Taxes and Audit Quality

Prof. Dr. Erich Pummerer
erich.pummerer@uibk.ac.at
++43/512/507-7264

Dr. Marcel Steller
marcel.steller@uibk.ac.at
++43/512/507-7265

University of Innsbruck
Department of Accounting, Auditing and Taxation,
Universitätsstraße 15, 6020 Innsbruck, AUSTRIA

Abstract

The effects of taxes have been discussed in almost every decision context in the extant literature, but the relationship between taxes and auditing has amazingly merited little attention. We explore the relationship between audit effort, audit quality and taxes from the perspective of both auditors and the public using an analytical research model.

The analysis provides evidence that even symmetric taxes significantly influence audit effort and audit quality when auditors' risk aversion is considered. While taxes do not influence audit effort monotonically, audit quality generally increases with decreasing tax rates. Hence, taxes may interfere with legislators' efforts to improve audit quality.

Additionally, we show that high quality audits should be a matter of public concern because the public is damaged whenever a party unfairly remains untaxed. Therefore, a socially optimal amount of audit effort exists. We derive a mandate- and auditor-specific liability limitation to achieve a socially optimal level of audit effort.

Keywords: Taxes, Audit Quality, Risk-aversion, Auditing

JEL Classification: M42, M48

1 Introduction

The effects of taxation on decision-making have been discussed in many contexts, but amazingly, neither tax or audit research have focused on the effects of taxation on audit quality. Given that auditors are usually familiar with particular tax regimes and practices in complex legal environments, especially auditors may not be considered to neglect the effect of taxes on decision-making. In this study, we explore the relationship between audit effort, audit quality and taxes from the perspective of auditors and the public.

Recent audit research focuses on the role of auditing in investor protection and the importance of auditing in the context of raising funds for risky investment projects (e.g. Newman, Patterson, and Smith 2005, 290). Thus, studies consider the institutional environment of auditing in the context of liability regimes (Dye 1993, Schwartz 1997, Laux and Newman 2010, 262, Pratt and Stice 1994, Narayanan 1994, Patterson and Wright 2003, Liu and Wang 2006, Hillegeist 1999) and the influence of standards on audit output (Ewert 1999, Bigus 2011, 2012, Willekens and Simunic 2007). These analytical papers examine the institutional parameters of audits with the aim of assuring audit effort and therefore audit quality.

We are aware that audit quality is a multidimensional measure that can be defined in various ways (Francis 2011, 127). In the context of our analysis, we simplify the measure by defining audit quality as the probability that a financial statement is misstated (Narayanan 1994, 41, Schwartz 1997). Francis and Michas (2013, 523) provide evidence that audit quality in terms of modified reports is more likely to be associated with office characteristics than audit-firm characteristics. Thus, audit quality should be examined at the partner level rather than at the audit-firm level.

Because decision-makers' attitude towards risk is considered an important characteristic in different decision-making contexts (Ghosh and Crain 1995, 358), auditors' risk aversion may also play an important role in audit quality (Amir, Kallunki, and Nilsson 2013, 3). Farmer (1993, 91) promotes an approach of classifying auditors according to their attitudes towards risk.

Despite the relevance of risk aversion in the audit-related decision context, analytical audit research usually assumes risk-neutral auditors. Most audit research is empirical, although to generate predictions and interpretations, analytical theories are required (Kirschenheiter, Simons, and Suijs 2011, 261). Only a few analytical papers address auditors' attitude toward risk. Ewert, Feess, and Nell (2000, 372) consider auditors' risk aversion in the context of third party liability and insurance. Jullien, Salanié, and Salanié (2007) discuss the composition of optimal contracts from the principals' perspective when agents' risk aversion is either public or private. Their

general decision setting is close to the situation for auditing. Bigus (2012) focuses on the effects of auditors' risk ambiguity.

All of these analytical papers neglect taxes. Therefore, this study contributes to closing that research gap by discussing the research question based on an analytical research model.

Neglecting taxes in the context of audit quality may be useful when a tax regime is defined in such a way as to not alter a pre-tax decision (Bond and Devereux 2003, 1292), or decision makers may act as "happy taxpayers" by simply ignoring taxes in decision-making. However, tax systems are not neutral regarding decision-makers' risk aversion, and auditors are especially unlikely to neglect taxes in decision-making. Surprisingly, reviews of tax research do not reveal any hint of the relationship between financial auditing and taxes (Hanlon and Heitzman 2010); instead, studies focus on tax audits (Shackelford and Shevlin 2001, 338, Graham, Raedy, and Shackelford 2012).

Results of analytical tax research indicate that the effect of taxes on risk taking is ambiguous and depends on decision-makers' risk aversion (e.g. Domar and Musgrave 1944, 411, Schneider 1980, 74). Incentives for risk taking provided by limited liability persist in the case of symmetric taxes (Ewert and Niemann 2012, 97). Hence, audit effort may be affected by taxes as well.

An additional motivation for exploring the effects of taxes on audit quality is the recent scandals that forced governments to nationalize certain systemic entities. Given that the public may suffer damage resulting from poor audit quality, audit quality should be a matter of public concern in addition to its role in general investor protection. Because the public is concerned with the outcome of auditing processes, especially if the parties involved are taxed, the public may have a different definition of a socially optimal audit effort than the private parties involved (Schwartz 1997, 386). However, prior audit research primarily focuses on negotiations between auditors and audited entities during the audit process (e.g. Laux and Newman 2010).

This study proceeds as follows. In Section 2, we introduce the research model and discuss the influence of taxes on audit effort and audit quality. In Section 3, we focus on auditing from the public's perspective, thereby distinguishing between a national and an international setting. Section 4 concludes.

2 Do taxes affect audit quality?

Model

An auditor is offered an unconditional audit fee f to audit a financial report containing a material error with probability ρ (audit risk). The audit fee is independent of the quality of the auditors' report (Schwartz 1997,

387). A material error, if undetected or unreported, causes damage Δ. If an error occurs, we assume that the auditor is sued and found liable (Carcello and Palmrose 1994, 2). We basically implement a limited negligence liability. Thus, an auditor must compensate for investors' losses only when the auditor failed to exercise due diligence (Liu and Wang 2006, 1054). Due to the liability limitation, the auditor must compensate the entity with Λ in spite of the damage Δ. We consider all errors to be detectable. Hence, any remaining error occurs because the auditor failed to exercise due diligence. We do not distinguish between the risk that an error occurs and the risk of being sued and found liable (Ewert 1999, 891, Dye 1993). Additional problems arise if the audit effort level is unobservable, even ex post (Roger 2013, 55). Therefore, we assume the audit effort to be ex post observable at zero cost.

We presume that the auditors' initial wealth is sufficient to cover the investors' claims (Dye 1993, 861). We do not consider the effects of additional social losses, although these can be massive (Chaney and Philipich 2002, 1244).

By accepting an audit task, an auditor faces audit risk due to litigation risk, which causes disutility. To reduce the risk of being sued and found liable, the auditor can make use of costly audit technology. Then an auditor's task is to balance the disutility related to the audit by choosing a specific level of effort.

We implement audit technology by defining a relationship between the audit effort and the probability that the auditor detects and reports a material error. It is reasonable to assume a declining marginal input/output relationship of audit technology (Banker, Chang, and Cunningham 2003, 259, Hillegeist 1999, Schwartz 1997, 387). Hence, we define audit output ω as a function of the audit effort by

$$\omega = 1 - e^{-\varepsilon}. \tag{1}$$

In realistic audit scenarios, the audit effort will be non-negative, but for the subsequent analysis, we make the weaker assumption $\varepsilon \in \mathbb{R}$.

If the auditor applies an effort level ε, then according to the audit technology, the damage probability ρ is reduced to the litigation probability given by

$$p_{lit} = \rho(1-\omega) = e^{-\varepsilon}\rho. \tag{2}$$

The relationship between audit effort and the litigation probability comprises that with infinite audit effort, the litigation probability converges to zero. It is notable that according to this definition, even in the case of a negative audit effort, the litigation probability is positive, but with negative audit effort, the characteristics of the probability measure may be violated because p_{lit} may converge to positive infinity.

Variable audit costs c_v are constant. Taking additional fixed audit costs c_f into account, the relationship between audit effort and audit costs is defined by

$$c_a(\varepsilon) = c_f + \varepsilon c_v . \tag{3}$$

We are discussing the effects of taxes on audit effort and audit quality. Hence, we assume that auditors are subject to a proportional income tax. We simplify by assuming that audits are carried out by an overall profitable audit firm. This assumption implies symmetric taxation of profits and losses. The conditional payoffs related to the litigation and non-litigation case are the following:

$$\begin{aligned} s^{notlit} &= (1-\tau)\left(f - c_{(\varepsilon)}\right) \\ s^{lit} &= (1-\tau)\left(f - c_{(\varepsilon)} - \Lambda\right) \end{aligned} . \tag{4}$$

The pretax version of (4) is similar to the decision problem described by Jullien, Salanié, and Salanié (2007, 154). When regarding auditing as an ordinary investment opportunity, the audit costs can be interpreted as the price of a lottery with pretax outcome f in the non-litigation case and $f - \Lambda$ in the litigation case. Thus, taxes influence the price and outcome of the investment. Therefore, the common assumption in analytical tax research, specifically that prices are unaffected by taxes (e.g.Bond and Devereux 2003, 1292), is violated.

For reasonable parameters, the outcome in the non-litigation case can be considered positive, while the outcome in the litigation case will be negative. Proportional tax rates are usually considered: $\tau \in \{|0,1|\}$. Thus, taxes proportionally reduce both outcomes and therefore equivalently reduce risk.

Against this background, we must stress that for the successive analysis in comparison to $\tau \in \{|0,1|\}$, we make the weaker assumption $\tau \leq 1$. Therefore, tax rates may be negative. Hence, taxes may change the sign of the audit outcome.

We assume auditors have an exponential utility function in the form of

$$U(x) = -e^{-\alpha x} , \tag{5}$$

hence, $U(x)' > 0$ and $U(x)'' < 0$. Individual risk aversion is denoted by α.

The expected utility as a function of audit effort after simplifying and rearranging is the following:

$$E(U_\alpha) = e^{-\varepsilon}\left[\rho\left(e^{-\alpha s_{\text{nonlit}}} - e^{-\alpha s_{\text{lit}}}\right) - e^{\varepsilon - \alpha s_{\text{nonlit}}}\right] . \tag{6}$$

The first factor represents audit technology, while the second factor is determined by utility differences in the litigation and non-litigation scenarios. This expression makes it obvious that an auditor, by choosing an effort

level, varies the balance of the slope of the audit technology on the one hand and of the utility function on the other hand.

For the successive analysis we assume, if not stated otherwise, the following domains of specific, audit related variables:

$$\{\rho > 0, \Lambda > 0, \Delta > 0, \Delta \geq \Lambda, c_v > 0, \alpha \geq 0\}. \tag{7}$$

In the next section, we derive the optimal audit effort and discuss the influence of taxes on the optimal audit effort and audit quality based on the framework of our research model.

Optimal audit effort and taxes

Risk-averse auditors determine the optimal audit effort ε^* by maximizing the expected utility. Hence, equaling the derivative of the expected utility with respect to the audit effort and zero and then solving for the audit effort results in the optimal audit effort. To show the effects of taxes explicitly, we first present in (8) the optimal audit effort for $\tau \to 0$:

$$\lim_{\tau \to 0} \varepsilon^* \to \log\left[\frac{\rho\left(e^{\alpha\Lambda} - 1\right)}{\alpha c_v}\right] + \log\left(1 - \alpha c_v\right). \tag{8}$$

The pre-tax optimal audit effort depends on the audit risk ρ , the liability limitation Λ and auditor-specific characteristics such as the auditor's risk aversion and the marginal audit costs. The marginal costs indicate how easily an auditor can access audit technology and therefore represent the personal skills of the auditor.

In the pre-tax case, the arguments of the log represent the utility changes associated with the audit. Because the exponential utility function comprises CARA, the optimum does not depend on the auditor's initial wealth.

The numerator of the first log represents disutility caused by the litigation scenario, while the denominator represents the insurance costs of avoiding the litigation scenario. Hence, the argument in the log can be interpreted as disutility of the litigation risk per disutility of marginal costs. With increasing marginal costs, the audit risk is assessed as less negative in comparison with the costs associated with avoiding risk. Therefore, according to the first log, an auditor will apply less audit effort with higher marginal costs.

The argument of the second log represents the disutility of applying audit effort. Hence, with increasing marginal costs, the optimal audit effort decreases.

When taxes are taken into account, the outcomes s^{lit} and s^{nonlit} are both linearly influenced. However, taxes do not influence the probability for the specific scenarios. Because the audit costs appear unconditionally in the outcomes, the marginal costs are decreased by τ as well.

Symmetric taxes reduce the conditional loss in the litigation case. Given that Λ is conditional, major effects of taxes are expected when auditors base their risk assessment on the net outcomes.

The optimal after-tax audit effort based on the net outcomes is

$$\varepsilon_\tau^* \to \underbrace{-\alpha\Lambda\tau}_{(i)} + \underbrace{\log\left[\frac{\rho\left(e^{\alpha\Lambda} - e^{\alpha\Lambda\tau}\right)}{\alpha c_v}\right]}_{(ii)} + \underbrace{\log\left(\frac{1}{1-\tau} - \alpha c_v\right)}_{(iii)}. \tag{9}$$

In addition to the factors for the pretax optimum, the tax rate τ obviously influences the optimal audit effort. The explanation for the dependence of the optimal audit effort on taxes is straightforward. Risk-averse decision-makers maximize their expected utility. Therefore, for any non-linear utility function, a tax-induced proportionate change in the conditional outcomes causes a disproportionate change in utility, and a pretax optimum will not persist if symmetric taxes are taken into account.

As risk aversion converges to zero, the nonlinearity of the utility function disappears. Then the utility function represents a risk-neutral decision-maker. The limit of the optimal audit effort with $\alpha \to 0$ is

$$\lim_{\alpha\to\infty} \varepsilon_\tau^* = \log\left(\frac{\Lambda\rho}{c_v}\right), \tag{10}$$

which is tax-independent. Symmetric taxes reduce the payoff in the non-litigation scenario and increase the payoff in the litigation scenario by τ. Hence, the expected profit is decreased by τ as well. Given that the risk-neutral auditor maximizes the expected profit, no tax effects concerning the optimal audit effort level occur. If profits and losses are taxed differently, as implemented in most tax regimes, taxes will cause a different effort level in comparison to the pretax scenario, even for risk-neutral decision-makers.

Against this background, only a risk-averse auditor's optimal audit effort is a function of the tax rate in the case of symmetric taxation. Therefore, we proceed by focusing on risk-averse auditors.

By comparing the optimal after-tax and pretax audit effort in (9) and (8), the following tax-induced differences can be distinguished:

- The first term (*i*) indicates that taxes will mute audit effort due to a reduction of the liability limitation to a net value. Hence, taxes will decrease audit effort independent of the audit technology.
- Taxes limit the assessment of the audit output. This effect is represented by (*ii*). The risk per costs related to the audit (weighed with the individual risk aversion) decreases with increasing taxes. Therefore, in comparison to the pretax case, audit effort decreases over and above the effect caused by the first term.

- The third term in (9) indicates that the auditor in the after-tax case only needs to consider the net marginal costs. That is, with increasing tax rates, applying audit effort becomes cheaper. Therefore, according to the third term, the auditor will use audit technology more. Hence, according to the third term of (9), taxes may amplify audit effort.

The overall tax effect on the audit effort level depends on which of the effects outweighs the other.

Threshold risk aversion/tax rate

Any reasonable optimal audit effort must fulfill $\varepsilon \in \mathbb{R}$. However, this statement is only true if the arguments of the log in (*ii*) and (*iii*) are at least non-negative. Given the set of assumptions defined in (7), the argument of the log in (*ii*) is positive whenever $e^{\alpha\lambda\tau} < e^{\alpha\lambda}$. This result holds if $\tau < 1$. Hence, the tax rate can even be negative.

In the context of examining the tax influences on optimal audit effort, the argument of the log in term (*iii*) deserves more attention. From an economic perspective, (*iii*) represents the auditor's assessment of the tax influence on the two alternatives "constant audit effort" and "change audit effort". The optimal audit effort is only $\varepsilon \in \mathbb{R}$ if the argument of the log (*iii*) is at least zero:

$$arg(iii) = \frac{1 - \alpha c_v (1-\tau)}{1-\tau} \overset{!}{=} 0 \tag{11}$$

Obviously, there are several solutions for the argument to be zero. We focus on the solutions for the tax rate and the level of risk aversion.

A first solution for (11) is achieved by solving for the auditor's risk aversion

$$\alpha \to -\frac{1}{(\tau-1)c_v} = \alpha_{max}. \tag{12}$$

In general, auditors must decide if applying audit effort and simultaneously increasing marginal costs is advantageous. With $\alpha \to \alpha_{max}$, the optimal audit effort converges to negative infinity. Hence, for $\alpha > \alpha_{max}$, $\varepsilon \notin \mathbb{R}$. Then auditors would not provide any audit services because even the first unit of audit effort applied would decrease the auditor's utility irrespective of the return. As taxes reduce the marginal costs of auditing, taxation influences the willingness of auditors to participate in an audit market. The relationship in (12) can be rearranged to determine a threshold tax rate:

$$\tau_{min} = 1 - \frac{1}{\alpha c_v}. \tag{13}$$

The threshold tax rate in (13) represents a minimum tax influence for causing the first applied unit of audit effort to be utility increasing. This threshold tax rate can be positive or negative. The threshold tax rate in (13) indi-

cates the transitional point for an auditor with risk aversion α. When $\tau \to \tau_{min}$, the term (*iii*) of (9) simplifies to negative infinity, so this term dominates the optimal audit effort in this threshold case.

The result that risk-averse auditors may require a threshold tax rate to potentially participate in the audit market may be counterintuitive and therefore requires some explanation. In general, an auditor must decide about playing the audit lottery. The "pure" lottery is defined by the conditional outcomes f in the non-litigation case and $f - \Delta$ in the litigation case. The marginal costs associated with the audit effort can be seen as the price of the lottery. By applying audit effort, the auditor simultaneously changes the price and the characteristics of the lottery in terms of reducing the probability of a negative outcome. In the threshold case, a risk-averse auditor is willing to play the pure audit lottery if the auditor receives an infinitely high price. This infinitely high price results from applying infinitely negative audit effort, implying infinitely negative costs.

Due to the declining marginal output of audit technology, managing the "upper parts" of the liability limitation is disproportionately expensive. Taxes therefore reduce the most expensive parts of the liability limitation free of charge. Thus, an auditor considering taxes must exploit the audit technology at a lower level, where the audit technology is characterized by a higher input/output relationship. Furthermore, the costs of reaching a certain level of the audit technology function decrease in the case of taxes because the auditor only faces the net marginal costs related to the audit. Due to these effects, an auditor may be willing to participate in the audit market in the case of taxation, while in the untaxed case, the risk of being sued and found liable may be too high.

Do taxes monotonically influence audit effort?

The overall effect of taxes on the optimal audit effort depends on the net effect of the auditor's assessment of the risk reduction by taxes on the one hand and the marginal cost reduction on the other hand. To discuss the relationship between the optimal audit effort and the tax rate, we focus on the derivative of the optimal audit effort with respect to the tax rate:

$$\frac{\partial \epsilon^*}{\partial \tau} = \underbrace{\frac{\alpha \Lambda e^{\alpha \Lambda}}{e^{\alpha \Lambda \tau} - e^{\alpha \Lambda}}}_{(I)} - \underbrace{\frac{1}{(\tau - 1)\left[\alpha(\tau - 1)c_v + 1\right]}}_{(II)}. \tag{14}$$

In contrast to the optimal after-tax audit effort shown in (9), the tax effects in (14) are condensed to two terms. Term (*I*) of (14) represents the sensitivity of the risk-averse auditors' optimal audit effort in response to the assessment of the lower after-tax risk.

The second term (*II*) indicates the sensitivity of the optimal audit effort in response to the tax influence on marginal costs. We discuss the characteristics of (14) by first focusing on the two boundaries $\tau \to 1$ and $\tau \to \tau_{min}$.

If α and liability limitation Λ are positive, then for all $\tau < 1$, the first term is negative. For $\tau \to 1$, the after-tax risk converges to zero. Given the assumptions in (7), (*I*) converges to negative infinity, while (*II*) converges to positive infinity because the marginal audit costs converge to zero. Hence, for $\tau \to 1$ the derivative of the optimal audit effort with respect to the tax rate is zero because there is no after-tax audit risk and insuring against risk would be free of charge. Hence,

$$\lim_{\tau \to 1} \frac{\partial \epsilon^*}{\partial \tau} = 0 \,. \tag{15}$$

It can be shown that for $\alpha\Lambda > 0$, (*I*) converges faster to positive infinity than (*II*) converges to negative infinity. For further analysis, it should be noted that the derivative converges from negative values to zero. Therefore, at least close to $\tau \to 1$, an increase in the tax rate will decrease a risk-averse auditor's optimal audit effort.

Focusing on the other boundary $\tau \to \tau_{min}$, (*I*) simplifies to

$$\alpha\Lambda \left(\frac{1}{1 - e^{\frac{\Lambda}{c_v}}} - 1 \right) . \tag{16}$$

The first term of the derivative characterizes the effect of facing the net risk instead of the pre-tax risk. For the threshold case $\tau \to \tau_{min}$, only the relationship between liability limitation and marginal audit costs is essential. Hence, even in this threshold case, the limit of (*I*) with $\tau \to \tau_{min}$ is bounded.

The second part of the derivative (*II*) with $\tau \to \tau_{min}$ converges to positive infinity. Therefore, the derivative of the optimal audit effort with respect to the tax rate at the minimum tax rate is infinitely positive.

$$\lim_{\tau \to \tau_{min}} \frac{\partial \epsilon^*}{\partial \tau} = \infty \,. \tag{17}$$

The economic explanation for the positively infinite derivative is that a specific auditor whose threshold tax rate is higher than the actual tax rate will not offer audit services at all. In the transition case $\tau \to \tau_{min}$, the auditor requires an infinitely negative price to participate in the audit lottery. For this auditor, the risk of the lottery is therefore at maximum. When the tax rate marginally exceeds the threshold tax rate, applying audit effort becomes favorable from the risk-averse auditor's perspective. The transition from negative infinity to another optimal audit effort level requires the derivative to be positively infinite.

We are discussing the relationship between audit effort, audit quality and taxes. Our first expectation was that taxes influence the optimal audit effort monotonically. However, as stated by Jullien, Salanié, and Salanié (2007, 155), intuition is a poor guide for these models.

For risk-averse auditors, limiting the range of the optimal audit effort to $\mathbb{R}$ means limiting tax rates to the domain $\tau \in \left\{\left|t_{min}, 1\right|\right\}$. The derivative of the optimal audit effort with respect to the tax rate for the lower boundary $\left|t_{min}\right.$ is infinite, while for the upper boundary $1\left|\right.$, the derivative is zero. The derivative of the optimal audit effort with respect to the tax rate for $\tau \to 1$ converges to zero from negative values. Hence, the optimal audit effort as a function of the tax rate must have at least one maximum in the interval $\tau \in \left\{\left|t_{min}, 1\right|\right\}$, implying that there is at least one tax rate that maximizes the audit effort. Therefore, taxes do not influence audit effort monotonically, and increasing taxes in some constellations will increase audit effort, while in other constellations, the optimal audit effort will decrease with increasing tax rates.

For further analysis, it would be convenient to determine the tax rate that maximizes an auditor's optimal audit effort by equaling the derivative to zero and solving for the tax rate. Because the tax rate in (14) appears both inside and outside the exponent of the exponential function, equaling (14) to zero results in a transcendental equation with respect to τ. Therefore, there is no algebraic solution for the tax rate τ that maximizes the audit effort ε.

Because the optimum is algebraically undeterminable, we provide at least an indication that taxes influence the optimal audit effort positively only in a very small interval, while over a large part of the interval $\tau \in \left\{\left|t_{min}, 1\right|\right\}$, increasing taxes negatively influences the audit effort and therefore the audit quality.

Part (*II*) of the derivative is positively infinite for both boundary cases. In the lower boundary, taxes cause a transition from a general rejection of the audit task to the optimization problem of how much audit effort an auditor should invest. The optimal audit effort is negative infinity at exactly the threshold tax rate. By definition, for any higher tax rate in the interval $\tau \in \left\{\left|t_{min}, 1\right|\right\}$, the optimal audit effort exceeds this entry level. Term (*II*) for $\tau \to \tau_{min} + \Delta t$ is

$$\frac{1}{\Delta\tau - \alpha\Delta\tau^2 c_v}. \tag{18}$$

Even for a small Δt, the second part of the derivative decreases very quickly. Hence, the advantage of the lower net marginal costs in comparison with the "constant audit effort" alternative decreases quickly as well. This effect can be explained by the fact that for a negative audit effort, the derivative of audit technology ω with respect to the audit effort exceeds the derivative of the audit technology at $\varepsilon \to 0$. According to the definition of audit technology, the derivative rapidly approaches negative infinity.

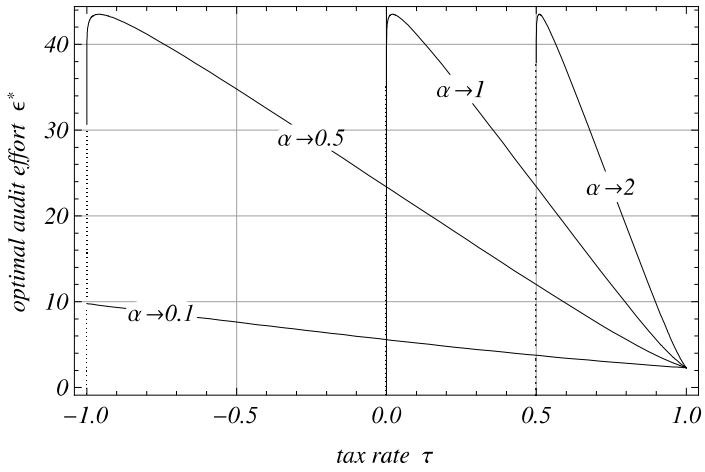
The discussion of negative tax rates or negative audit effort may sound theoretical from an economic perspective. However, the fact that τ_{min} is positive for higher levels of risk aversion or marginal costs indicates the relevance of the demonstrated effects in reality.

We illustrate the effects of taxes on the optimal audit effort by introducing a numerical example. We use the following set of parameters:

$$\{\rho \to 0.2, \Lambda \to 50, \Delta \to 1{,}000, c_v \to 1\}. \tag{19}$$

To highlight the dependence of tax effects on an auditor's risk aversion, the optimal audit effort as a function of the tax rate is shown for four different levels of auditors' risk aversion.

Figure 1: Optimal audit effort as a function of the tax rate



In Figure 1, the tax rates range from -1 to 1. For auditors with low levels of risk aversion $(\alpha \to 0.1, \alpha \to 0.5)$, the threshold tax rate is negative, according to (13). The threshold tax rate for the auditor $\alpha \to 1$ is exactly zero, while for auditors with higher levels of risk aversion, the threshold tax rate is positive $(\alpha \to 2)$.

For levels of risk aversion $\alpha \to 0.1$ and $\alpha \to 0.5$, the slope of the optimal audit effort with increasing tax rates over the domain $\tau \in \{|0,1|\}$ is negative. These auditors will decrease their audit effort when tax rates increase. For these auditors, one may assume a monotonically decreasing relationship for realistic tax rates.

As explained above, the optimal audit effort is negatively infinite with the threshold tax rate. Due to the high sensitivity of the optimal audit effort close to the threshold tax rate τ_{min}, Mathematica does not draw the line directed to negative infinity when assuming common plot points; therefore, the sharp decline to negative infinity is indicated by manually drawn dotted lines.

The tax effects are only diverse for auditors whose maximum, tax-dependent audit effort $\varepsilon^*_{(\tau)}$ is given in the interval $\tau \in \left[\left|0,1\right|\right]$. As explained in (18), the region of tax rates associated with a positive derivative of the optimal audit effort as a function of the tax rate is very small.

For risk-averse auditors, a threshold risk for potentially participating in the audit market exists. This threshold risk in the non-tax case is determined by $\alpha_{max} \to 1/c_v$. For auditors with higher levels of risk aversion, applying even the first unit of audit effort decreases utility. In a scenario with symmetric taxation, an auditor faces only the net marginal costs. Therefore, the maximum level of risk aversion is $\alpha_{max} \to 1/\left[c_v(1-\tau)\right]$, which explains why in an after-tax setting, more risk-averse auditors should be willing to participate in the market. The auditor $\alpha \to 2$ will only participate in the audit market if the tax rate is at least 0.5.

The maximum of the audit effort as a function of the tax rate seems to be independent of the auditor's risk aversion, which indicates that the maximum is only determined by the audit risk, the liability limitation and the marginal audit costs.

Taxes and audit quality

Given the tax effects on the optimal audit effort, the tax influence on audit quality can be determined. Substituting the audit effort in (2) by the optimal audit effort derived in (9) results in

$$p^*_{lit} \to \frac{\alpha c_v(1-\tau)e^{\alpha\Lambda\tau}}{\left(e^{\alpha\Lambda}-e^{\alpha\Lambda\tau}\right)\left[1-\alpha c_v(1-\tau)\right]}. \tag{20}$$

This auditor-specific optimal litigation probability represents the balance of the disutility caused by reducing the damage probability by applying audit effort on the one hand and excepting the remaining risk on the other hand. The return of applying audit effort is determined by the audit technology, while the disutility caused by auditing is scaled by the utility function.

The optimized litigation probability in (20) can be defined as the audit risk a specific auditor is willing to take without investing audit effort. Hence, the optimized litigation probability is a useful indicator for an optimal audit effort of zero. Because the tax rate in (20) appears both inside and outside the exponent of the exponential function, there is again no explicit algebraic solution to determine a tax rate that causes an optimal audit effort of exactly zero.

According to the definitions of litigation probability and audit technology, the optimal litigation probability is non-negative. Whenever the initial audit risk ρ is lower than the auditor-specific acceptable litigation probability p^*_{lit}, the auditor will apply a negative audit effort. Because the optimized damage probability p^*_{lit} is not a

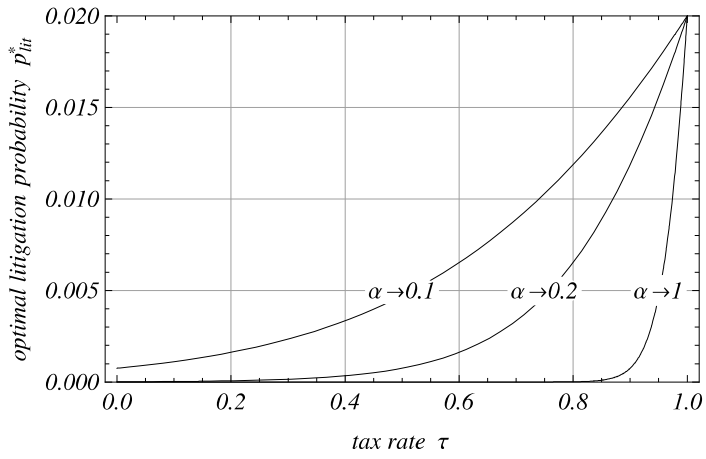
function of the audit effort at all, the optimized audit probability is always positive. With $\tau \to 1$, p_{lit}^* converges to

$$\lim_{\tau \to 1} p_{lit}^* = \frac{c_v}{\Lambda}. \tag{21}$$

This equation represents the audit quality provided by a risk-neutral auditor. Hence, with tax rates of $\tau < 1$, risk-averse auditors will always provide higher audit quality than risk-neutral auditors.

To illustrate the effect of taxes in the context of the auditor's optimal litigation probability, Figure 2 shows the optimal litigation probability for different levels of auditors' risk aversions as a function of the tax rate.

Figure 2: Taxes and audit quality



In contrast to Figure 1, Figure 2 shows lower auditor risk aversions. The optimal litigation probability steadily increases with increasing tax rates only for low levels of risk aversion and for reasonable tax rates, indicating a decrease in audit quality. With increasing auditor risk aversion, the quantitative tax effects seem to be limited to high tax rates. Hence, these auditors will provide high audit quality for reasonable tax rates because with their high level of risk aversion, the taxes reduce the risk to very little.

To summarize the exploration of tax effects from an auditor's perspective, we highlight the following results:

The main result is that the symmetric taxation of profits and losses influences the audit effort of risk-averse auditors but is irrelevant for risk-neutral auditors.

For a wide range of auditors' levels of risk aversion, the audit effort monotonically decreases with increasing tax rates because an auditor determines the optimal audit effort by focusing on the net risk exposure.

For $\tau \in \left[|0,1|\right]$ (and neglecting those auditors who enter the market within this interval), audit effort would be at a maximum with a tax rate of zero. Therefore, maximizing audit quality implies an auditors' tax rate of zero.

Prima facie tax rates of zero for the audit industry seem to be an unfavorable constellation for a tax authority. Considering the legislators' efforts to improve audit quality, interfering with the intended effects by simultaneously taxing auditors could be critical because improving the audit quality of private firms is favorable to the public, especially if tax revenue is affected by audit failures due to poor audit quality. In the next section, we discuss the issue of auditing from a national fiscal authority's perspective.

3 Auditing and the fiscal authority

In the end, the relationship between an auditor and an audited entity is defined by negotiations between the concerned private parties. By defining the product of "auditing" an entity and an auditor agree on an audit fee for the services offered. Therefore, the audit fee is the relevant factor to account for the economic interests of the private parties involved.

The public, represented by a national fiscal authority, does not usually participate in this negotiation process. However, by defining the tax system and the institutional parameters for auditing (e.g., a limited liability regime), a national fiscal authority is a partner in the audit industry. Because auditing may influence the position of the "public" party, we next discuss the institutional parameters of the "tax rate" and "liability limitation" from the public's perspective. First, we focus on a national setting in which all of the parties involved are taxed by the same national fiscal authority. Second, we examine the public's position when the beneficiary of a harm is a non-resident party and is therefore not subject to taxation by the national fiscal authority under consideration.

National setting

For this analysis, we assume that the public, represented by the fiscal authority, is risk neutral. The fiscal authority maximizes the expected tax revenue by maximizing the expected tax base.

Whenever it is reasonable for a fiscal authority to assume that all of the parties potentially associated with a possible harm can be taxed, then the expected tax base is determined by:

$$\begin{aligned} TB_A &= f - c_a - p_{lit}\Lambda \\ TB_E &= \rho\Delta - p_{lit}(\Delta - \Lambda) - f \\ TB_B &= (\rho - p_{lit})\Delta \end{aligned} \quad . \tag{22}$$

The expected tax base of the auditor TB_A consists of the audit fee and the tax-deductible audit costs. If the auditor is sued and found liable, the compensation is usually tax deductible as well. By applying audit effort, audit costs increase, while the litigation probability decreases.

Auditing may prevent an audited entity from suffering a damage Δ that has a probability ρ of arising in an unaudited case. In the audited case, the entity faces only the net damage that occurs with the litigation probabil-

ity. Hence, in the case of an audit, the expected tax base of the entity TB_E increases in comparison to the unaudited case. The audited entity is charged the audit fee, which is also tax deductible.

Whenever the entity suffers damage, there must be a beneficiary party (Bigus 2011, 289). In the unaudited case, the expected profit of the beneficiary party is $\rho\Delta$. Auditing reduces the expected profit of the beneficiary party to $p_{lit}\Delta$. If the beneficiary party can be taxed by the fiscal authority, then the audit-related change of the tax base is

$$TB_{domestic} = TB_A + TB_E + TB_B = -c_a(\varepsilon). \tag{23}$$

All of the other parts of the tax base offset each other because tax law constitutes that the public is a shareholder of all entities because of taxes. Whenever audit costs are tax deductible, the domestic tax base is reduced by these audit costs.

With increasing audit effort, audit costs increase, and a national fiscal authority will optimize the tax base when the audit effort is zero. That is, from a public perspective, audit quality in such a basic setting is negative. Hence, because the public is by definition a shareholder of all entities because of taxes, a conflict exists. For this reason, it is irrelevant from the public's perspective who suffers the damage in this simple setting as long as the beneficiary party is taxed. Hence, the goal of investor protection is in conflict with maximizing the tax base.

In this setting, the fiscal authority maximizes tax revenue only by setting the tax rate for audit-related parts of the tax base to zero. Otherwise, increasing the audit effort means linearly decreasing the tax base. Given that auditors increase their audit effort with decreasing tax rates, an audit-related tax rate of zero (or tax exemptions for audit-related parts of the tax base) maximizes audit quality. In a national setting, such a situation would be favorable to the public, investors and auditors. Although it seems to be a win-win situation for all of the parties, tax exemptions for the audit industry do not seem to be enforceable from a political perspective.

International setting

The situation for the national treasury changes if the beneficiary party of harm or damage is a non-resident and is therefore not taxable by the national fiscal authority. In an unaudited case, the national treasury may suffer damage whenever the entity suffers a tax-deductible harm. In the case of a foreign beneficiary party, the expected tax base only consists of the expected tax base of the auditor and the entity:

$$TB_{foreign} = \Delta p_{lit}\rho - \varepsilon c_v - c_f\ . \tag{24}$$

In contrast to the national setting with solely national parties involved, audit effort influences the tax base positively by reducing the risk of suffering harm while also influencing the tax base negatively by increasing the

audit costs. Because the sign of these effects is different, an optimal audit effort from the public's perspective exists in an international setting:

$$\varepsilon^*_{public} \to \log\left(\frac{\Delta\rho}{c_v}\right). \tag{25}$$

Hence, the public should be interested in the auditor applying audit effort by using audit technology. The extent of the use of audit technology in the case of the national treasury is solely determined by the slope of the technology function. Therefore, the public should also be interested in creating incentives for auditors to improve audit technology.

In contrast to the auditors' perspective, the optimal audit effort from the public's perspective depends on the amount of the damage incurred instead of the amount of compensation due to the liability limitation. Because audit costs influence the tax base, even the national treasury is interested in at least a limited audit effort.

From the public's perspective, the problem is that the auditor, not a public authority, determines the level of audit effort. Hence, it is reasonable that a legislator representing the public would establish an institutional framework to incentivize auditors to comply with the public interest.

Comparing the socially optimal audit effort in (25) with the optimal audit effort of a risk-neutral auditor in (10) reveals that the optimal audit effort for the auditor is determined by the liability limitation, while the public's optimal audit effort is determined by the potential damage. Therefore, the optima are only equal if the compensation in case of litigation equals the possible damage. Hence, from the public's perspective, unlimited liability for risk-neutral auditors would minimize the expected damage:

$$\varepsilon^*_{public} \overset{!}{=} \lim_{\alpha\to 0} \varepsilon^*_{\tau} \Rightarrow \Lambda^* \to \Delta. \tag{26}$$

As discussed in the prior section, the optimal audit effort of a risk-averse auditor for $\tau < 1$ always exceeds the optimal audit effort of a risk-neutral auditor and is tax sensitive.

If the national treasury is affected by the applied level of audit effort, there is an incentive for a legislator to establish favorable institutional parameters in terms of "tax rate" and/or "liability limitation". Specific tax rates for the audit industry sound more unrealistic (and are algebraically undeterminable in our research model) than specific liability limitation regulations. Therefore, an auditor-specific optimal liability limitation can be determined by equaling the public and auditor's optimal audit effort. After simplifying and rearranging, solving for the liability limitation results in:

$$\varepsilon^*_{public} \overset{!}{=} \varepsilon^*_{\tau} \Rightarrow \Lambda^* \to -\frac{\log\left(\frac{1-\alpha c_v(1-\tau)}{1-\alpha\left[c_v(1-\tau)+\Delta(1-\tau)\right]}\right)}{\alpha(1-\tau)}. \tag{27}$$

According to the used utility function, (27) represents a certainty equivalent. The argument in the log shows a comparison between the litigation case and the non-litigation case. For $\Delta > 0 \wedge \alpha > 0$, the denominator of the argument of the log will always exceed the numerator, and the log is negative. As expected, the optimal liability limitation from the public's perspective increases with increasing damage, and, as auditors face the net risk, increasing tax rates.

We must emphasize that the optimal liability limitation is independent of the specific audit risk. The only audit-task-specific parameter is the damage, and the public may suffer. For example, to operationalize an auditor- and mandate-specific liability limitation, the potential damage could be determined by the size of the entity.

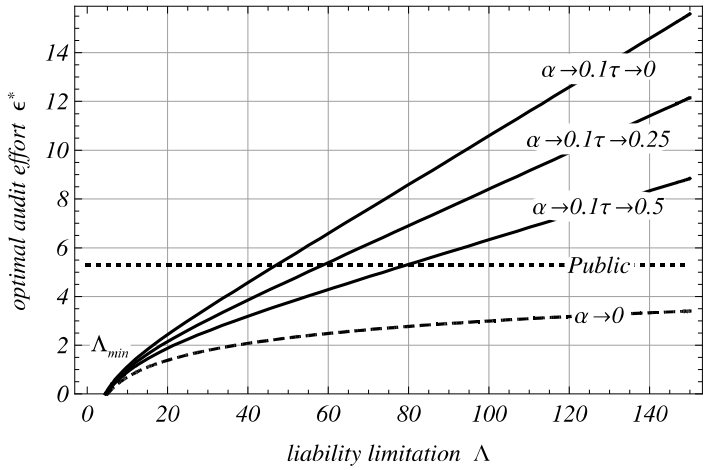
The other parameters are auditor specific. In comparison with the auditor's risk aversion, the marginal audit costs are easier to measure. Even when the literature provides approaches to at least classify auditors by the level of risk aversion (Farmer 1993), determining an auditor's risk aversion is a crucial issue. Without claiming that the optimal liability limitation shown in (27) is easy to operationalize, considering a mandate-specific liability limitation in the context of taxes could make sense.

We illustrate the tax- and risk-aversion-dependence of optimal liability in Figure 3 by showing the optimal audit effort as a function of the liability limitation.

The horizontal dotted line represents the public's optimal audit effort based on the parameters introduced in (19). The dashed line represents the risk-neutral auditor's optimal audit effort as a function of the liability limitation. As derived in (26), equaling the public's and risk-neutral auditor's optimal audit effort requires $\Lambda \to \Delta$.

The solid lines represent a risk-averse auditor with a low level of risk aversion of $\alpha \to 0.1$ who is facing different tax rates.

Figure 3: Taxes, optimal audit effort and liability limitation



According to Figure 3, there seems to be a common intersection with the x-axis, indicating that auditors require the same minimum liability limitation Λ_{min} for providing an optimal audit effort of exactly zero. However, auditors with different levels of risk aversion are characterized by different levels of optimal litigation risk, which are determined by the liability limitation.

$$\Lambda_{min} \to \frac{1}{\alpha(1-\tau)} log\left[1-\frac{\alpha c_v}{\rho\left(\alpha c_v - 1/1-\tau\right)}\right] \tag{28}$$

Whenever the liability limitation approaches this minimum, the overall risk faced by an auditor is low. Therefore, the minimum liability limitation to determine an audit effort of zero is not sensitive to the auditors' risk aversion.

With increasing tax rates, the optimal liability limitation also increases. Even for an auditor with a low level of risk aversion, the optimal liability limitation is tax-rate sensitive. If the same liability limitation is applied for differently taxed auditors, the auditors with lower tax rates will exceed the socially optimal audit effort. Because of the limiting effects of taxation in the litigation scenario, higher taxed auditors must have higher liability limitations to provide audit effort and therefore audit quality, which is in line with the public interest.

If the liability limitation for a specific auditor is too high, the auditor will apply an inefficient level of audit effort from the public's perspective, resulting in a decrease in the expected tax base due to excessively high audit costs.

The main takeaway of this section is that through taxation, a legislator potentially interferes with efforts to improve audit quality. In a national setting in which all of the parties associated with auditing are taxed, tax rates of zero or tax exemptions for audit-related parts of the tax base may improve audit quality. Then a national legislator could maximize the tax base by simultaneously improving audit quality.

Taking into account that a beneficiary party in the case of a harm may be abroad and therefore remain untaxed by the national treasury, the public may suffer damage through poor audit quality. Therefore, a socially optimal audit effort level exists.

The results indicate that a socially optimal level of audit effort crucially depends on tax rates and the auditor's risk aversion. Therefore, a general liability limitation for legal entities and natural persons may be unfavorable when the entities and persons face different tax rates. The tax dependency of audit efforts suggests that measures to improve audit quality should be assessed jointly with the tax system in which the auditor practices.

Even if mandate-specific and therefore auditor-specific liability limitations may sound unrealistic, the potential damage the public may suffer due to poor audit quality at least justifies a more intense debate on the role of financial auditing from the public's perspective.

4 Summary and conclusions

In this study, we explore the relationship between audit effort, audit quality and taxes from auditors and the public's perspective using an analytical approach. The model is based on several simplifying and limiting assumptions. Nevertheless, we consider our model to be a useful basis to derive indications about the relationship between audit quality and taxes, without claiming that the model provides a sound basis for predicting quantitative relationships between exogenous variables and audit quality.

The main implication of the paper is that taxes may crucially influence audit quality. Because taxes may interfere with other measures to improve audit quality, a joint assessment of the institutional environment for auditing and the respective tax system is necessary.

Symmetric taxes with a proportional tax rate simultaneously influence marginal audit costs and conditional audit outcomes. Thus, taxes proportionately influence expected profits. While risk-neutral auditors maximize their expected profit, but risk-averse auditors maximize their expected utility, symmetric taxes solely affect the risk-averse auditors' level of optimal audit effort.

The analytical analysis provides evidence that taxes do not influence the optimal audit effort monotonically. For auditors with low levels of risk aversion, one may assume a decrease of audit effort, resulting in a decrease of audit quality and increasing tax rates. This finding implies that only low tax rates are in line with the goal of legislators to improve audit quality.

Whenever the beneficiary party of a harm cannot be taxed, the public, as investors, should be interested in high audit quality. The analysis also provides evidence that to achieve a socially optimal audit effort level, auditor- and mandate-specific liability limitation regimes may be favorable.

References

Amir, Eli, Juha-Pekka Kallunki, and Henrik Nilsson. 2013. "The association between individual audit partners' risk preferences and the composition of their client portfolios." *Review of Accounting Studies*:1-31. doi: 10.1007/s11142-013-9245-8.

Banker, Rajiv D., Hsihui Chang, and Reba Cunningham. 2003. "The public accounting industry production function." *Journal of Accounting and Economics* no. 35 (2):255-281. doi: 10.1016/S0165-4101(03)00021-1.

Bigus, Jochen. 2011. "Auditors' Liability with Overcompensation and Reputation Losses." *OR Spectrum* no. 33 (2):287-307.

Bigus, Jochen. 2012. "Vague Auditing Standards and Ambiguity Aversion." *Auditing* no. 31 (3):23-45. doi: 10.2308/ajpt-50170.

Bond, Stephen R., and Michael P. Devereux. 2003. "Generalised R-Based and S-Based Taxes under Uncertainty." *Journal of Public Economics* no. 87 (5-6):1291-1311.

Carcello, Joseph V., and Zoe-Vonna Palmrose. 1994. "Auditor Litigation and Modified Reporting on Bankrupt Clients." *Journal of Accounting Research* no. 32:1-30. doi: 10.2307/2491436.

Chaney, Paul K., and Kirk L. Philipich. 2002. "Shredded Reputation: The Cost of Audit Failure." *Journal of Accounting Research* no. 40 (4):1221-1245. doi: 10.1111/1475-679X.00087.

Domar, E. D., and R. A. Musgrave. 1944. "Proportional income taxation and risk-taking." *Quarterly Journal of Economics* no. 58:388-422.

Dye, Ronald A. 1993. "Auditing Standards, Legal Liability, and Auditor Wealth." *Journal of Political Economy* no. 101 (5):887-914. doi: 10.1086/261908.

Ewert, Ralf. 1999. "Auditor liability and the precision of auditing standards." *Journal of Institutional and Theoretical Economics* no. 155 (1):181-206.

Ewert, Ralf, Eberhard Feess, and Martin Nell. 2000. "Auditor liability rules under imperfect information and costly litigation: the welfare-increasing effect of liability insurance." *European Accounting Review* no. 9 (3):371-385. doi: 10.1080/09638180020017122.

Ewert, Ralf, and Rainer Niemann. 2012. "Limited Liability, Asymmetric Taxation, and Risk Taking Why Partial Tax Neutralities Can Be Harmful." *FinanzArchiv: Public Finance Analysis* no. 68 (1):83-120. doi: 10.1628/001522112X632023.

Farmer, Timothy A. 1993. "Testing the Effect of Risk Attitude on Auditor Judgment Using Multiattribute Utility Theory." *Journal of Accounting, Auditing & Finance* no. 8 (1):91-110.

Francis, Jere R. 2011. "A Framework for Understanding and Researching Audit Quality." *Auditing: A Journal of Practice & Theory* no. 30 (2):125-152. doi: 10.2308/ajpt-50006.

Francis, Jere R., and Paul N. Michas. 2013. "The Contagion Effect of Low-Quality Audits." *Accounting Review* no. 88 (2):521-552. doi: 10.2308/accr-50322.

Ghosh, Dipankar, and Terry L. Crain. 1995. "Ethical Standards, Attitudes toward Risk, and Intentional Noncompliance: An Experimental Investigation." *Journal of Business Ethics* no. 14 (5):353-365. doi: 10.2307/25072655.

Graham, John R., Jana S. Raedy, and Douglas A. Shackelford. 2012. "Research in accounting for income taxes." *Journal of Accounting and Economics* no. 53 (1–2):412-434. doi: 10.1016/j.jacceco.2011.11.006.

Hanlon, Michelle, and Shane Heitzman. 2010. "A review of tax research." *Journal of Accounting and Economics* no. 50 (2–3):127-178. doi: 10.1016/j.jacceco.2010.09.002.

Hillegeist, Stephen A. 1999. "Financial Reporting and Auditing under Alternative Damage Apportionment Rules." *Accounting Review* no. 74 (3):347-69.

Jullien, Bruno, Bernard Salanié, and François Salanié. 2007. "Screening risk-averse agents under moral hazard: single-crossing and the CARA case." *Economic Theory* no. 30 (1):151-169. doi: 10.1007/s00199-005-0040-z.

Kirschenheiter, MichaelT, Dirk Simons, and Jeroen Suijs. 2011. "Special issue on accounting and auditing." *OR Spectrum* no. 33 (2):261-264. doi: 10.1007/s00291-011-0241-8.

Laux, V., and D. P. Newman. 2010. "Auditor Liability and Client Acceptance Decisions." *Accounting Review* no. 85 (1):261-285. doi: 10.2308/accr.2010.85.1.261.

Liu, Chiawen, and Taychang Wang. 2006. "Auditor Liability and Business Investment." *Contemporary Accounting Research* no. 23 (4):1051-1071. doi: 10.1506/E023-337T-180P-18U4.

Narayanan, V. G. 1994. "An Analysis of Auditor Liability Rules." *Journal of Accounting Research* no. 32:39-59. doi: 10.2307/2491438.

Newman, D. P., E. R. Patterson, and J. R. Smith. 2005. "The role of auditing in investor protection." *Accounting Review* no. 80 (1):289-313. doi: 10.2308/accr.2005.80.1.289.

Patterson, Evelyn, and David Wright. 2003. "Evidence of Fraud, Audit Risk and Audit Liability Regimes." *Review of Accounting Studies* no. 8 (1):105-31.

Pratt, J., and J. D. Stice. 1994. "The Effects of Client Characteristics on Auditor Litigation Risk Judgments, Required Audit Evidence, and Recommended Audit Fees." *Accounting Review* no. 69 (4):639-656.

Roger, Guillaume. 2013. "Optimal Contract under Moral Hazard with Soft Information." *American Economic Journal: Microeconomics* no. 5 (4):55-80. doi: 10.1257/mic.5.4.55.

Schneider, Dieter. 1980. "The Effects of Progressive and Proportional Income Taxation on Risk-Taking." *National Tax Journal* no. 33 (1):67-75.

Schwartz, Rachel. 1997. "Legal regimes, audit quality and investment." *Accounting Review* no. 72 (3):385-406.

Shackelford, Douglas A., and Terry Shevlin. 2001. "Empirical tax research in accounting." *Journal of Accounting and Economics* no. 31 (1–3):321-387. doi: 10.1016/S0165-4101(01)00022-2.

Willekens, Marleen, and Dan A. Simunic. 2007. "Precision in auditing standards: effects on auditor and director liability and the supply and demand for audit services." *Accounting and Business Research* no. 37 (3):217-232. doi: 10.1080/00014788.2007.9730073.