implies that for a risk-averse auditor, in addition to the expected loss, a risk premium must be compensated. An audit fee that is below the costs that are caused by the optimized audit effort, the expected loss and the required risk premium, results in a negative certainty equivalent profit, which would lead a risk-averse auditor to refuse such a mandate. Comparable to the case of a risk-neutral auditor, an (marginal) audit fee can be determined that makes a risk-averse auditor indifferent to adopting the mandate.

Whereas in the case of the risk-neutral auditor, the first derivative of the expected profit was set to zero and solved for the audit fee, in the case of the risk-averse auditor, the certainty equivalent profit is maximized. These results are shown above in another optimized audit effort of the risk-averse auditor compared with the risk-neutral auditor. Provided that the certainty equivalent profit is not negative, the risk-averse auditor will accept the mandate. To determine the marginal fee from the perspective of a risk-averse auditor, we therefore set the certainty equivalent profit, as optimized with respect to the audit effort, to zero and solve this equation for the fee. This results in:

$$f_{ra}^{min} = \underbrace{cf + \frac{cv \cdot ln\left[\frac{r}{p_{lit,ra}^{*}}\right]}{cx}}_{optimized\ costs} + \underbrace{\frac{ln\left[-\frac{cx}{a \cdot cv - cx}\right]}{a}}_{min.\ risk\ spread} = 6.821 \tag{23}$$

After a few transformations, it is obvious that the marginal fee essentially consists of two components: The optimized costs and the minimum spread for risk taking. The costs are represented by the first two terms. The third term in the formula above represents the minimum spread between the optimal costs and the fees that the risk-averse auditor requires for auditing the mandate:

$$f_{ra}^{min} - ca_{ra}^{*} = rp_{ra}^{*} + p_{lit,ra}^{*} \cdot comp = 0{,}527 \,. \tag{24}$$

The combination of the spread, the relation of compensation for the expected loss and the risk premium for bearing the risk depends significantly on the risk aversion of the auditor and the complexity of the audit environment. The variable costs represent the price for insuring against the risk of liability and are therefore also considered in the minimum risk premium.

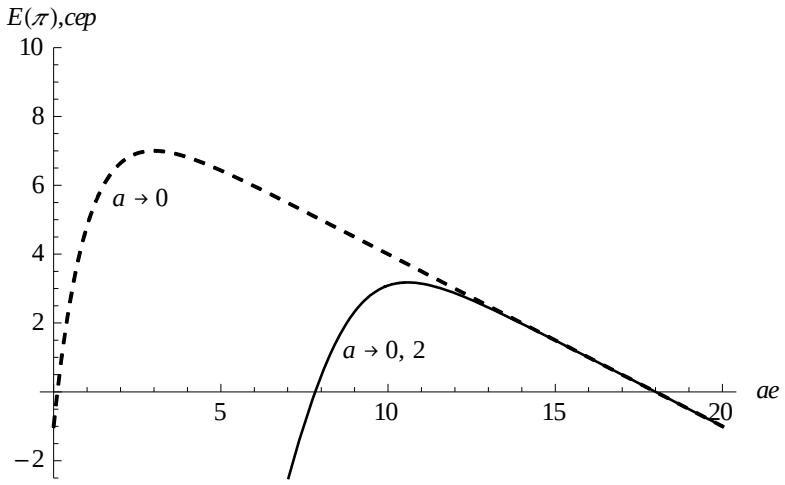
A significant difference between risk-neutral and risk-averse auditors is that the spread is split differently. While the absolute spread of the risk-neutral auditor is only determined by the expected loss, the minimum spread of a risk-averse auditor is manly dominated by the risk premium. Economically, this means that a similar premium (resulting from the assumptions of our numerical sample) indicates a much lower probability of misstatement from the risk-averse auditor when compared with that of the risk-neutral auditor. With the risk-averse auditor, the product of the optimized damage probability and the payment in cases of liability is negligible.

4 Sensitivity Analyses

4.1 Audit Intensity and Risk Aversion

As part of the results, we analyze the main differences between risk-neutral and risk-averse auditors. Of particular interest are the differences in the reactions of the auditors to environmental changes depending on their level of risk aversion. In summary, the following Figure III illustrates the expected profit respective of the certainty equivalent profit as a function of the audit effort.

Figure III: Optimal audit effort and risk aversion.



As with the optimum audit effort, both the expected profit and the certainty equivalent profit are positive and both risk-neutral and risk-averse auditors take part in the market. We assume that both auditors audit two basically identical audits, which are characterized by the same risk and the same audit fee of 10 units. According to our analysis, we know that the risk-neutral auditor will invest much less in his/her mandate than will the risk-averse auditor. However, as both auditors are assumed to provide an unqualified audit opinion, the user is not able to distinguish whether the financial statements were audited by a risk-averse auditor, which would result in a much lower probability of misstatement. Based on these considerations of the different behaviors of the different auditors, we will now discuss the influence of changing liability on the audit quality.

Optimizing the audit effort results in differently optimized liability probabilities depending on the risk aversion of the auditor. The probability of liability, from the perspective of an auditor, can also be interpreted as the probability of damage from the perspective of financial statement users. The lower this probability is, the higher the audit quality is. We are primarily interested in comparing risk-averse and risk-neutral auditors to reveal the effects of those differences on the audit quality. Accordingly, we make use of a relative audit quality as defined in (4), setting the probability of a risk-averse auditor in relation to the liability of a risk-neutral auditor:

$$raq = \frac{p^*_{lit,ra}}{p^*_{lit,rn}} = -\frac{a \cdot comp \cdot cx}{(a \cdot cv - cx) \cdot (e^{a \cdot comp} - 1)}. \tag{25}$$

This relationship is summarized in the equation above and shows that the measurement of audit quality depends on the relative risk aversion of the auditor, the compensation in case of liability, the complexity of the audit environment and the variable audit costs. Only risk aversion and the variable audit costs are auditor specific. The other parameters of the relative audit quality are not related to the auditor. The complexity depends on the audit object, and the compensation in case of liability is determined by the legislature.

Figure IV: The relative audit quality as a function of the risk aversion.

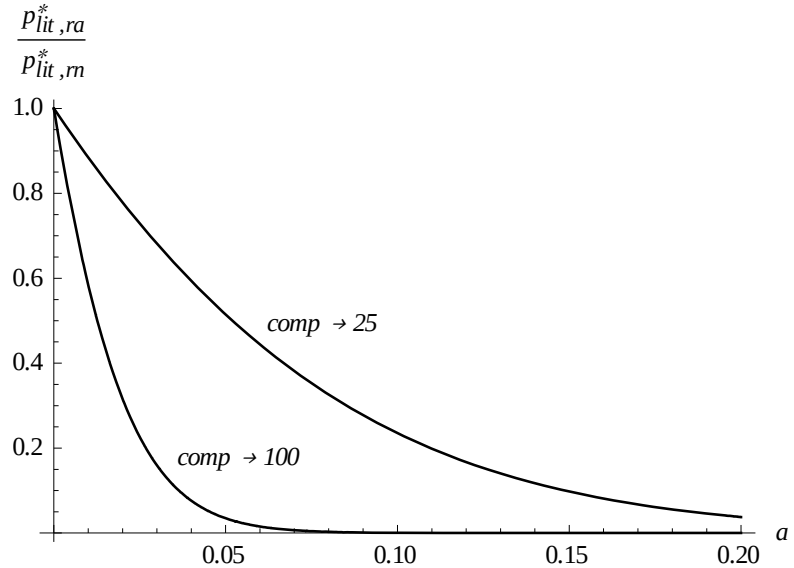


Figure IV shows the extent to which the probability of liability of a risk-averse auditor is lower when with the probability of liability of a risk-neutral auditor. The figure presents two scenarios that differ by the amount of liability.

Assuming a situation involving a high level of compensation indicated by the amount 100 (represented by the lower line in the graph), reveals that a low risk aversion significantly reduces the likelihood of liability. Moreover, at a risk aversion of just over 0.05, no significant reduction of the litigation probability is gained due to an increase in risk aversion. Thus, this high level of compensation leads risk-averse auditors to invest a great deal of audit effort relatively quickly to reduce the probability of liability. The upper line in the figure above represents a situation with a lower compensation (indicated by a compensation of 25) in cases involving litigation. Here, the graph clearly shows that this smaller compensation makes risk-averse auditors up to a high level of risk aversion respond to reduce the probability of liability. These results regarding the different behaviors of risk-averse auditors indicate that the success of increasing the liability with respect to an improvement in audit quality mainly depends on the liability payments of the base setting and on the risk aversion of the auditors in the market that is under consideration.

Moreover Figure IV illustrates that risk-neutral and risk-averse auditors behave completely differently. Risk-neutral auditors are willing to accept a much higher liability risk. This finding implies that insurance premiums should be designed dependent on risk aversion. Otherwise, with uniform insurance contracts where the premiums are based on the average damage, the risk-averse auditors would subsidize the risk-neutral auditors.

In this context, the oversight bodies should not only focus on monitoring the formal requirements but also contribute to the assertion of differences in the audit quality. The assertion of a different risk aversion between different auditors, and thus a different quality of the audit, could make the job of the quality assurance oversight bodies more valuable to the investors.

In the next section, we investigate the reaction of risk-averse auditors to changes in the total liability with respect to the optimized audit effort. The previous results indicate that an increase in liability leads the auditors to invest more in their audit effort, which may result in significantly higher audit costs but contributes only marginally to an increase in the audit quality. Therefore, the quickly rising marginal audit fee of a risk-averse auditor is often justified as a reaction to the increased risk that is induced by an increased liability. Hence, an increase in the amount of liability can cause risk-averse auditors, who significantly contribute to the audit quality, to leave the market.

4.2 The Impact of Liability Limits on the Audit Quality

Beyond the development and issuance of standards, the compensation payment in case of liability is mainly the responsibility of the legislator. The results so far show that the relative audit quality depends mainly on the risk aversion of the auditor. The following derivation of the relative audit quality with respect to the compensation in case of liability shows that the influence of a change in the liability is also largely determined by the risk aversion:

$$\frac{\partial p^{*}_{lit,ra}}{\partial comp} = \frac{a^2 \cdot cv \cdot Csch\left[\frac{a \cdot comp}{2}\right]^2}{4(a \cdot cv - cx)} \; mit \; Csch[z] = \frac{2}{e^{z} - e^{-z}} . \tag{26}$$

Converging the factor for the risk aversion to zero reveals how a risk-neutral auditor would respond to a change to the sum of the compensation.

$$Lim\left(\frac{\partial p^{*}_{lit,ra}}{\partial comp}, a \to 0\right) = -\frac{cv}{comp^2 \cdot cx} . \tag{27}$$

According to (27), even for a risk-neutral auditor, the influence of a change to the liability compensation on the optimized probability of misstatement depends on the initial base of compensation. Thus, assuming a high initial value, for a risk-neutral auditor, an additional increase in liability would only lead to a slight reduction in the probability of liability.

In contrast the situation of a risk-averse auditor is completely different because a change to the litigation probability and a change in the compensation converge relatively quickly to zero when compared with a risk-neutral auditor. Thus, a further increase to the amount of compensation that is considered to be reasonable at the moment would not result in an increase in the audit quality. Risk-neutral auditors would only respond slightly to increased liability amounts because they weigh the increase in risk as relatively unimportant. Risk-averse auditors would respond to an increased compensation by a significant expansion of their audit effort. However, as their audit effort is already very high at the current level of litigation, this expansion of audit effort only leads to a marginal reduction in the probability of liability due to a diminishing marginal utility of the audit effort.

In the next section, we show that compensation must not only contribute to an (small) increase in audit quality but may result in a lower level of audit quality.

4.3 Liability Limitation and the Marginal Audit Fee

In the previous section, we showed that an increase in the compensation can positively affect the audit quality. The price for this improvement in quality is an increase in the audit effort. This increased audit effort necessitates an increase to the fee. Auditors, who already participate in the market, are faced with a reduction to their expected profit or the certainty of expected profit when the compensation is increased. If the increase to the marginal fee that is induced by a higher compensation is so high that the marginal fee of the respective auditor is below the fee that could be achieved at the market, the respective auditor with the highest risk-aversion will leave the market. Thus, the audit quality on the market (as the sum of the weighted liabilities of litigation) is then determined by the remaining auditors. If they provide a lower quality, the overall audit quality will decrease despite the increased liability.

The first derivation of the marginal fee with respect to the compensation is shown in the next equation:

$$\frac{\partial f^{*}_{min,ra}}{\partial comp} = \frac{a \cdot cv \cdot e^{a \cdot comp}}{cx \cdot (e^{a \cdot comp} - 1)}. \tag{28}$$

In addition to the compensation amount, the change in the marginal fee depends on the variable costs, the complexity of the audit environment and most significantly on the risk aversion of the auditor. The marginal fee of a risk-neutral auditor responds quite differently to a change in the total liability. The marginal fee of a risk-neutral auditor is presented in the subsequent equation. It is calculated as the limit $(a \to 0)$ of the partial derivative of the marginal fee of a risk-averse auditor with respect to *comp*:

$$Lim\left(\frac{\partial f^{*}_{min,ra}}{\partial comp}, a \to 0\right) = \frac{cv}{comp \cdot cx}. \tag{29}$$

Comparing the change to the marginal fee of a risk-neutral auditor with the change to the probability of liability, it is striking that the probability of liability decreases according to a square relationship that depends on the compensation, while the marginal fee increases. Hence, the increase in the audit quality in the form of a declining probability of liability is bought by a disproportionate increase of the marginal fee. Moreover, the analysis shows that with an increasing amount of liability, the increase to the marginal fee decreases. According to the result of the marginal value transition when the liability compensation approaches infinity, the marginal fee then increases proportionally.

4.4 Risk Aversion and Market Participation

The results of the analyses show that auditors choose their optimal audit effort depending on their risk aversion. As long as the certainty equivalent profit is not negative (or the expected profit in case of risk-neutrality), auditors react to changes in the audit environment by adjusting their audit effort. This reduces the certainty equivalent profit and/or the expected profit. If the changes to the audit environment result in an optimal audit effort that equates to a negative certainty equivalent profit (or expected profit), the auditor will leave the market. Thus,

the influence of different marginal fees for different risk-averse auditors is relevant to the audit quality at the market because the auditors with the highest risk aversion, and therefore the highest audit effort and quality, are the ones that leave the market. The functional relationship between the marginal fee and the liability compensation depending on the different levels of risk aversion are shown in Figure V.

Figure V: The marginal audit fee as a function of the liability payment.

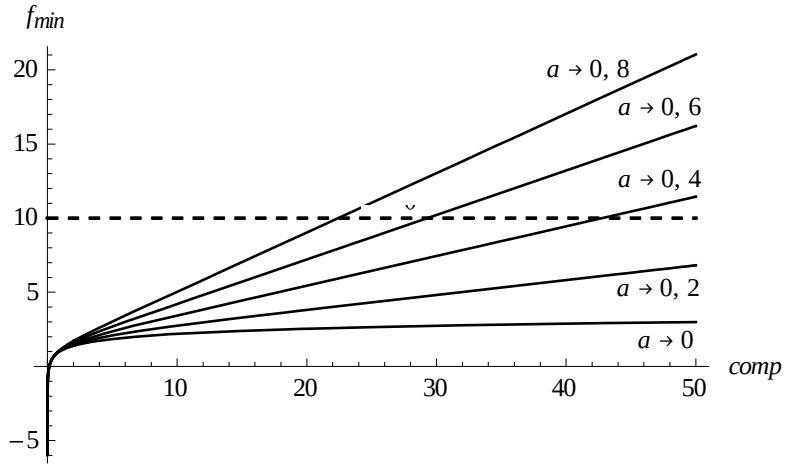


Figure V shows the marginal fee as a function of the total compensation for five auditors who differ only in their level of risk-aversion. Shown above are five iterations of risk-averse auditors between 0 (a risk-neutral auditor) and 0.8, with a step size of 0.2. It is striking that regardless of the risk aversion, an increasing compensation results in a largely linear increase to the marginal fee. Taking the marginal partial derivative of the marginal fee with respect to the compensation as the compensation approaches infinity results in:

$$Lim\left(\frac{\partial f^{*}_{min,ra}}{\partial comp}, comp \to \infty\right) = a \cdot \frac{cv}{cx}. \tag{30}$$

The increase in the marginal fee is dependent on the risk aversion and the relationship of variable costs to the complexity of the audit environment.

Overall Figure V shows a market situation, in which five different risk-averse auditors participate in the audit market. It is assumed that these five auditors audit five identical mandates.

Hence, the average audit quality for the market is expressed as the sum of the weighted individual probabilities of liability. A total liability of zero would result in a negative marginal fee. In this situation, all of the auditors, regardless of their risk aversion, would not invest in the audit effort due to the absence of risk.

Next, we assume that a fee of 10 is offered for the respective audits, which is increased by the legislative aims to increase the compensation. Until reaching a compensation of approximately 22, all auditors will participate in the market. The increase to the compensation between 10 and 22 is linked to an increase in the audit quality, as the auditors invest in their audit effort to reduce the probability of liability at the expense of a diminishing certainty equivalent profit or expected profit. Hence, until the respective profit is positive, the auditors will stay in the market. If the compensation marginally increases above the amount of 22, the marginal fee of the auditor with the highest risk aversion is higher than the audit fee. Accordingly, his certainty equivalent profit becomes negative and he will leave the market, meaning his client must be audited by one of the remaining four auditors. As such, the employees of the resigned auditor would alternate to the less risk-averse auditor. Hence, this audit firm will have the capacity to perform the audit. From the perspective of the audit quality, this marginal increase in compensation results in a decrease of the audit quality in the market. This decrease of quality is because the auditor with the highest risk aversion resigns and the client is therefore audited by an auditor with a lower risk aversion and thus a higher probability of liability.

If a legislator knows the market situation exactly, he could further increase the compensation to 30, at which point the next risk-averse auditor would exit the market. Here, the question for further research arises whether the audit quality at the market level (as expressed by the sum of the weighted probabilities of the liability) can be increased by a further increase in compensation above the level that was reached by the five initial auditors. However, these procedures would require that the standard setter has perfect knowledge of the market situation and of the individual risk aversions of the market participants.

In addition, the question arises whether it is appropriate to look at the average audit quality. The average audit quality may not be applicable to a typical financial statement user because such an approach would only make sense if the corresponding user held a portfolio that contained equal parts of companies, as audited by the auditor. If a user only holds a single company, he is only interested in the quality of this individual audit and the probability that the financial statements might be misstated. Nevertheless, the standard setters seem to mostly focus on the average audit quality. For example, the implementation of high qualitative auditing standards (e.g., the International Standards on Auditing - ISAs) should contribute to a minimum common level of audit quality ("an audit is an audit").

Overall, the results of our analysis show that the response of the auditor to a possible change in the environment largely depends on their risk aversion. Thus, a rapid change in the framework or the audit environment without considering the differences in risk-aversion can lead to counterproductive results.

4.5 Implications

The results of the analysis presented above clearly show that there are differences between the behaviors of risk-neutral and risk-averse auditors. Based on the results, the following implications arise:

Implication 1: Risk Disposition and the Optimal Audit Program

The optimal audit program is highly influenced by the auditors' risk disposition, meaning that a higher risk aversion is associated with an improved audit quality due to an increased audit effort. The increased audit effort of the risk-averse auditor leads to a reduction in the probability of liability (or the probability damage from an investor's point of view) when compared with a risk-neutral auditor. The higher audit effort incurs higher audit costs and results in a higher marginal audit fee.

Although risk-neutral auditors only require compensation for the expected damage, risk-averse auditors require a premium for bearing risk in addition to the compensation for the expected damage. The composition of the spread, defined as the sum of the risk premium and the compensation for the expected damage, depends on the risk aversion. Even a small amount of risk aversion leads to a reduction of the spread, which is mainly caused by a reduction in the expected loss due to an increased audit effort. From the addressee's point of view, it is preferable to favor a risk-averse auditor rather than a risk-neutral auditor because the risk-averse auditor provides a higher quality audit.

Implication 2: Risk Disposition and the Marginal Audit Fee

Risk-neutral auditors demand a higher marginal audit fee for participating in the market.

However, this does not mean that an increase in audit fees (for example as a result of regulatory changes) results in an increase in the audit effort and therefore in the audit quality at the market level. The absolute amount of the audit fee has only an indirect impact on the audit quality, as the audit fee influences which auditor participates in the market. The decision of an auditor to join a market for a given audit fee depends on his/her willingness to take risks. In other words, the fee determines which level of risk-averse auditor will be active in the market.

A higher audit fee would potentially result in more risk-averse auditors joining the market, but this does not necessarily equate to a higher audit quality. Auditors with a lower risk aversion (risk-neutral auditors) would increase their profits without raising their audit efforts to improve their audit quality. Conversely, a lower audit fee pushes auditors with a higher risk aversion out of the market. Thus, to ensure high quality audits, it is critical that auditors with a higher risk aversion remain in the market, which requires the differentiation between auditors with different risk attitudes.

Implication 3: Liability Changes

In the presence of risk, risk-averse auditors increase their audit efforts significantly more than do risk-neutral auditors. The effects of changes to liability limits strongly depend on the initial situation. Assuming an existing high level of liability, even a low level of risk-aversion results in a significant reduction to the likelihood of liability. A high level of liability will make risk-averse auditors relatively eager to increase their audit effort to reduce the probability of liability. With a lower level of liability in the initial situation, risk-averse auditors up to a higher level of risk aversion respond significantly differently when compared with risk-neutral auditors. Thus, the extent of the improvement in the quality resulting from an increase in the level of liability depends on the initial level of liability and on the auditors risk aversion. The increase in liability is related to an increase to the marginal audit fee, which increases especially with higher risk aversion. However, if this fee cannot be achieved in the market, this leads to a market withdrawal or a lack of participation by the auditor with the highest risk aversion.

In the first instance, a risk-averse auditor leaves the market, causing the audit quality to decline because the mandates that are left by the risk-averse auditor are taken up by the less risk-averse auditors. The intended effect of an increase in the level of liability to improve the audit quality acts in the contrary. With an exact knowledge of the market situation (especially the number and the individual risk aversions of the market participants), the quality could potentially be increased by increasing the liability. Furthermore, it can be implied that insurance premiums should be designed as a function of risk aversion. Otherwise, with uniform insurance premiums, the risk-averse auditors will subsidize the risk-neutral auditors.

Moreover, with respect to improving the audit quality as a result of an increase in audit effort in combination with an increased liability, it should be considered that risk-neutral auditors would only respond slightly to an increased liability, whereas risk-averse auditors respond more significantly; however, even this response is limited by a diminishing marginal utility of audit effort. This might result in a marginal reduction of the probability of liability while significantly increasing the related minimum fee.

Implication 4: Users' points of View and the Probability of Damage

From the addressee's point of view, risk-averse auditors are preferable because those auditors reduce the probability of damage. Thus, for the individual audit engagement, it is important that the auditor with the greatest risk aversion receives the assignment. In this context, various measures can ensure a high audit effort: in particular, in the selection process of the auditor on the basis of the offer and by supervising the auditor's work. Thus, the client is able to assess the risk aversion of the auditor. The supervisory board and, in particular, the audit committee, is predestined for this task.

Although the risk disposition of the auditor cannot be measured directly, it can easily be determined from his/her quotation. An auditor with a higher risk aversion will offer a higher audit effort and a more complex audit program. A possible criterion for the differentiation of the level of risk aversion in terms of the offered audit effort includes the number of planned hours for the audit, although the number of hours should not be the decisive criterion. What matters is the use and duration of (highly) qualified (specialized) staff. For example, the use of IT-auditors and the number and duration of assignment for the auditors and qualified personnel on a mandate can provide an insight into the auditors' risk-aversion. Such criteria are usually visible in all stages of an audit and are more or less easy to check for. In particular, the audit committee is able to supervise the audit with regard to the proposed audit effort.

Another possibility for communicating the audit quality to third parties (e.g., shareholders) is to provide additional information of the auditor's opinion (opinion) or in the audited financial statements (annual report). In one of these reports, information about the audit effort and the already required compensation (fee) data could be provided to the users. Thus, information in the annual report about the number of audit hours or the composition of the audit team would make sense. According to Japanese reporting requirements, information regarding the audit team must be provided in the annual report (see *Fukukawa* 2011). As the inherent risk of the audited entity materially affects the amount of the audit fees (see *Hay et al.* 2006), a quantita-

tive or qualitative assessment of the client risk can act as an indicator of the audit effort and the audit quality, respectively, in the auditor's report or in the annual report.

The auditing directive of the European Commission requires firms auditing public interest companies to publish an annual transparency report. The aim of this publication is to strengthen the confidence in the services that are provided by these audit firms, to preserve their independence, to demonstrate the transparency of the audit firms and to clarify the implementation of quality assurance measures. This report contains information on the legal form, the governance structure, and, if appropriate, the audit firm network, education and training[8]. This information should contribute to a higher quality of the provided services. It is conceivable to increase the existing reporting requirements for select important clients to include relevant information such as the assessment of the client risk, the number of audit hours, and the industry specialization of the audit firm (see *Owhoso et al.* (2002) and *Thibodeau* (2003)).

5 Summary

The model-theoretical analysis of the impact of risk aversion on the optimal audit effort and the associated audit quality provides the following results:

Risk-averse auditors invest considerably more in their audits to minimize the risk of liability. Rising risk aversion results, ceteris paribus, in a significantly increased level of audit effort. Despite his/her optimal level of audit effort, the risk-averse auditor requires a risk premium for the remaining liability and for bearing risk. The optimized audit effort is not dependent on this fee. Thus, the fee is only relevant with regard to whether he/she participates in the market.

The relevant marginal fee that determines the market participation of the respective auditor is defined by a premium on the cost at an optimized level of audit effort. For risk-neutral auditors, the premium is based only on the compensation for the expected damage. Risk-averse auditors require a risk premium in addition to the compensation for an expected loss. Because of their risk aversion, the optimal level of their audit effort is much higher, which implies a

lower probability of damage. Therefore, the premium of a risk-averse auditor, even at a similar absolute level as that of a risk-neutral auditor, is mainly determined by the risk premium and not by the compensation for the expected damage. As the risk premium is dependent on the auditor and not on a financial statement addressee, the market participation of risk-averse auditors is principally desirable.

In light of these results, planned measures should not only investigate the positive relationship between the varying size and the audit quality but also whether proposed measures will lead to the market exits of risk-averse auditors. We show in our example that an increase in the level of the liability may result in the market exit of risk-averse auditors. Because risk-averse auditors always apply a higher level of audit effort than do risk-neutral auditors, the market exit of the auditors with the highest risk aversions reduces the overall audit quality in the market, as the auditors with a lower level of risk aversion are required to conduct the audits.

The audit fee plays an important role in retaining risk-averse auditors in the audit market. A generally higher audit fee may not be justified because this may lead to auditors only raising their profits without raising their level of effort. Therefore, the increase to the audit fee must be limited to the risk-averse auditors, which would require the measurement of the risk preference of a specific auditor. At the level of the legislature, such a proposal seems unable to be realized.

With regard to the potential increase of the fee, it also must be considered that auditors with a high level of risk aversion assess the level of their audit effort even when there is low compensation in cases of liability. If these auditors would be incited by a higher fee to stay in the market in cases of increasing liability, the overall audit quality will only increase slightly, despite the substantial additional costs. In this context, it is the responsibility of the legislature to find the desired balance and not to fall into activism.

The risk aversion of an auditor is measurable, not for the addressee of the financial statements, but by the client of an audit. For large companies, this will be the audit committee. In light of these results, corresponding initiatives by legislators that recommend that audit committees not exclude risk-averse auditors due to their higher fees are desirable. Furthermore, the legislators could address making the different levels of risk aversion of different auditors visible for the addressee of financial statements.

The results concerning the importance of the auditor's risk aversion on the level of his/her audit effort show that an addressee of the financial statements can assume that in an audit performed by a risk-averse auditor, much more was done to prevent an avoidable misstatement than by an audit performed by a risk neutral auditor. Therefore, initiatives that make the individual audit quality visible to the outside are preferable to a more easily communicable increase in liability through the legislature.

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Notes

[1] These primarily include the accounting scandals of Flowtex (2000), Enron and ComRoad (2001), Worldcom (2002), Ahold and Parmalat (2003) and Siemens (2006).

[2] These include the implementation of the mandatory auditor oversight, stronger requirements regarding auditors' independence, and the prohibition of performing audit and non-audit services in parallel for listed entities.

[3] Therefore, see KOM (2010) 561 from 13.10.2010, Green Paper: Audit Policies: Lessons from the Crisis.

[4] Based on an analysis of empirical studies, Francis (2004) found a rare occurrence of errors, a reduced audit fee, and a nearly acceptable level of audit quality at relatively low costs.

[5] For an overview, see *Ewert* (1999), *Wagenhofer/Ewert* (2007) S. 470-499, and *Bigus* (2007).

[6] For an overview, compare *Schwartz* 1998 and *Ewert* 1999.

[7] For a summary, see *Wagenhofer/Ewert* (2007) S. 499-514.

[8] Regarding the minimal requirements of the transparency report in Austria, see § 24 Abs. 1 Nr. 1-10 A-QSG or the European Commission's Directive EU L 157 from 09.06.2006, Directive 2006/43/EG - Article 41.