Management Compensation, Monitoring and Aggressive Corporate Tax Planning

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Abstract

The empirical literature shows that management incentives often reduce corporate tax aggressiveness. Focussing on the riskiness of tax aggressiveness this paper offers one explanation for the observed negative relation. Using an agency framework, I analyze the manager's choice of effort dedication in other tasks and her explicit choice of the firm's tax risk. I show that corporate tax aggressiveness may decrease with compensation incentives. By choosing the tax risk, the manager (partly) determines her compensation risk. When the manager is assumed to be risk averse, an increase in compensation incentives motivates her to reduce her compensation risk through a less aggressive tax planning strategy. Further, a good governance structure may mitigate this effect of incentive compensation when marginal returns for tax planning are sufficiently low. I also demonstrate that the tax deductibility of performance-based pay yields less aggressive tax planning.

JEL classification: H25, D82, D21

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1 Introduction

How do management incentives affect corporate aggressive tax planning? Some studies show that corporate tax aggressiveness and management incentives are negatively related.[1] Desai and Dharmapala's (2005) results suggest that from the manager's point of view, avoiding taxes and extracting rents are interdependent activities, i.e. when incentives are high the manager reduces rent extraction and due to a complementary relationship she also lowers the firm's tax avoidance. On the other hand, Seidman and Stomberg (2012) argue that since management incentives are tax deductible, these deductions create alternative tax shields and reduce the incentives for engaging in further tax avoidance (tax exhaustion).

Focussing on the riskiness of tax avoidance, this paper offers an alternative explanation for the observed negative relation between management incentives and aggressive tax planning.[2] I assume that when choosing a tax planning strategy the manager faces a risk-return trade-off. When the risk averse manager determines the firm's tax risk, higher incentives may induce her to choose a less aggressive tax planning strategy in order to reduce her compensation risk. Thus, even in the absence of managerial rent extraction, increasing incentives may result in less tax aggressiveness when tax planning is viewed as a risky activity. This view of tax planning is in line with Armstrong et al. (2015), Hanlon and Heitzman (2010) and Rego and Wilson (2009), who consider corporate tax planning activities as a continuum of tax strategies with outcomes that range from certain to risky or aggressive, where risky tax positions are those that are relatively more likely to be challenged by the tax authorities. Besides management incentives, I consider the effect of a firm's monitoring ability and the degree of tax deductibility of bonus payments.

This paper is closely related to Desai and Dharmapala (2005). Their framework is based on the assumption that the manager's costs of tax planning and rent extraction are interdependent. They empirically test their argument and find support of a complementary relationship between rent extraction and tax avoidance. Firms with poor governance structures exhibit a stronger negative relationship between performance-based pay and tax

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[1] Other empirical studies find a positive relationship between management incentives and corporate tax planning; see for example Rego & Wilson (2012), Philips (2003), or Gaertner (2013). Armstrong et al. (2012) find no significant effects of managerial incentives on corporate tax avoidance but on the reported GAAP effective tax rate. For a general overview of the determinants of corporate tax planning behavior see Hanlon and Heitzman (2010).

[2] For purposes of this study I consider the degree of aggressiveness or riskiness in corporate tax planning instead of differing between tax evasion, aversion or noncompliance. See Hanlon and Heitzman (2010) for semantic overview on different corporate tax avoidance categories.

avoidance than firms with good governance structures. In contrast, this paper examines the equilibrium contract and outcomes assuming that the manager faces a risk-return trade-off when choosing a tax planning strategy. Further, I do not assume any interdependencies between the choice of tax aggressiveness and effort dedication, i.e. the manager exerts productive effort which results in effort costs for her but the choice of the tax planning strategy comes at no effort cost for her. This paper is also related to Ewert and Niemann (2014) who analyze corporate tax avoidance in a Linear-Exponential-Normal (LEN) model when the manager allocates effort among tax avoidance and other productive tasks. In contrast, the framework used here views tax aggressiveness as a risky project choice that requires no additional managerial effort. Choosing a tax strategy rather than exerting managerial effort for tax planning is consistent to the concept that executives set the 'tone at the top' (see for example Dyreng et al. (2010) or Law and Mills (2014)).

Seidman and Stomberg's (2012) suggestion that the tax deductibility of managerial bonuses may explain the negative relationship between incentives and corporate tax avoidance is incorporated into the framework. The results show that a higher tax deductibilty may result in less tax aggressivenss without directly affecting the returns of tax planning but affecting the attractiveness of performance-based payments.

For analyzing the optimal compensation scheme and the tax planning decision of a manager, I use a LEN agency framework. The model is built on Holmström and Milgrom (1987), on Hirshleifer and Suh (1992) as well as on Grossman et al. (2011) and shows that the effects of performance-based pay on productive effort and on tax aggressiveness may be countervailing. In particular, the results show that aggressive tax planning is decreasing while productive effort is increasing with increasing (linear) performance-based payment. The reason is, that by chosing the tax risk of a firm, the manager indirectly determines her compensation risk. A higher variable payment component increases effort incentives as well as the manager's costs of risk bearing resulting from exogenous firm risk and from her choice of the tax risk. Thus, the risk averse manager responds with a reduction in compensation risk by chosing a less aggressive tax planning strategy. Therefore, the shareholders trade-off the incentives induced by the compensation scheme with regard to the selection of tax risk and productive effort. The analysis is extended by an additional governance instrument, i.e. monitoring, and by the degree to which management payments are tax deductible. It can be shown that the equilibrium performance-based pay is increasing in the degree of tax deductibility. It follows that effort increases and aggressive tax planning decreases. The results further indicate that the impact of monitoring on the equilibrium outcomes

is ambiguous. But monitoring may eliminate the trade-off when marginal returns of tax planning are sufficiently low, i.e. a higher performance-based pay due to an increased monitoring ability results in higher productive effort and higher tax aggressiveness. When marginal returns from tax planning are sufficiently high, then higher monitoring results in a decreasing performance-based pay resulting in higher tax aggressiveness.

The remainder of the paper is organized as follows. The next section develops a model of corporate tax avoidance which is based on standard principal agent theory and derives the optimal contract between a manager and the shareholders when the manger is responsible for the firm's tax compliance. Section 3 analyzes the impact of corporate governance and incentives provided by the tax system. Section 4 provides a conclusion.

2   The basic model

The following model is built on the risk-return trade-off scenario in Hirshleifer and Suh (1992) and on the basic model in Holmström and Milgrom (1987). Assume a simple principal-agent-framework in which the well diversified shareholders of a firm are risk neutral and contract with a manager. The compensation contracts are limited to the class of linear contracts, i.e. the compensation scheme, w, consists of a fixed (f) and a performance-related component (v). The risk averse manager chooses a more or less aggressive tax planning strategy from a menu of tax planning strategies, $s \in [0, \bar{s}]$, as well as productive effort, $a \in [0, \bar{a}]$. Firm output is generated by the technology $h(a) = a + \varepsilon_f$, where $\varepsilon_f \sim N(0, \sigma_{\varepsilon f}^2)$ indicates firm risk and the marginal productivity of effort is normalized to one.

A risky or aggressive tax planning strategy is a strategy that yields an uncertain outcome relating to the tax base and therefore to tax payments. In other words: aggressive tax planning might be accepted by the tax authority leading to a reduction of tax payments or it might be deemed to be noncompliance implying penalties or interest payments, and thus implicitly higher tax payments. Depending on the manager's choice of tax aggressiveness, s, the firm alters its tax base by $s(k + \varepsilon_t)$ and generates tax savings to the amount of $\tau s(k + \varepsilon_t)$, where τ is the tax rate on corporate income, $k > 0$ is the marginal tax base reduction due to aggressive tax planning and $\varepsilon_t \sim N(0, \sigma_{\varepsilon t}^2)$ denotes the tax risk. Note that tax savings may become negative which can be interpreted as a penalty imposed by the tax authority when the tax planning strategy is not accepted. Choosing a tax planning strategy does not imply costs for the manager in the sense of managerial effort dedication. But tax planning involves (linear) costs for the firm in form of $c(s) = \alpha s$ which are assumed to be tax deductible, e.g. costs for external tax advisory or costs for implementing

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or concealing the tax strategy.[3,4] The manager, on the other hand, is assumed to be effort averse and exerting productive effort to generate firm income implies costs for her. These costs are given by the cost function $c(a) = \frac{a^2}{2}$.

The firm's after-tax income, denoted by x, depends on managerial effort and the choice of tax aggressiveness in the following way

$$x = [a + \varepsilon_f - c(s)] (1 - \tau) + \tau s(k + \varepsilon_t). \tag{1}$$

The two shocks, ε_t and ε_f, are assumed to be independently distributed indicating that ε_t is tax strategy specific and ε_f is effort specific, i.e. $COV(\varepsilon_f, \varepsilon_t) = 0$. According to equation (1), the impact of tax planning, s, on firm value is threefold: First, with $k > 0$, a more aggressive tax strategy increases expected tax savings $\tau s k$. Thus, k can be interpreted as the reward for risk-bearing provided by the tax-strategy. It is assumed that the amount of a tax base reduction, $sk + \varepsilon_t$, is not limited to the amount of productive firm income, i.e. there is always enough taxable firm income against which a resulting tax base reduction can be credited, e.g. via tax loss carry backwards. Second, a higher s increases the variance of tax savings or penalties which is given by $\tau^2 s^2 \sigma_{\varepsilon\tau}^2$. Third, a more aggressive tax strategy implies higher after-tax costs of tax planning, $c(s)(1 - \tau)$. Hence, the manager can choose safe tax strategies with low expected tax savings at low costs or she can choose risky tax planning strategies with high expected tax savings at higher costs.

It is further assumed that the manager has a strictly concave utility function with constant absolute risk aversion:

$$U = -e^{-r(w-c(a))}, \ r > 0, \tag{2}$$

where r is the coefficient of absolute risk aversion and $w = f + vx$ denotes management compensation. For simplicity and for the investigation of risk allocation, I assume that the manager maximizes her certainty equivalent, CE, which is equivalent to maximizing expected utility when assuming that utility over income is exponential.

The timing is as follows: first, the shareholders make a take-it-or-leave-it offer to the manager. If the manager rejects the offer, the game ends and the manager receives her

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[3]For example, Wilson (2009) documents the average fees paid to tax shelter purveyors for a sample of US firms that were accused for tax sheltering to an amount of almost 8% of the tax savings.

[4]The assumption of a linear cost function is for preventing the model from becoming overly complex. A quadratic cost function would qualitatively not change the results of this paper.

reservation certainty equivalent, $\overline{CE}$. If the manager accepts the contract, she simultaneously chooses her effort level and the degree of corporate tax aggressiveness. Finally, all parties observe the final outcome and pay-offs are realized.

Unlike Crocker and Slemrod (2005), it is assumed that neither the actual level of tax deductions nor the cost of tax planning $c(s)$ nor the firm's productive outcome $h(a)$ are separately observable and therefore contractible, i.e. the shareholders and the government cannot distinguish between tax planning and productive outcome. Thus, the government can base taxation only on $(a + \varepsilon_f - c(s) - sk - \varepsilon_t)$ and the shareholders can only observe and base the contract on after-tax firm income x.[5] The model is solved by backwards induction starting with the manager's decision for a given compensation scheme. The manager's expected compensation is given by $E(w) = f + v[(a - c(s))(1 - \tau) + sk\tau]$ and the variance of the compensation contract is $Var(w) = v^2(1 - \tau)^2\sigma_{\varepsilon f}^2 + v^2\tau^2 s^2\sigma_{\varepsilon t}^2$. Note that this variance consists of two terms: the first term consisting of the firm risk depends solely on variables that are beyond the manager's control and the second term consisting of the tax risk is also determined by the manager's choice of tax aggressiveness s. In other words: The manager determines the obscurity or accuracy of the performance measure indirectly via her choice of s.

The manager's maximization problem is given by

$$\max_{a,s} CE = E(w) - \frac{a^2}{2} - \frac{r}{2}Var(w). \tag{3}$$

Hence, for a given compensation scheme, the manager responds with

$$s^* = \frac{\tau k - \alpha(1 - \tau)}{rv\tau^2\sigma_{\varepsilon t}^2} \quad \text{and} \quad a^* = v(1 - \tau). \tag{4}$$

The terms are derived by summarizing the manager's first order conditions resulting from equation (3). A higher performance based compensation yields an increase in managerial effort and a decrease in aggressive tax planning which constitutes a trade-off for the shareholders when deciding on the degree of performance based pay. Setting $v = 1$, i.e. making the manager a 100% shareholder, would result in the first best effort dedication but in the

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[5]The investigation under the assumption of non-observability of tax reductions can easily be applied to an analysis where the key performance metric is the after-tax firm income. For an empirical analysis of the impact of after-tax and pre-tax performance measures on corporate tax avoidance see for example Gaertner (2013) or Powers et al. (2013).

highest deviation from the first best tax planning strategy.[6] I derive the following lemma:

Lemma 1 *When performance-based pay is based on after-tax firm income, then an increase (decrease) in v induces the manager to decrease (increase) corporate tax aggressiveness s^* and to increase (decrease) managerial effort a^*.*

Proof. $\frac{\partial s^*}{\partial v} < 0; \frac{\partial a^*}{\partial v} > 0$. ∎

From the manager's perspective, an increased performance based compensation, increases the expected revenue of effort exertion and the expected revenue of tax aggressiveness, but at the same time a higher v increases the costs of risk taking associated with the tax planning strategy. Since a higher performance-based pay increases the expected management compensation for risky tax planning linearly (i.e. by $v [k\tau - \alpha(1 - \tau)]$), and at the time increases the costs of tax-risk-taking quadratically (i.e. by $rv^2\tau^2\sigma_{\varepsilon t}^2$), the manager reduces the aggressiveness of the corporate tax planning strategy with an increasing performance-based pay.

When contracting with the manager, the shareholders anticipate the countervailing effects of performance-based pay on managerial effort and the degree of tax aggressiveness. Their maximization problem becomes

$$\max_{f,v} E(\pi) = [a^* - c(s^*)] (1 - \tau) + \tau s^* k - w(a^*, s^*)$$

subject to the manager's participation constraint

$$\overline{CE} \le f + v [(a - \alpha s)(1 - \tau) + \tau s k] - \frac{a^2}{2} - \frac{r}{2} Var(w) \tag{5}$$

and the incentive compatibility constraint shown as the manager's first order condition

$$(a^*, s^*) \in \arg\max_{a,s} CE.$$

The shareholder's first order condition is derived by using the participation constraint as well as the incentive compatibility constraint and is given by

$$0 = (1 - \tau)^2 - v(1 - \tau)^2 - rv(1 - \tau)^2\sigma_{\varepsilon f}^2 - \frac{[\tau k - \alpha(1 - \tau)]^2}{v^2 r\sigma_{\varepsilon t}^2\tau^2}. \tag{6}$$

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[6] In the absence of asymmetric information, the manager would be remunerated with a fixed amount compensating her for the desired effort exertion and the shareholders would make her choose $a^* = (1 - \tau)$ and $s^* = \bar{s}$.

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See appendix A for details on the derivation of equation (6). This first-order condition establishes the relation between performance-based pay and shareholder wealth. First, increasing performance-based pay increases expected corporate tax payments, i.e. it decreases expected tax deductions by $-\tau k \frac{[\tau k - \alpha(1-\tau)]}{v^2 r \sigma_{\varepsilon t}^2 \tau^2}$. The reason is that a marginal increase in performance based pay induces the manager to reduce her choice of corporate tax aggressiveness as described above in lemma 1. Since a higher v implies lower aggressive tax planning the costs of tax planning, $\alpha(1-\tau)\frac{\tau k - \alpha(1-\tau)}{v^2 r \sigma_{\varepsilon t}^2 \tau^2}$ are accordingly reduced. Second, basing management compensation on uncertain after-tax firm income increases the risk premium that the shareholders have to pay to the risk averse manager in order to meet her participation constraint by $rv(1-\tau)^2 \sigma_{\varepsilon f}^2$. Note that the effect of a marginal increase in performance-based pay on the risk premium consists solely of that part of the variance that depends on firm risk which is beyond the manager's control. The reason is that the manager's response to a higher performance-based pay and with it to higher compensation risk from aggressive tax planning is completely offset by her reduction in the tax aggressiveness. Third, marginally increasing performance-based pay induces the manager to exert more productive effort (see lemma 1). This leads to an increase in after-tax firm income given by $(1-\tau)^2$. At the same time, an increase in performance based pay yields a one-to-one decrease in expected firm income because this fraction is exactly the profit share v.

Rearranging the shareholder's first order condition given by (6) and using $a^* = v(1-\tau)$, implicitly gives the optimal performance-based payment:

$$ v^* = \frac{1}{\left(1 + r\sigma_{\varepsilon f}^2\right)} \left(1 - \frac{[\tau k - \alpha(1-\tau)]^2}{r\sigma_{\varepsilon t}^2 \tau^2 (a^*)^2}\right). \tag{7} $$

Using the manager's participation constraint (5) gives the optimal fixed compensation component:

$$ f^* = \overline{CE} - \frac{[\tau k - \alpha(1-\tau)]^2}{2r\sigma_{\varepsilon t}^2 \tau^2} - \frac{1}{2}v^2(1-\tau)^2 \left(1 - r\sigma_{\varepsilon f}^2\right). $$

Together with the optimal management actions given in (4) this constitutes the equilibrium.

Proposition 1 *The equilibrium contract is given by $w(v^*, f^*)$ and the respective management actions are given by a^* and s^*. The derived equilibrium has an interior solution if the expected marginal tax base reductions due to aggressive tax planning are sufficiently small, i.e. $[\tau k - \alpha(1-\tau)]^2 < \frac{1}{2}v^3 r\sigma_{\varepsilon t}^2 \tau^2 (1-\tau)^2 (1 + r\sigma_{\varepsilon f}^2).$*

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Proof. See appendix B. ∎

From equation (7) it can be seen that v^* is lower the higher the expected marginal return of tax planning $[\tau k - \alpha(1 - \tau)]$. But proposition 1 further states that $[\tau k - \alpha(1 - \tau)]^2$ may not exceed a certain threshold. For an interior solution, the term $[\tau k - \alpha(1 - \tau)]^2$ denoting the expected marginal net return of aggressive tax planning, needs to be small enough. Otherwise, the equilibrium results in a corner solution. The reason is as follows. For too high returns of aggressive tax planning, the shareholders reduce the performance-based payment to the smallest possible amount, i.e. for very high returns of tax planning $v^* = \frac{1}{(1 + r\sigma_{\varepsilon f}^2)} \left(1 - \frac{[\tau k - \alpha(1 - \tau)]^2}{r\sigma_{\varepsilon t}^2 \tau^2 (a^*)^2}\right)$ becomes negative. According to lemma 1, lower values of v^* result in a higher degree of tax aggressiveness, lower effort exertion, and a small amount of expected productive firm outcome. In other words: When the return of aggressive tax planning is too high, incentivizing tax planning by setting v very low is more profitable than incentivizing effort exertion. Thus, the shareholders pay the manager the smallest performance-based pay and the firm solely exists to save taxes without generating any productive outcome. These cases are ruled out by assuming that $[\tau k - \alpha(1 - \tau)]^2$ is small enough.[7]

Moreover, the following relations can be derived with regard to the tax risk and the firm risk parameter:

Proposition 2 *The firm risk and the tax risk have countervailing effects on the equilibrium contract and its outcomes. In particular,*

(i) $\frac{\partial v^*}{\partial \sigma_{\varepsilon f}^2} < 0$, $\frac{\partial a^*}{\partial \sigma_{\varepsilon f}^2} < 0$ *and* $\frac{\partial s^*}{\partial \sigma_{\varepsilon f}^2} > 0$

(ii) $\frac{\partial v^*}{\partial \sigma_{\varepsilon t}^2} > 0$, $\frac{\partial a^*}{\partial \sigma_{\varepsilon t}^2} > 0$ *and* $\frac{\partial s^*}{\partial \sigma_{\varepsilon t}^2} < 0$.

Proof. See appendix C. ∎

All else equal, optimal performance-based pay v^* is decreasing in firm risk $\sigma_{\varepsilon f}^2$ which results in less effort exertion and a higher degree of tax aggressiveness. It is intuitive, that a higher firm risk makes variable pay more expensive due to an increased variance in the compensation scheme. On the other hand, a higher tax risk $\sigma_{\varepsilon t}^2$ increases the optimal performance-based compensation. Recall the shareholder's first order condition given by

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[7]Note that as long as tax planning is costly, basing the payment on pre-tax income results in $s^* = 0$. Thus, as long as tax planning is profitable it is never optimal to base the variable payment on pre-tax income.

equation (6), i.e. $0 = (1-\tau)^2 - v(1-\tau)^2 - rv(1-\tau)^2\sigma_{\varepsilon f}^2 - \frac{(\tau k - \alpha(1-\tau))^2}{v^2 r \sigma_{\varepsilon t}^2 \tau^2}$. The impact of an increasing tax risk is as follows: First, $\sigma_{\varepsilon t}^2$ has a direct effect on the manager's choice of tax aggressiveness, i.e. a higher $\sigma_{\varepsilon t}^2$ makes tax planning less attractive which results in lower s^*. This implies less expected tax savings due to less aggressive tax planning, i.e. $-\frac{[\tau k - \alpha(1-\tau)]^2}{v^2 r \sigma_{\varepsilon t}^2 \tau^2}$. Second, the risk premium is reduced by less tax planning and directly enhanced by a higher $\sigma_{\varepsilon t}^2$. The effect of a reduction in tax planning is larger than the direct effect. Thus, an increased tax risk makes variable payment less expensive for the shareholders due to a reduced risk premium. It follows that v^* and with it effort increases and tax planning decreases.

3 Corporate governance and bonus tax deductibility

In this section, I analyze the effect of corporate governance and tax deductibility of managerial pay on the equilibrium compensation contract and the manager's choice of actions.

3.1 Corporate governance

Incentive-based payment is not the only way to motivate the manager to act in the shareholders' interests. The governance structure of a firm might play an additional role in determining the compensation scheme (v^*, f^*) and the resulting behavior of the manager (a^*, s^*), see for example Desai & Dharmapala (2006) or Armstrong et al. (2015) who empirically analyze the interaction between compensation incentives, corporate governance, and corporate tax avoidance. The existing model is now extended by introducing a firm's governance structure. It is assumed that the governance structure of a firm is exogenously given by the shareholder's monitoring ability m. Like Liang et al. (2008) it is assumed that monitoring reduces the uncertainty of the performance measure and with it the compensation risk that is borne by the manager, i.e. $Var(w)$ is reduced by $\frac{1}{m}$ where $m > 1$. It is assumed that monitoring reduces the total compensation risk. This implies that the shareholders are able to monitor both managerial actions equally.[8] Thus, for a given compensation scheme, the new maximization problem of the manager is

$$\max_{a,s} CE = E\left[w(x)\right] - \frac{a^2}{2} - \frac{r}{2m} Var(w).$$

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[8] Separating the monitoring ability for the two managerial action variables does not yield further insights. Fully eliminating the firm (tax) risk results in a higher (lower) optimal performance based payment compared to v^* in proposition 1. It follows that s^* decreases (increases) and a^* increases (decreases).

It follows that for a given compensation scheme, the manager responds with

$$s^g = \frac{[\tau k - \alpha(1-\tau)]\, m}{rv\tau^2\sigma_{\varepsilon t}^2} \quad \text{and} \quad a^g = v(1-\tau). \tag{8}$$

From the manager's perspective, i.e. for a given v, monitoring makes aggressive tax planning more attractive and leaves the effort decision unaffected, i.e. $s^g > s^*$ and $a^g = a^*$. The reason is that monitoring reduces the compensation risk which includes the indirect costs of tax planning in form of the choice of tax riskiness. The total compensation risk is now given by $Var(w) = \frac{1}{m}\left(v^2(1-\tau)^2\sigma_{\varepsilon f}^2 + v^2\tau^2 s^2\sigma_{\varepsilon t}^2\right)$. Recall, that this variance consists of two terms. The first term consisting of the firm risk depends solely on variables that are beyond the manager's control, i.e. compensation risk is still unaffected by the manager's choice of effort. The second term consisting of the tax risk is also determined by the manager's choice of tax aggressiveness s. It follows that for a reduction in compensation risk due to a more accurate performance measure the manager reacts with an increased s which in turn decreases the accuracy of the performance measure. This effect is summarized in the following proposition.

Proposition 3 *An increase in the shareholder's monitoring ability increases the manager's choice of tax aggressiveness and indirectly incentivizes her to increase obscurity in the performance measure.*

Proof. The effect of a marginal increase in m on aggressive tax planning is given by $\frac{\partial s^g}{\partial m} = \frac{[\tau k - \alpha(1-\tau)]}{rv\tau^2\sigma_{\varepsilon t}^2} > 0$. The effect of an marginal increase in m on compensation risk is given by $\frac{\partial Var(w)}{\partial m} = -\frac{v^2(1-\tau)^2\sigma_{\varepsilon f}^2}{m^2} - \frac{[\tau k - \alpha(1-\tau)]^2}{r^2\tau^2\sigma_{\varepsilon t}^2} + \frac{2[\tau k - \alpha(1-\tau)]^2}{r^2\tau^2\sigma_{\varepsilon t}^2}$. It is easy to see, that the direct effect of monitoring (second term) on risk reduction with respect to tax risk is smaller than the indirect effect (third term). ∎

Thus, for a given compensation scheme, monitoring directly reduces the compensation risk but incentivizes the manager to choose a more aggressive tax planning strategy which in turn increases the variance of the compensation package. The direct effect of the risk reduction with respect to tax risk is outweighed by the indirect increase due to a higher degree of tax aggressiveness.

The shareholders anticipate the manager's behavior and solve

$$\max_{f,v} E(\pi) = [a^g - c(s^g)]\,(1-\tau) + \tau s^g k - w(a^g, s^g)$$

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subject to the manager's new participation constraint given by

$$\overline{CE} \leq f + v\left[(a - \alpha s)(1 - \tau) + \tau ks\right] - \frac{a^2}{2} - \frac{r}{2m}Var(w) \tag{9}$$

and the incentive compatibility constraint shown as the manager's first order condition

$$(a^g, s^g) \in \arg\max_{a,s} CE.$$

The shareholder's first order condition is again derived by using the participation constraint (9) as well as the incentive compatibility constraint and is given by

$$0 = (1 - \tau)^2 - v(1 - \tau)^2 - rv(1 - \tau)^2\frac{\sigma_{\varepsilon f}^2}{m} - \frac{[\tau k - \alpha(1 - \tau)]^2 m}{v^2 r\sigma_{\varepsilon t}^2 \tau^2}. \tag{10}$$

Rearranging and using $a^g = v(1 - \tau)$ gives implicitly the optimal performance-based payment:

$$v^g = \frac{1}{1 + \frac{r\sigma_{\varepsilon f}^2}{m}}\left(1 - \frac{m\left[\tau k - \alpha(1 - \tau)\right]^2}{r\sigma_{\varepsilon t}^2 \tau^2\left(a^*\right)^2}\right).$$

The fixed payment is set so as to satisfy the manager's participation constraint given by equation (9), i.e.

$$f^g = \overline{CE} - \frac{m\left[\tau k - \alpha(1 - \tau)\right]^2}{2r\sigma_{\varepsilon t}^2 \tau^2} - \frac{1}{2}v^2(1 - \tau)^2\left(1 - \frac{r\sigma_{\varepsilon f}^2}{m}\right).$$

Together with the optimal management actions given in (8) this constitutes the equilibrium.

Proposition 4 *When managerial actions are monitored, $m > 1$, the equilibrium contract is given by $w(f^g, v^g)$ and the respective management actions are given by a^g and s^g. The derived equilibrium has an interior solution if the expected marginal tax base reductions due to aggressive tax planning are sufficiently small, i.e. $[\tau k - \alpha(1 - \tau)]^2 < \frac{1}{2m}v^3 r\sigma_{\varepsilon t}^2 \tau^2(1 - \tau)^2(1 + \frac{r\sigma_{\varepsilon f}^2}{m})$.*

Proof. See appendix D. ■

The impact of monitoring on the optimal compensation package is described in the following lemma.

Lemma 2 *The impact of monitoring on optimal performance-based pay depends on the marginal benefit of tax planning:*

(i) $\frac{dv^g}{dm} < 0$, if the marginal benefit of tax planning is sufficiently large, i.e. $(\tau k - \alpha(1-\tau))^2 > \frac{r^2\sigma_{\varepsilon f}^2(1-\tau)^2\sigma_{\varepsilon t}^2 v^3\tau^2}{m^2}.$

(ii) $\frac{dv^g}{dm} > 0$, if the marginal benefit of tax planning is sufficiently small, i.e. $(\tau k - \alpha(1-\tau))^2 < \frac{r^2\sigma_{\varepsilon f}^2(1-\tau)^2\sigma_{\varepsilon t}^2 v^3\tau^2}{m^2}.$

Proof. Writing the first order condition (10) as a function and resubstitution of $a^g = v(1-\tau)$ gives

$$0 = 1 - \frac{m(\tau k - \alpha(1-\tau))^2}{r\sigma_{\varepsilon t}^2 v^2\tau^2(1-\tau)^2} - v\left(1 + \frac{r\sigma_{\varepsilon f}^2}{m}\right) \equiv \varphi(v).$$

Differentiation with respect to m and v and rearranging gives

$$\frac{dv^g}{dm} = \frac{\left(\frac{vr\sigma_{\varepsilon f}^2}{m^2} - \frac{(\tau k - \alpha(1-\tau))^2}{r\sigma_{\varepsilon t}^2 v^2\tau^2(1-\tau)^2}\right)}{\left(1 + \frac{r\sigma_{\varepsilon f}^2}{m} - \frac{2m(\tau k - \alpha(1-\tau))^2}{r\sigma_{\varepsilon t}^2 v^3\tau^2(1-\tau)^2}\right)} \tag{11}$$

Since the denominator is unambiguously positive (see proposition 4), the sign of the total effect of m on v depends on the nominator. For $\frac{vr\sigma_{\varepsilon f}^2}{m^2} < \frac{(\tau k - \alpha(1-\tau))^2}{r\sigma_{\varepsilon t}^2 v^2\tau^2(1-\tau)^2}$ the effect is negative. Rewriting brings the expression in (i). Accordingly, for $\frac{vr\sigma_{\varepsilon f}^2}{m^2} > \frac{(\tau k - \alpha(1-\tau))^2}{r\sigma_{\varepsilon t}^2 v^2\tau^2(1-\tau)^2}$ the effect of monitoring on optimal performance-based pay is positive. Rearranging brings the expression in (ii). ■

In summary, the effect of monitoring on performance-based pay is ambiguous and depends on

$$\frac{vr\sigma_{\varepsilon f}^2(1-\tau)^2}{m^2} \gtrless \frac{(\tau k - \alpha(1-\tau))^2}{r\sigma_{\varepsilon t}^2 v^2\tau^2}.$$

The term on the left hand side indicates that an marginal increase in v increases the risk premium.[9] This effect is reduced by the monitoring ability of the shareholders, i.e. monitoring makes variable pay less expensive. This effect is in line with traditional agency theory

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[9] Recall, that only that part of the risk premium is affected by v that consists of the firm risk. The reason is that the manager's response to a higher performance based pay and with it to higher compensation risk from aggressive tax planning is completely offset by her reduction in the tax aggressiveness.

(e.g. Milgrom & Roberts (1991)) suggesting a complementary relationship between monitoring and incentive-based pay. The right-hand term, on the other hand, is the marginal reduction in after-tax profit due to a less aggressive tax planning strategy as a response to an increase in v. This reduction is higher the higher the monitoring ability m. Thus, the impact on the manager's choice of tax aggressiveness depends on the relation between these two effects and is summarized in the following proposition.

Proposition 5 *The impact on equilibrium tax aggressiveness and productive effort is as follows:*
(i) If $\frac{dv^g}{dm} < 0$, then monitoring unambiguously yields higher tax aggressiveness and lower productive effort.
(ii) If $\frac{dv^g}{dm} > 0$, then monitoring eliminates the trade-off between effort exertion and tax planning stated in lemma 1 for small levels of marginal tax planning benefits, i.e. $(\tau k - \alpha(1-\tau))^2 < \frac{r^2(1-\tau)^2\sigma_{\varepsilon t}^2 v^3 \tau^2}{m}$.
(iii) If $\frac{dv^g}{dm} > 0$ and $(\tau k - \alpha(1-\tau))^2 > \frac{r^2(1-\tau)^2\sigma_{\varepsilon t}^2 v^3 \tau^2}{m}$, then monitoring does not eliminate the trade-off between effort exertion and tax planning stated in lemma 1.

Proof. Total differentiation of the manager's response equations given in (8) brings

$$\frac{da^g}{dm} = (1-\tau)\frac{dv^g}{dm}$$

and

$$\frac{ds^g}{dm} = \frac{(\tau k - \alpha(1-\tau))}{rv\tau^2\sigma_{\varepsilon t}^2}\left[1 - \frac{m}{v}\cdot\frac{dv^g}{dm}\right]. \tag{12}$$

For $\frac{dv^g}{dm} < 0$ the impact of monitoring on productive effort is negative and the impact on tax aggressiveness is positive which proves part (i).

For $\frac{dv^g}{dm} > 0$ the effect on productive effort is unambiguously positive. However, the effect on the manager's choice of aggressive tax planning is ambiguous. Substituting (11) in (12) brings

$$\frac{ds^g}{dm} = \frac{(\tau k - \alpha(1-\tau))}{rv\tau^2\sigma_{\varepsilon t}^2}\left[1 - \frac{m}{v}\frac{\left(\frac{vr\sigma_{\varepsilon f}^2}{m^2} - \frac{(\tau k - \alpha(1-\tau))^2}{r\sigma_{\varepsilon t}^2 v^2 \tau^2 (1-\tau)^2}\right)}{\left(1 + \frac{r\sigma_{\varepsilon f}^2}{m} - \frac{2m(\tau k - \alpha(1-\tau))^2}{r\sigma_{\varepsilon t}^2 v^3 \tau^2 (1-\tau)^2}\right)}\right].$$

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The term in brackets is positive, if $\frac{m}{v}\left(\frac{vr\sigma^2_{\varepsilon f}}{m^2} - \frac{(\tau k - \alpha(1-\tau))^2}{r\sigma^2_{\varepsilon t}v^2\tau^2(1-\tau)^2}\right) < \left(1 + \frac{r\sigma^2_{\varepsilon f}}{m} - \frac{2m(\tau k - \alpha(1-\tau))^2}{r\sigma^2_{\varepsilon t}v^3\tau^2(1-\tau)^2}\right)$. From which follows the threshold in (ii): $(\tau k - \alpha(1-\tau))^2 < \frac{r\sigma^2_{\varepsilon t}v^3\tau^2(1-\tau)^2}{m}$. For $(\tau k - \alpha(1-\tau))^2 > \frac{r\sigma^2_{\varepsilon t}v^3\tau^2(1-\tau)^2}{m}$ the term becomes negative and tax aggressiveness is reduced by an increase in monitoring. ∎

It follows that monitoring might eliminate the trade-off stated in lemma 1 between effort and tax planning and yields a higher performance-based payment, a higher effort dedication and a higher degree of tax aggressiveness if the marginal benefit of tax planning is not too large. The reason is, that for small marginal tax planning benefits, the effect of m on tax planning s^g is positive and larger than the negative marginal effect of an increased v on tax planning, i.e. the tax planning effect outweighs the performance-based pay effect on aggressive tax planning.

3.2   Tax deductibility of incentive pay

So far the effect of tax deductibility of management bonus payments for the corporation has been negleglected. Seidman and Stomberg (2012) find that an increasing performance-based pay reduces corporate tax avoidance suggesting that high bonuses imply large tax benefits which in turn reduce the firm's demand for additional corporate tax avoidance (so called tax exhaustion theory).

Now assume that δ is the extent to which management bonus is tax deductible. We abstract from monitoring by setting $m = 1$. When the bonus payment is tax deductible to a degree $\delta \in (0, 1)$, the shareholder's maximization problem is given by:

$$\max_{f,v} E(\pi) = [a - c(s)](1-\tau) + \tau sk - w(a,s) + \tau v\delta E(x).$$

Since the tax deductibility of bonus payments does not affect the manager's optimal choices of s and a, her maximization problem and her best responses to a given compensation scheme are still given by equations (3) and (4). Derivation of the shareholder's profit with respect to v while using s^* and a^* as well as the participation constraint gives the new first order condition:

$$0 = 1 - \frac{\tau k - \alpha(1-\tau)}{rv^2\tau^2\sigma^2_{\varepsilon t}(1-\tau)^2} + v\left(2\tau\delta - 1 - r\sigma^2_{\varepsilon f}\right) \tag{13}$$

Summarizing and using $a^* = v(1-\tau)$ gives the optimal performance-based payment when

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the manager's variable payment is tax deductible:

$$v^d = \frac{1}{1 + r\sigma_{\varepsilon f}^2 - 2\tau\delta} \left[1 - \frac{(\tau k - \alpha(1-\tau))^2}{r\sigma_{\varepsilon t}^2 \tau^2 (a^*)^2} \right]$$

The fixed payment is set so as to satisfy the manager's participation constraint given by equation (5), i.e.

$$f^d = \overline{CE} - \frac{[\tau k - \alpha(1-\tau)]^2}{2r\sigma_{\varepsilon t}^2 \tau^2} - \frac{1}{2}v^2(1-\tau)^2 \left(1 - r\sigma_{\varepsilon f}^2\right).$$

Together with the optimal management actions given in (4) this constitutes the equilibrium.

Proposition 6 *When performance-based payments are tax deductible, the equilibrium contract is given by $w(f^d, v^d)$ and the respective management actions are given by a^* and s^*. The derived equilibrium has exactly one solution if the expected marginal tax base reductions due to aggressive tax planning are sufficiently small, i.e. $[\tau k - \alpha(1-\tau)]^2 < \frac{1}{2}v^3 r\sigma_{\varepsilon t}^2 \tau^2 (1-\tau)^2 (1 + r\sigma_{\varepsilon f}^2 - 2\tau\delta).$*

Proof. See appendix E. ∎

The impact of the degree of tax deductibility of performance-based payments, such as bonuses, is summarized in the following proposition:

Proposition 7 *The higher (lower) the deductibility of the performance-based pay, the higher (lower) the performance-based payment, the higher (lower) the equilibrium productive effort, and the lower (higher) the degree of corporate tax aggressiveness.*

Proof. Writing equation (13) as a function of v yields

$$0 = 1 - \frac{(\tau k - \alpha(1-\tau))^2}{r\sigma_{\varepsilon t}^2 v^2 \tau^2 (1-\tau)^2} - v(1 + r\sigma_{\varepsilon f}^2 - 2\tau\delta) \equiv \varphi(v^d).$$

The impact of δ on optimal v is obviously positive. Implicit differentiation of $\varphi(v)$ with respect to the degree of tax deductibility yields:

$$\frac{\partial v^d}{\partial \delta} = -\frac{2v\tau}{-1 - r\sigma_{\varepsilon f}^2 + 2\tau\delta + \frac{2(\tau k - \alpha(1-\tau))^2}{r\sigma_{\varepsilon t}^2 \tau^2 (1-\tau)^2 v^3}}$$

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which is unambiguously positive. Since the denominator is negative as stated in proposition 6, it follows that $\frac{\partial v^d}{\partial \delta} > 0$. Since the manager's response is still given by the equations in (4), lemma 1 applies. Thus, effort increases and tax aggressiveness decreases with an increasing performance-based pay. ■

A high degree of tax deductibility makes performance-based pay less expensive and therefore more attractive for the shareholder which may offer a different explanation for the empirically observed negative relationship between tax deductibility and corporate tax aggressiveness. They increase performance-based pay which yields an increase in productive effort and a decrease in corporate tax aggressiveness due to the effects stated in lemma 1.

4 Conclusion

In this paper, a principal-agent model is used to analyze how managerial incentives provided by the compensation scheme as well as monitoring affect the level of corporate tax aggressiveness. In the model, shareholder value is determined by managerial productive effort as well as by the choice of the corporate tax planning strategy. Choosing a tax planning strategy is viewed as an investment choice and is characterized by its variance as well as by its expected tax savings, i.e. a higher expected value of tax savings implies a higher level of tax risk.

The framework used in this paper suggests a negative relationship between linear performance-based pay and corporate aggressive tax planning as well as an ambiguous effect of monitoring on performance-based pay when tax planning is viewed as a risky project. This paper extends the existing literature on corporate tax avoidance and management incentives by taking the compensation scheme offered by the shareholders as endogenous and by assuming that the manager can, besides dedicating productive effort, explicitly determine the total compensation risk by choosing a more or less risky tax strategy. The model shows countervailing effects of performance-based pay on productive effort and tax aggressiveness when introducing asymmetric information. In particular, the results show that aggressive tax planning is decreasing while productive effort is increasing with increasing (linear) performance-based payment, such as bonuses or stock holdings. The reason is that a higher variable payment increases the compensation risk. The risk-averse manager responds with a reduction in the compensation risk by choosing a less aggressive tax planning strategy. The model is extended by the firm's corporate governance structure operationalized as monitoring as well as by the degree to which management payments are

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tax deductible. It can be shown that the equilibrium performance-based pay is increasing in the degree of tax deductibility. It follows that effort increases and aggressive tax planning decreases. The results further indicate that the impact of corporate governance on the equilibrium outcomes is ambiguous but that corporate governance may eliminate the contrary effects of performance-based pay when marginal returns of tax planning are sufficiently low, i.e. a higher performance-based pay due to an increased monitoring ability results in higher productive effort and higher tax aggressiveness. When marginal returns from tax planning are sufficiently high, then higher monitoring results in a decreasing performance-based pay resulting in higher tax aggressiveness.

In summary, the model presented here allows an equilibrium analysis of the compensation package that is offered to the manager and the resulting management behavior with respect to tax aggressiveness and effort dedication. The results offer an additional explanation for the empirical observations that show a negative relationship between management incentives and corporate tax avoidance and gives insights in the interdependencies between monitoring, incentives and corporate tax aggressiveness. Moreover the impact of monitoring on performance-based pay and on corporate tax aggressiveness may depend on the marginal returns of tax planning. This paper provides helpful hypotheses that can be tested in future empirical studies.

A Derivation of the shareholder's first order condition

The shareholder's maximization problem is given by

$$\max_{f,v} E(\pi) = [a - c(s)] (1 - \tau) + \tau sk - f - v \left[(a - c(s))(1 - \tau) + \tau sk \right]. \qquad (14)$$

We obtain the following term for the fixed compensation component by using the manager's participation constraint which in equilibrium holds as an equality:

$$f = \overline{CE} - v \left[(a - \alpha s)(1 - \tau) + \tau sk \right] + \frac{a^2}{2} + \frac{r}{2} Var(w)$$

Using equation (14) and the incentive compatibility constraint, the problem becomes:

$$\max_{v} E(\pi) = [a^* - \alpha s^*] (1 - \tau) + \tau s^* k - \overline{CE} - \frac{(a^*)^2}{2} - \frac{1}{2} r \left[v^2 (1 - \tau)^2 \sigma_{\varepsilon f}^2 + v^2 \tau^2 (s^*)^2 \sigma_{\varepsilon t}^2 \right].$$

Using (4) and the above derived terms for f yields

$$\max_{v} E(\pi) = \left[v(1 - \tau) - \alpha \frac{\tau k - \alpha(1 - \tau)}{vr\sigma_{\varepsilon t}^2 \tau^2} \right] (1 - \tau) + \tau k \frac{\tau k - \alpha(1 - \tau)}{vr\sigma_{\varepsilon t}^2 \tau^2}$$

$$- \overline{CE} - \frac{(v(1 - \tau))^2}{2} - \frac{1}{2} r \left[v^2 (1 - \tau)^2 \sigma_{\varepsilon f}^2 + v^2 \tau^2 \sigma_{\varepsilon t}^2 \left(\frac{\tau k - \alpha(1 - \tau)}{vr\sigma_{\varepsilon t}^2 \tau^2} \right)^2 \right].$$

Derivation with respect to v yields:

$$0 = \left[(1 - \tau) + \alpha \frac{\tau k - \alpha(1 - \tau)}{v^2 r \sigma_{\varepsilon t}^2 \tau^2} \right] (1 - \tau) - \tau k \frac{[\tau k - \alpha(1 - \tau)]}{v^2 r \sigma_{\varepsilon t}^2 \tau^2} - v(1 - \tau)^2 - rv(1 - \tau)^2 \sigma_{\varepsilon f}^2$$

Summarizing gives the first order condition.

B Existence of the equilibrium (proposition 1)

This proof follows Grossmann et al. (2011). The shareholder's first order condition is given by

$$0 = (1 - \tau)^2 - v(1 - \tau)^2 - rv(1 - \tau)^2 \sigma_{\varepsilon f}^2 + \alpha(1 - \tau) \frac{\tau k - \alpha(1 - \tau)}{v^2 r \sigma_{\varepsilon t}^2 \tau^2} - \tau k \frac{\tau k - \alpha(1 - \tau)}{v^2 r \sigma_{\varepsilon t}^2 \tau^2}.$$

The shareholder's second order condition for an interior maximum is given by

$$\frac{\partial^2 E(\pi)}{\partial v^2} = -(1-\tau)^2 - r\sigma_{\varepsilon f}^2(1-\tau)^2 + 2 \cdot \frac{[\tau k - \alpha(1-\tau)]^2}{r\sigma_{\varepsilon t}^2 \tau^2 v^3} < 0$$

and is satisfied if $[\tau k - \alpha(1-\tau)]^2 < \frac{1}{2}v^3 r\sigma_{\varepsilon t}^2 \tau^2(1-\tau)^2(1+r\sigma_{\varepsilon f}^2)$.

Summarizing and writing the first-order condition as a function of v yields

$$0 = 1 - \frac{(\tau k - \alpha(1-\tau))^2}{r\sigma_{\varepsilon t}^2 v^2 \tau^2(1-\tau)^2} - v(1+r\sigma_{\varepsilon f}^2) \equiv \varphi(v). \tag{15}$$

Function (15) is a continuous function of v on the interval $(0,1]$, where $\lim\limits_{v\to 0}\varphi(v) = -\infty$ and $\varphi(1) = -\frac{(\tau k - \alpha(1-\tau))^2}{r\sigma_{\varepsilon t}^2 \tau^2(1-\tau)^2} - r\sigma_{\varepsilon f}^2 < 0$. Recall that only those cases are considered where risky corporate tax planning implies a net benefit, i.e. $\tau k - \alpha(1-\tau) > 0$. From $\frac{\partial \varphi(v)}{\partial v} = \frac{2(\tau k - \alpha(1-\tau))^2}{r\sigma_{\varepsilon t}^2 v^3 \tau^2(1-\tau)^2} - (1+r\sigma_{\varepsilon f}^2)$ and $\frac{\partial^2 \varphi(v)}{\partial v^2} = -\frac{6(\tau k - \alpha(1-\tau))^2}{r\sigma_{\varepsilon t}^2 v^4 \tau^2(1-\tau)^2} < 0$ it follows that function (15) has one local maximum at $v^{\max} = \sqrt[3]{\frac{2(\tau k - \alpha(1-\tau))^2}{r\sigma_{\varepsilon t}^2 \tau^2(1-\tau)^2(1+r\sigma_{\varepsilon f}^2)}} \in (0,1)$ with $\varphi(v^{\max}) > 0$ for $[\tau k - \alpha(1-\tau)]^2 < \frac{4r\sigma_{\varepsilon t}^2 \tau^2(1-\tau)^2}{27(1+r\sigma_{\varepsilon f})}$. Together with the above values of the interval limits it follows that the function has two zeros, i.e. one that is smaller than $v^{\max}$ and one that is higher than $v^{\max}$. Since $v^{\max}$ is the point where the shareholder's second-order condition becomes zero and $\frac{\partial \varphi(v)}{\partial v} > 0$ for $v < v^{\max}$ as well as $\frac{\partial \varphi(v)}{\partial v} < 0$ for $v > v^{\max}$, it follows that $v^* > v^{\max}$ is the equilibrium value of the bonus rate.

C   Firm and tax risk

Implicit differentiation of $\varphi(v^*)$ with respect to firm risk $\sigma_{\varepsilon f}^2$ gives

$$\frac{\partial v^*}{\partial \sigma_{\varepsilon f}^2} = -\frac{\frac{\partial \varphi(v)}{\partial \sigma_{\varepsilon f}^2}}{\frac{\partial \varphi(v)}{\partial v}} = \frac{vr}{\frac{2(\tau k - \alpha(1-\tau))^2}{r\sigma_{\varepsilon t}^2 \tau^2(1-\tau)^2 v^3} - 1 - r\sigma_{\varepsilon f}^2} \tag{16}$$

which is unambiguously negative. The nominator is positive because $v \in (0,1]$ and $\tau \in (0,1)$ per definition. Rewriting $\frac{\partial \varphi(v)}{\partial v}$ brings:

$$\frac{2(\tau k - \alpha(1-\tau))^2 - (1+r\sigma_{\varepsilon f}^2)r\sigma_{\varepsilon t}^2 \tau^2(1-\tau)^2 v^3}{r\sigma_{\varepsilon t}^2 \tau^2(1-\tau)^2 v^3}.$$

Since the denominator is negative (see lemma 2), $\frac{\partial v^*}{\partial \sigma_{\varepsilon f}^2}$ is negative from which follows that $\frac{\partial v^*}{\partial \sigma_{\varepsilon f}^2} < 0$.

Further, the derivative of the equilibrium effort exertion $a^* = v(1-\tau)$ with respect to $\sigma_{\varepsilon f}^2$ is given by

$$\frac{\partial a^*}{\partial \sigma_{\varepsilon f}^2} = (1-\tau)\frac{\partial v^*}{\partial \sigma_{\varepsilon f}^2} < 0.$$

With $\frac{\partial v^*}{\partial \sigma_{\varepsilon f}^2} < 0$ it follows that $\frac{\partial a^*}{\partial \sigma_{\varepsilon f}^2} < 0$.

The derivative of the optimal degree of tax aggressiveness is given by

$$\frac{\partial s^*}{\partial \sigma_{\varepsilon f}^2} = -\frac{\tau k - \alpha(1-\tau)}{r v^2 \tau^2 \sigma_{\varepsilon t}^2} \cdot \frac{\partial v^*}{\partial \sigma_{\varepsilon f}^2} > 0.$$

Since $\frac{\partial v^*}{\partial \sigma_{\varepsilon f}^2} < 0$ it follows that $\frac{\partial s^*}{\partial \sigma_{\varepsilon f}^2} > 0$.

Implicit differentation of $\varphi(v^*)$ with respect to tax risk $\sigma_{\varepsilon t}^2$ gives

$$\frac{\partial v^*}{\partial \sigma_{\varepsilon t}^2} = -\frac{\frac{\partial \varphi(v)}{\partial \sigma_{\varepsilon t}^2}}{\frac{\partial \varphi(v)}{\partial v}} = -\frac{\frac{(\tau k - \alpha(1-\tau))^2}{r\left(\sigma_{\varepsilon t}^2\right)^2 \tau^2 (1-\tau)^2 v^2}}{\frac{2(\tau k - \alpha(1-\tau))^2}{r\sigma_{\varepsilon t}^2 \tau^2 (1-\tau)^2 v^3} - 1 - r\sigma_{\varepsilon f}^2} > 0. \tag{17}$$

Since the denominator is negative, the effect of the tax risk on variable pay is unambiguously positive. Further, the derivative of the equilibrium effort exertion $a^* = v(1-\tau)$ with respect to $\sigma_{\varepsilon t}^2$ is given by

$$\frac{\partial a^*}{\partial \sigma_{\varepsilon t}^2} = (1-\tau)\frac{\partial v^*}{\partial \sigma_{\varepsilon t}^2} > 0.$$

The derivative of the optimal degree of tax aggressiveness is given by

$$\frac{\partial s^*}{\partial \sigma_{\varepsilon t}^2} = -\frac{[\tau k - \alpha(1-\tau)]}{r\tau \left(\sigma_{\varepsilon t}^2\right)^2 v} - \frac{[\tau k - \alpha(1-\tau)]}{r\tau \sigma_{\varepsilon t}^2 v^2}\frac{\partial v^*}{\partial \sigma_{\varepsilon t}^2} < 0.$$

Since $\frac{\partial v^*}{\partial \sigma_{\varepsilon t}^2} > 0$ it follows that $\frac{\partial s^*}{\partial \sigma_{\varepsilon t}^2} < 0$.

D Equilibrium with corporate governance (proposition 5)

The shareholder's first order condition is

$$0 = (1-\tau)^2 - v(1-\tau)^2 - \frac{rv(1-\tau)^2 \sigma_{\varepsilon f}^2}{m} - \frac{m[\tau k - \alpha(1-\tau)]^2}{v^2 r \sigma_{\varepsilon t}^2 \tau^2}. \tag{18}$$

The second order condition for an interior maximum is given by

$$\frac{\partial^2 E(\pi)}{\partial v^2} = -(1-\tau)^2 - \frac{r\sigma_{\varepsilon f}^2(1-\tau)^2}{m} + \frac{2m\left[\tau k - \alpha(1-\tau)\right]^2}{r\sigma_{\varepsilon t}^2\tau^2 v^3} < 0$$

and is satisfied if $[\tau k - \alpha(1-\tau)]^2 < \frac{1}{2m}v^3 r\sigma_{\varepsilon t}^2\tau^2(1-\tau)^2(1+\frac{r\sigma_{\varepsilon f}^2}{m})$. The derivation for the existence and uniqueness of this equilibrium works analogously to appendix B and is therefore omitted.

E Equilibrium with tax deductibility (Proposition 6)

The shareholder's second order condition for a maximum is given by

$$\frac{\partial^2 E(\pi)}{\partial v^2} = -1 - r\sigma_{\varepsilon f}^2 + \frac{2\left[\tau k - \alpha(1-\tau)\right]^2}{r\sigma_{\varepsilon t}^2\tau^2 v^3(1-\tau)^2} + 2\tau\delta < 0$$

which is only satisfied if $[\tau k - \alpha(1-\tau)]^2 < \frac{1}{2}v^3 r\sigma_{\varepsilon t}^2\tau^2(1-\tau)^2(1+r\sigma_{\varepsilon f}^2-2\tau\delta)$. The derivation for the existence and uniqueness of this equilibrium works analogously to appendix B and is therefore omitted.

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