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Fiscal treatment of managerial compensation - a welfare analysis

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Abstract

In a principal-agent model, we analyze the consequences of bonus taxes agents need to pay, limited deductibility of bonuses from company profits and a corporate income tax (CIT). We explore how these tax instruments affect managerial incentives and how they change the design of incentive contracts used in equilibrium. Introducing bonus taxes decreases the agent's net bonus and reduces effort. Limited deductibility has neither effect. In equilibrium, both instruments reduce the agent's effort and net bonus. Gross bonus payments may increase when a bonus tax is introduced. The CIT has no effect on the incentive contract. In terms of welfare, limited deductibility and bonus taxes are close substitutes. Both lead to a welfare loss compared to a CIT raising the same amount of tax revenue. Welfare can be increased by paying a subsidy for bonus payments.

Keywords: Bonus Tax; Limited Deductibility; Principal-Agent Model; Welfare Effects; Executive Compensation

JEL Codes: H25; J3; M52

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1 Introduction

In the context of the recent financial and fiscal crisis, a public debate about high payments for bankers and other managers, their compensation packages and possible regulating mechanisms came up. Several politicians called out “greed and recklessness” in the financial system¹ and considered bankers’ pay to be disproportionately high.² In response, some countries reformed and many others discussed the tax treatment of managerial compensation. Nevertheless, there is not much known about the various effects thereof.

This paper compares three taxation instruments in a unified principal-agent framework and fills this gap. We use a tax system with tax instruments that were discussed - and partly even implemented. These are bonus taxes, limited deductibility of bonus payments and a corporate income tax (CIT). Comparing them, we analyze their effects on managerial incentives, the design of incentive contracts used in equilibrium and their welfare implications. This will be done using a principal-agent model in which the agent with limited liability can receive a fixed wage and a bonus and in which both the principal’s profit and the agent’s income are potentially subject to the following taxes. First, we consider a CIT payable by the principal and based on net profit. Second, we introduce a bonus tax which is a surtax on managerial bonuses payable by the agent. This tax is comparable to the 50% bank payroll tax introduced in the UK in 2009 and levied on bankers’ bonus payments exceeding 25.000 GBP for the fiscal year 2009-2010 (UK Finance Act 2010, Schedule 1).³ Other examples are Ireland, that introduced a 90% bankers’ bonus tax in January 2011 for banks supported by the government⁴, and the US, where the House of Representatives approved such a 90% tax already in March 2009.⁵ The third tax instrument modeled is a set of rules concerning

¹“Darling Targets Bonuses, Says Rich will Pay More Tax” (bloomberg.com, 2009, Sep 28).

²See “E.U. Could Trim Bank Bonuses” (advisorone.com, 2012, Apr 25): “[...] According to Michel Barnier, the financial services commissioner of the E.U., some banker pay is beyond ‘all reason, common sense and morality.’ [...]” or “Obama attacks Wall Street’s executive bonuses as ‘shameful’” (Financial Times, 2009, Jan 30) .

³In UK, the bank payroll tax had to be paid by the banks. Eventhough, as our interest in the tax incidence and the effects on compensation structure does not depend on the taxpayer, we model the bonus tax in line with literature (e.g. Dietl et al., 2011) that it be payable by the manager.

⁴See “Ireland to reintroduce 90% bank bonus tax” (guardian.co.uk, 2011, Jan 26).

⁵“Bonus Tax Heads to Senate After House Passes 90% Levy” (bloomberg.com, 2009, Mar 20).

the deductibility of bonus payments as operating expenses against the corporate income tax. Limited deductibility of bonuses from the corporate tax base broadens the corporate tax base and leads to a higher corporate tax burden, *ceteris paribus*. In the US, annual salaries exceeding 1 Mio USD are not deductible.⁶ In other countries, limited deductibility is publicly debated. In Germany, limited deductibility of business expenses for bonus payments is requested by the parties “Die Linke” and “Bündnis 90, Die Grünen”. In Switzerland, the Swiss Federal Council and the Council of States also tried to incorporate a limited deductibility of salaries exceeding 3 Mio CHF in a referendum but were blocked by the National Council.⁷

Our results suggest the following: For a given compensation structure, a bonus tax directly lowers the agent’s net bonus and leads to a reduced effort choice once it is introduced. In contrast, neither limited deductibility nor a CIT affect existing managerial incentives. In equilibrium, where the principal anticipates the agent’s optimal effort choice, any taxation of bonuses will lead to reduced effort and net bonus. In the case of limited deductibility, the principal accounts for his own higher tax burden and thus incentivizes a lower effort level by reducing the agent’s bonus. A bonus tax, however, can also lead to an increased gross bonus payment by the principal. Nevertheless, both mentioned ways of bonus taxation are close substitutes and lower welfare. Compared to a situation where only a CIT is used to raise tax revenue, both reduce the principal’s and the agent’s rent. With full deductibility of bonuses thereof, a CIT is superior as it affects neither managerial incentives nor the design of the incentive contracts used in equilibrium. Without regard to its political implications, we find that governmental intervention can increase welfare towards the first best solution. This can be achieved by using a corrective tax system: subsidizing bonus payments while financing those expenses by way of an increased CIT.

Existing research on executive compensation generally can be divided into two lines of literature: the managerial power approach and the efficient-contracting approach.⁸ In the former view, compensation agreements are seen as an outcome

⁶According to § 162 (m)(1) IRC, for the CEO and the next four highest-paid officers of a firm, no deduction for remuneration that exceeds 1 Mio USD for the tax year is allowed. It should be noted that there is a complex exception for compensation paid under a “performance-based plan”.

⁷See “Switzerland: Proposals affecting executive compensation” (pwc.ch, 2012, Oct).

⁸Frydman and Jenter (2010) and Murphy (2013) provide an overview on the contributions

of powerful, rent-seeking managers that can influence their own pay. It was mostly proposed by Bebchuk et al. (2002), Bebchuk and Fried (2003) and Bebchuk and Fried (2004). We, and literature in large part, focus on the latter line of efficient or optimal contracting by using agency theory. This line of literature studies the relationship between a firm owner and a manager who is incentivized to operate the company. Competitive market forces foster optimal contracting and allow an analysis of the problem of imperfect information and moral hazard.⁹ Our framework builds on the assumption of limited liability, which was first introduced by Sappington (1983). He shows that a first best outcome is not obtainable between a risk-neutral principal and a risk-neutral, wealth-constrained agent. In contrast to Sappington (1983), in which the agent made an ex-post effort choice after observing the realization of the state of nature, we analyze a situation where the agent makes an ex-ante effort choice as in Innes (1990), Park (1995) and Kim (1997), among others. As Laffont and Martimort (2001, p. 194) we additionally assume two possible outcomes with a continuum of effort levels. In order to compare tax instruments, we expand their specification in that respect and adjust the structure of compensation payments to our purposes.

The effects of different tax instruments on executive compensation have also been studied empirically. Hall and Liebman (2000) analyze how various tax rates (personal, corporate and capital gains tax rates) affect the structure of executives' compensation and find little evidence for tax policy influencing remuneration. Katuscák (2004) evaluates the impact of personal income taxes on the pay-to-stock-price sensitivity generated by stock-option and restricted stock grants. While, for option grants, higher tax rates decrease the pay-to-performance sensitivity, no such effect can be found for the sensitivity generated by restricted stock grants. For bonus taxes as modeled in this paper, von Ehrlich and Radulescu (2012) explore the reaction of compensation structure to the above mentioned UK bank payroll tax which was introduced in 2009. Their data suggests a reduction in bonus payments of 40%, which, however, was accompanied by an one-to-one increase in other pay components not subject to the tax. Altogether, they find that overall compensation was not affected by the bonus tax.

in both lines of literature and analyze strengths and weaknesses of both.

⁹Early contributions in this area were made by Ross (1973), Jensen and Meckling (1976), Harris and Raviv (1979), Holmström (1979), Shavell (1979), and Grossman and Hart (1983) among others.

Apart from the literature on agency theory, this paper is related to studies on taxation and regulation of the financial sector.¹⁰ Regarding bonus taxation, this literature can be split in two basic lines of research: with and without externalities. The first one models taxation in combination with bailout or competition as a systemic externality. For the externality of bailouts, Besley and Ghatak (2011) find that a bonus tax affects the tradeoff between efficiency and rent extraction, whereas Keen (2011b) claims that corrective taxation requires a charge on the bank's borrowing which can be supported by minimum capital requirements. According to Besley and Ghatak (2013) bonus taxation, next to standard progressive income taxation, is optimal when there is moral hazard with respect to both effort and risk taking. The negative externality of competition is emphasized in Thanassoulis (2011). He finds that competing for the best teams of bankers drives up remuneration and, thus, rival banks' expected costs of bankruptcy. With regard to financial regulation his findings suggest that bonus caps are value-destroying. A second research line models bonus taxation without systemic externalities. Dietl et al. (2011) analyze the effects of a bonus tax on the composition of executives' compensation and their incentives to exert effort in a principal-agent model with a risk-averse agent. They find that the effects depend on the uncertainty of the economic environment and the agent's risk aversion. Grossmann et al. (2012) extend this model to an agent who can influence expected outcome next to effort also via his risk-taking behavior. There, a bonus tax induces higher risk-taking and lower effort by the agent. The compensation structure shifts towards a fixed salary. The effects of a bonus tax in a two-country framework with endogenous or exogenous reservation wages are studied in Radulescu (2012). She also finds that the introduction of a bonus tax in one country results in a decline in the agent's effort and that the incidence mainly falls on the firm's shareholders. In the case of endogenous reservation wage, results are largely similar and depend on the strength of the negative reaction of the reservation wage to the bonus tax.

This paper contributes to the literature as it - next to an analysis of the effects of a bonus tax - additionally examines the effects of different tax instruments such as a CIT and limited deductibility of bonus payments from the CIT. We provide a unified framework, making the mentioned tax instruments and their effects on

¹⁰For a broader analysis of proposed and discussed additional new tax measures on the financial sector, e.g. the Financial Transactions Tax or the Financial Activities Tax, see Shackelford et al. (2010), Keen (2011a) and Devereux (2011).

effort choice and welfare comparable.

The paper is structured as follows. In the next section the model will be introduced and the optimal compensation structure chosen by the principal will be derived. In addition, the different tax instruments and their effects on the effort level and the bonus payments are analyzed. Section 3 discusses the welfare effects of the different tax instruments. Section 4 concludes.

2 Incentive Contracts in a Principal-Agent-Setup

In the following subsections we will first introduce the model and solve the equilibrium (section 2.1). In section 2.2, comparative statistics will follow.

2.1 Model and Equilibrium

Principal-agent setup.

The model specification is as follows: There is one risk-neutral shareholder (principal) who delegates the task of operating the company to a risk-neutral manager (agent), who has limited liability and zero initial wealth.¹¹ This is done by offering a take-it-or-leave-it contract to the manager, who has an exogenous outside option $\underline{u} \in R_0^+$. If the manager accepts the contract, he starts operating the firm by choosing an unobservable effort level from a continuum $e \in [0, 1]$. For the manager, the effort he exerts comes at an effort cost $C(e)$. In line with the literature, we make two assumptions on the effort cost function: First, it is considered as strictly convex ($C''(e) > 0$, $C'''(e) > 0$, $C''''(e) > 0$) with $C(0) = 0$.¹² Second, to ensure interior solutions, the Inada conditions $C'(0) = 0$ and $\lim_{e \rightarrow 1} C'(e) = \infty$ are imposed on the cost function. Firm profit is random and depends on the state of the world $s \in \{1, 2\}$. It can take two values: high (and equal to π_1) or low (and equal to π_2) with $\pi_1 > \pi_2 \geq 0$. Effort e determines the probability by which profit is high. By appropriate normalization, this probability is equal to e . Once the profit π_s is determined, the agent is paid. As compensation for the task of operating the company, the manager is offered a linear payment

¹¹We decided on a risk-neutral principal and a risk-neutral agent as we are interested in the effects of different tax instruments rather than in risk sharing issues.

¹²Note that $C''''(e) > 0$ ensures strict concavity of the principal's maximization problem. Though, in order to satisfy the second order condition for a maximum, $C''''(e^{SB}) > -\frac{2C'''(e^{SB})}{e^{SB}}$ is sufficient.

scheme consisting of two components. First, the agent is paid a fixed wage $A \in \mathbb{R}_0^+$ independently of the state of the world. Secondly, the principal can remit an additional bonus when the task was successful, i.e. if $\pi_s = \pi_1$.¹³ This bonus is specified such that a bonus rate $b \geq 0$ is applied on the difference between the profit levels in the good and the bad state of the world. This gives, in total, a bonus $b(\pi_1 - \pi_2)$ to be added to the fixed wage A . The principal keeps the residual of the profit. Accordingly, the expected payoff EU_P for the principal is

$$EU_P = e(1-t)(\pi_1 - A) - e(1-\alpha t)b(\pi_1 - \pi_2) + [1-e](1-t)(\pi_2 - A). \quad (1)$$

Government.

Before the take-it-or-leave-it contract is offered to the agent, the government can implement up to three different tax instruments. First, the principal's operating profits net of compensation payments can be taxed by a corporate income tax (CIT), $t \in [0, 1]$. Second, deductibility of bonus payments from the CIT base can be restricted, thereby broadening the CIT base and increasing taxes. Tax deductibility of bonus payments is captured by parameter $\alpha \in [0, 1]$, where $\alpha = 1$ means full deductibility of bonus payment from the CIT base. For $\alpha \neq 1$, fixed compensation A and bonus payments $b(\pi_1 - \pi_2)$ are treated differently when it comes to corporate income taxation. The fixed wage is fully deductible from the CIT base whereas bonus payments are not. If $\alpha = 0$, then bonuses are not tax deductible at all from the CIT base, whereas the fixed wage is fully deductible. It follows that, with bonus payments, the firm's tax base, and, accordingly, its tax burden, is higher the lower α is.¹⁴ Third, bonuses can be subject to a bonus tax, $t_b \in [0, 1]$, which has to be paid by the agent.

The agent's total net-compensation, x_1 in the good state of the world and x_2 if the bad state of the world occurs, can be denoted by:

$$\begin{aligned} x_1 &= A + (1 - t_b)b(\pi_1 - \pi_2), \\ x_2 &= A. \end{aligned} \quad (2)$$

¹³Because the principal can observe profit but not the agent's effort, an enforceable contract can only be specified on realized profit π_s .

¹⁴Because of these two tax instruments, the principal's expected payoff EU_P is defined as the difference between operating profit π_s and compensation payments, taking into account the applied tax rates and deductibility.

When the principal offers a contract to the agent, the agent maximizes his expected net income $E(x) - C(e)$ by choosing effort e . Depending on the proposed fixed wage, bonus payments, his effort costs and taxes, the agent's maximization problem is therefore given by

$$\max_{e \in [0,1]} \{A + e(1 - t_b)b(\pi_1 - \pi_2) - C(e)\},$$

from which we get the following first order condition:

$$(1 - t_b)b(\pi_1 - \pi_2) = C'(e). \quad (3)$$

The agent's effort choice will be such that the marginal (net of tax) benefit of an increase in effort equals the marginal effort costs. Taking the agent's optimality condition into account, the principal in the first stage chooses a compensation structure consisting of fixed wage A and bonus parameter b which maximizes his expected payoff EU_P . His maximization problem is as follows:

$$\max_{(A,b) \geq 0} \{e(1 - t)(\pi_1 - A) - e(1 - \alpha t)b(\pi_1 - \pi_2) + [1 - e](1 - t)(\pi_2 - A)\} \quad (4)$$

subject to

$$A + e^{SB}(1 - t_b)b^{SB}(\pi_1 - \pi_2) - C(e^{SB}) \geq \underline{u} \quad (5)$$

$$e^{SB} \in \arg \max_{e \in [0,1]} [E(x) - C(e)] \quad (6)$$

$$x_1, x_2 \geq 0 \quad (7)$$

Equation (5) shows the agent's Participation Constraint, which the principal

has to consider. It states that the agent will only accept the principal's take-it-or-leave-it offer if his expected net-compensation (after income-/ bonus tax) at least remunerates him for the effort level e^{SB} that the principal chooses to induce and the exogenous outside option $\underline{u} \in R_0^+$ which he foregoes. The Incentive Compatibility Constraint (eq. 6) is derived from the agent's FOC (3). It ensures that the agent has a higher expected income when choosing the principal's desired effort level than he would have with any other effort level. To further analyze the case with information asymmetry between principal and agent, we implement moral hazard by assuming $eC''(e) - C(e) \geq \underline{u}$. This condition ensures that the incentive constraint (6) is binding, whereas the participation constraint (5) is not (in case of strict inequality). In addition, we impose the limited liability constraint (7) on the agent's net compensation.¹⁵ Thus, the compensation in any state of the world cannot be negative due to the wealth restrictions the agent is faced with. As the bonus payment is positive by definition, we assume the fixed wage to be non-negative.¹⁶ For x_2 , the constraint is binding, whereas it is slack for x_1 .

Proposition 1. *Suppose that $eC''(e) - C(e) \geq \underline{u}$ holds. Then, there exists a unique equilibrium (A^{SB}, b^{SB}, e^{SB}) where the principal chooses to offer a fixed compensation $A^{SB} = 0$ and a bonus rate*

$$b^{SB} = \frac{1-t}{1-\alpha t} - \frac{e^{SB} C''(e^{SB})}{(1-t_b)(\pi_1 - \pi_2)} \quad (8)$$

and the agent's effort choice is defined such that

$$b^{SB}(\pi_1 - \pi_2) = \frac{C'(e^{SB})}{(1-t_b)}. \quad (9)$$

Proof. See Appendix A1. □

The fact that the fixed wage $A^{SB} = 0$ comes from the assumption on the

¹⁵Constraint (7) ensures that the principal can not apply the general solution of making the agent the residual claimant of the firm to overcome the Moral Hazard problem when both the agent and the principal are risk neutral. This has been shown for example by Harris and Raviv (1979) or Shavell (1979).

¹⁶This implies that the principal cannot extract rents from the agent by paying a negative fixed wage.

agent's exogenous outside option.¹⁷ In order to incentivize the agent to exert the desired effort level e^{SB} , the principal has to pay a bonus b^{SB} . By assuming $eC'(e) - C(e) \geq \underline{u}$, this bonus is in expectation already higher than would be necessary in order to satisfy the participation constraint (5). The principal would like to pay a negative fixed wage, as this would lead to a binding PC. This, again, would leave a higher rent for him. As per assumption, the limited liability constraint (7) prevents him from paying negative compensation; thus, the agent gains an expected rent

$$EU_A = [E(x) - C(e)] = eC'(e) - C(e) > \underline{u} \quad (10)$$

due to his informational advantage combined with his limited liability.

Equation (9) also shows, that only a bonus tax has effects on existing managerial incentives. The introduction of a bonus tax decreases the agent's net bonus and leads to reduced effort by the agent. Limited deductibility has no effects on existing managerial incentives as it has to be borne by the principal via the CIT.

Combining equations (8) and (9) from Proposition 1, we get the following equation which defines the second-best effort level e^{SB} that is induced by the principal:

$$(1 - t)(\pi_1 - \pi_2) = \frac{1 - \alpha t}{(1 - t_b)} [C'(e^{SB}) + e^{SB} C''(e^{SB})]. \quad (11)$$

This second-best effort level under moral hazard is lower than in the first-best case, where effort e^{FB} is observable and contractable. In the first best scenario, characterized by $(1 - t)(\pi_1 - \pi_2) = \frac{1 - \alpha t}{(1 - t_b)} C'(e^{FB})$, the marginal expected profit gain (on the left hand side of the equation) from increasing the effort level by a small amount equals the marginal expected employment costs. In the second best scenario, there is an additional term $\frac{1 - \alpha t}{(1 - t_b)} e^{SB} C''(e^{SB})$.¹⁸ This additional

¹⁷The outcome of $A^{SB} = 0$ relies on the agent's limited liability and the assumptions on the exogenous outside option $eC'(e) - C(e) \geq \underline{u}$. While limited liability ensures $A \geq 0$, the latter constraint makes the Limited Liability Constraint (7) for the bad state of the world binding, i.e. $x_2 = A^{SB} = 0$. As shown by Pitchford (1998), lump sum transfers have no incentive effects whereas an increase in the gap between state-contingent payments leads the agent to increase effort.

¹⁸For comparison, the equation for first best effort shows a situation where only a bonus is paid to the agent. However, as the principal in the first-best case can observe agent's effort, a fixed wage $A^{FB} = C(e^{FB}) + \underline{u}$ and a bonus $b^{FB} = 0$ or a combination making the participation

expression states the tax adjusted marginal costs of the agent's limited liability rent under moral hazard and induces the principal to reduce the implemented effort level to one below the first-best level. This in turn reduces his expected employment costs.¹⁹

2.2 Comparative Statics

Proposition 1 shows that the equilibrium bonus rate paid to the agent (and so the equilibrium effort) depends on the slope and the curvature of the effort cost function and on the different taxation instruments included in the model. In the following, we analyze the different taxation instruments and their effects on the effort level that is incentivized and the respective bonus payment required.

First we look at a bonus tax on bonus payments made if the agent's task was successful (π_1 is observed). As we can see from the optimality conditions (equations (8) and (9)), the conditions for the optimal bonus and the optimal effort for both the principal and the agent depend on t_b , whereas the fixed wage is not affected by a bonus tax.

Corollary 2.

- (i) *Equilibrium effort e^{SB} is strictly decreasing in the bonus tax t_b .*
- (ii) *The equilibrium bonus rate b^{SB} is strictly increasing in the bonus tax t_b if and only if $\pi_1 - \pi_2 > C''(e) \left[\frac{1-\alpha t}{(1-t)(1-t_b)} e + \frac{1}{2C''(e)+e^{SB}C'''(e)} \right]$.*

Proof. See Appendix A2. □

The Corollary shows that the agent's effort choice negatively reacts to a bonus tax. The bonus rate b does not necessarily decrease in the bonus tax t_b .

Ad (i): According to the agent's FOC (3), a (higher) bonus tax reduces the agent's marginal net of tax benefit while marginal costs remain unchanged. From this follows that the agent will reduce equilibrium effort as long as the bonus rate is not increased in such a way that it perfectly compensates for the bonus tax he

constraint binding is also possible. This payment will be made whenever the agent exerts the desired effort e^{FB} - no matter whether the task was successful or not.

¹⁹As we are interested in the differential taxation of compensation components, we abstract from a taxation of the fixed wage. Including a personal income tax, $t_i \in [0, 1)$, based on all of the agent's income components would mean that bonuses would be burdened twice with taxes if both $t_i > 0$ and $t_b > 0$. Note that for the equilibrium fixed wage $A^{SB} = 0$, a personal income tax and a bonus tax would have the same tax base and therefore would be substitutes.

bears. This again does not pay for the principal as incentivizing the same effort level as before is more expensive if the bonus payment is subject to a bonus tax. Using equation (11), one can see that equilibrium effort strictly decreases. The principal's marginal expected profit gain from effort remains unchanged, while the marginal expected employment costs of effort increase with the bonus tax. Therefore, equilibrium effort decreases.

Part (ii) of Corollary 2 shows that the total effect of a bonus tax on the bonus rate is ambiguous. There are two effects driving the bonus rate: equilibrium effort and the bonus tax. As the agent reduces equilibrium effort, he expects a lower net-of-tax bonus as his marginal cost of exerting effort also decreases. *Ceteris paribus*, this lowers the (net-of-tax) bonus rate. On the other side, there is the tax-effect from the additional bonus tax that has to be paid. As the agent is only interested in his net-wage, the principal has to compensate him for the additional tax burden. This effect, *ceteris paribus*, increases the (gross) bonus rate which the principal has to pay to the agent.

Second, for the CIT and limited tax deductibility of bonus payments, the described tax-effect of a bonus tax on the bonus rate does not exist. Limited deductibility of bonuses from the CIT-base broadens the tax base for the CIT and, so, indirectly increases the principal's tax burden. The agent, in contrast, is not subject to this tax and does not include it in his FOC (3). From this, we can already follow that, in equilibrium, the effect on effort level and bonus rate will always go in the same direction. For the agent, net and gross bonus rates do not differ for these instruments. Still, there is an effect on effort and the bonus payment via the principal's optimization.

Corollary 3.

(i) *If bonuses are fully deductible ($\alpha = 1$), e^{SB} and b^{SB} are not affected by the CIT t .*

(ii) *If there is limited deductibility of bonuses from the CIT ($\alpha < 1$), then e^{SB} and b^{SB} are strictly decreasing in t . Less deductibility increases the marginal effect of the CIT t if and only if $\frac{1-t}{1-\alpha t} > t$.*

(iii) *If there is a CIT ($t < 1$), then e^{SB} and b^{SB} are strictly increasing in the deductibility α . A higher CIT always increases the marginal effect of α .*

Proof. See Appendix A3. □

Part (i) of the corollary follows from equation (11). With full deductibility of bonus payments from the CIT, a (higher) CIT changes the marginal expected profit gain of effort to the same extent as do the marginal expected employment costs. Therefore there is no change of the bonus rate and, as a result, no adjustment in the desired effort level.²⁰ Parts (ii) and (iii) of Corollary 3 show the distortion due to the limited deductibility of bonus payments from the CIT-base. According to equation (11), there is still no change in the principal's marginal expected profit gain due to the combination of CIT and limited deductibility compared to a situation with full deductibility of bonuses. However, limited deductibility increases the marginal expected employment costs via broadening the CIT-base in case the agent was successful. Therefore, equilibrium effort decreases and a lower bonus is paid in equilibrium. This effect is more pronounced either for the CIT the less deductible bonus payments are, or for limited deductibility the higher the CIT already is.

3 Welfare Comparison of the tax instruments

We have seen how the different taxation instruments distort the implemented effort level (defined by equation (11)) and the agent's bonus rate. We now want to assess whether or not one instrument is superior to the others with regard to welfare implications. For this purpose, we define welfare as the sum of agent's payoff EU_A , principal's payoff EU_P and tax revenue T . This yields welfare $EU_A + EU_P + T = e\pi_1 + (1 - e)\pi_2 - C(e)$. Furthermore, we suppose that the government has to raise an exogenous tax revenue to fulfill its public duties. We denote this revenue requirement by B . By assumption, the government sets its tax rates before the contract between principal and agent is specified. Thus, it takes the equilibrium results from Proposition 1 as given.

The total expected tax revenue consists of two parts: The expected bonus tax paid by the agent, $T_b = eb(\pi_1 - \pi_2)t_b$, and the expected corporate income tax paid by the principal, $T_{cit} = et(\pi_1 - A - \alpha b(\pi_1 - \pi_2)) + (1 - e)t(\pi_2 - A)$. Inserting our equilibrium results from Proposition 1, we get the following expression for

²⁰For the sake of completeness, we would like to add that, without CIT ($t = 0$), limited deductibility does not have any effects as a broadening of the (non-existing) tax base cannot have an impact.

total expected tax revenue $E(T)$:

$$E(T) = t [\pi_2 + e^{SB} (\pi_1 - \pi_2)] + e^{SB} \frac{C' (e^{SB}) (t_b - \alpha t)}{(1 - t_b)}. \quad (12)$$

As all parties involved in our model (principal, agent and government) are risk neutral, all payments (wage, tax) have only distributional impacts and do not affect welfare. Altogether, our welfare optimization problem can be written as

$$\max_{t, t_b, \alpha} \{e\pi_1 + (1 - e)\pi_2 - C(e)\}$$

s.t.

$$E(T(t, t_b, \alpha)) = B \quad (13)$$

where the government chooses its tax instruments in such a way that overall efficiency is highest while still being able to raise in expectation the desired tax revenue B from equation (12). Note that without the tax revenue constraint (13) and being able to directly choose the effort level, the welfare maximizing government would opt for the following result:

$$\pi_1 - \pi_2 = C'(e^*). \quad (14)$$

Confronted with (13) and knowing that the second-best case, due to the agent's limited liability rent, is already characterized by an inefficiently low effort $e^{SB} < e^*$, the government will choose a tax structure which least distorts the agent's effort choice beyond that.

3.1 Optimal mixture of tax instruments

Let us first consider a situation in which the government can choose between the tax instruments in a "normal" range - meaning $t, t_b \in [0, 1)$ and $\alpha \in [0, 1]$. In this setting, the government will always choose to raise its necessary tax revenue solely with the CIT. According to Corollary 3, in the absence of limited deductibility ($\alpha = 1$), this tax instrument does not distort the principal's desired effort level beyond the limited liability rent. Equation (11) reduces to

$(\pi_1 - \pi_2) = [C'(e_t^*) + e_t^* C''(e_t^*)]$ and implies the highest possible effort level in this case. This, again, maximizes welfare whereas a bonus tax and limited deductibility would reduce effort and, consequently, welfare. The optimal tax structure is given by $t^* = \frac{B}{\pi_2 + e^{SB}(\pi_1 - \pi_2)(1 - b^{SB})}$, $\alpha^* = 1$ and $t_b^* = 0$. For politicians, this has the implication that bonus taxation should not be used for revenue purpose because both a bonus tax and limited deductibility of bonuses from the CIT are inferior to a CIT.

3.2 Comparison of bonus tax and limited deductibility of bonuses

Assume restrictions, e.g. an exposure to tax competition, which limit the CIT to $\bar{t} < t^*$ and therewith prohibit the government from raising it to the optimal level analyzed above. In this case, there is some tax revenue which has to be raised from one of the remaining instruments: limited deductibility of bonuses from the CIT and a bonus tax. In order to compare the different bonus taxation regimes, we maximize welfare with an exogenously given CIT $\bar{t} < t^*$ by choosing t_b and α .

From corollaries 2 and 3, we know that both a bonus tax and limited deductibility strictly decrease equilibrium effort e^{SB} . Due to this distortion, a welfare maximizing government will not raise tax revenue beyond its requirement B and will set the CIT to the highest possible level \bar{t} . It follows that the tax revenue constraint (13) will be binding, allowing α and t_b to each be expressed as a function of the other. Inserting either $\alpha(t_b)$ or $t_b(\alpha)$ in equation (11) to define the effort induced by the principal shows that any combination of the two instruments which satisfies the tax revenue requirement (13) maximizes welfare. Thus, it does not matter whether the government limits deductibility to $\alpha^{SB} = \frac{\bar{t}\pi_2 + e_t^{SB}\bar{t}(\pi_1 - \pi_2) - B}{e_t^{SB}\bar{t}C'(e_t^{SB})} < \alpha^*$ while abstaining from a bonus tax, or whether it chooses a bonus rate $t_b^{SB} = \frac{\bar{t} + \mu}{1 + \mu} > t_b^*$ with $\mu = \frac{B - \bar{t}\pi_2 - e_t^{SB}\bar{t}(\pi_1 - \pi_2)}{e_t^{SB}C'(e_t^{SB})}$ while making bonus payments fully deductible from the CIT. Any $\alpha(t_b) = \frac{t_b}{\bar{t}} - \frac{1 - t_b}{e_t^{SB}C'(e_t^{SB})\bar{t}}B + \frac{1 - t_b}{e_t^{SB}C'(e_t^{SB})}[\pi_2 + e(\pi_1 - \pi_2)]$ is welfare equivalent and induces the principal to incentivize effort $e_t^{SB} < e^{SB}$. Compared to the optimal structure of tax instruments (t^*, α^*, t_b^*) , it follows that taxation of bonuses reduces welfare as equilibrium effort will be inefficiently low. Moreover, they are substitutes as they distort effort and welfare to the same extent.

3.3 Increasing welfare by subsidizing bonus payments

Note that welfare maximizing effort is indirectly defined by equation (14), which in our model cannot be reached as information asymmetry and limited liability lead to moral hazard. The principal is faced with a trade-off between efficiency and distribution of rents. Because of the additional marginal costs of the agent's limited liability rent $\frac{1-\alpha t}{(1-t_b)} e^{SB} C''(e^{SB})$, the principal can reduce his expected employment costs by inducing lower effort. This distortion in inducing effort increases the principal's expected rent EU_P at the expense of the agent's rent EU_A . Because of reduced efficiency, this goes along with a welfare loss.

Unlike the principal, the government does not pay attention to the distribution of rents. Its only concern is the maximization thereof. With moral hazard and limited liability, a welfare increase can be achieved if the government is allowed to choose corrective tax instruments, i.e. a negative bonus tax or a very high deductibility of bonus payments ($\alpha > 1$), while financing these subsidies by a higher CIT.²¹

By subsidizing costs related to incentivizing the agent, the government can reduce the principal's expected employment costs. This in turn leads the principal to induce a higher effort level. The effort level with subsidy e^{sub} is shifted towards the welfare maximizing effort e^* . According to equation (11) for second best effort, this is the case for small deviations from the equilibrium as long as the tax component $\frac{1-\alpha t}{(1-t)(1-t_b)}$, on the right hand side, is smaller than 1. Deviating from the tax structure (t^*, α^*, t_b^*) , the government can increase welfare by choosing $t^{sub} > t^*$ and financing with the higher expected revenues either $\alpha^{sub} > \alpha^* = 1$ or $t_b^{sub} < t_b^* = 0$. This leads to higher net bonus payments for the agent.

Proposition 4 summarizes the results gained above:

Proposition 4. *Given a tax revenue requirement B , the following tax structures maximize welfare:*

- (i) *For $t, t_b \in [0, 1]$ and $\alpha \in [0, 1]$, the optimal tax structure is given by $t^* = \frac{B}{\pi_2 + e^{SB}(\pi_1 - \pi_2)(1 - b^{SB})}$, full deductibility ($\alpha^* = 1$) and no bonus tax ($t_b^* = 0$).*
- (ii) *If $\bar{t} < t^*$, any combination of a bonus tax t_b and deductibility of degree $\alpha(t_b) = \frac{t_b}{\bar{t}} - \frac{1-t_b}{eC'(e)\bar{t}}B + \frac{1-t_b}{eC'(e)}[\pi_2 + e(\pi_1 - \pi_2)]$ is welfare maximizing.*

²¹This result has been shown in a setting of optimal tax interventions with incomplete insurance markets by Banerjee and Besley (1990). There, a risk neutral government can use a profit tax to subsidize and thus reduce the capital market interest rate for the risk-averse agent. By this intervention in the credit market, welfare can be increased.

(iii) Allowing for $t_b < 0$ and/or $\alpha > 1$ is welfare increasing compared to (t^*, α^*, t_b^*) .

Proof. See Appendix A4. □

The different tax combinations analyzed in the subsections above also influence the distribution of rents between principal and agent differently. According to equation (10), the agent gains an expected rent $EU_A = eC'(e) - C(e)$. As the marginal expected rent $eC''(e)$ is always positive by assumption, the agent's rent increases when a higher effort level is incentivized and decreases with a less incentivized effort level. As $e_{\bar{t}}^{SB} < e^{SB} < e^{sub}$ in the cases analyzed above, the agent's rent is highest when a bonus subsidy is paid and lowest when the CIT cannot be chosen, but is exogenously given.

The principal's rent can be expressed by simplifying his maximization problem (4) to

$$EU_P = e\pi_1 + (1 - e)\pi_2 - eC'(e) - T \quad (15)$$

which, by assumption, is strictly concave in e and has a global maximum (in the presence of moral hazard) at the effort satisfying $(\pi_1 - \pi_2) = [C'(e) + eC''(e)]$. According to the findings above, the principal's expected rent is maximized for (t^*, α^*, t_b^*) with effort e^{SB} . Whenever either the bonus tax or the limited deductibility deviate from their optimal level t_b^* and α^* , the principal's expected net profit EU_P decreases. This is the case for both an exogenous CIT \bar{t} and a bonus subsidy ($t_b < 0$ or $\alpha > 1$).

4 Conclusion

In this paper, we used a principal-agent model to study the effects of different tax treatments of managerial compensation. More precisely a corporate income tax, a special tax on bonuses and limited deductibility of bonuses from the corporate income tax were subject to our analysis. We identified how these tax instruments affect existing managerial incentives, how they change the design of incentive contracts used in equilibrium and, keeping total tax revenue constant, what their welfare effects are.

Introducing an additional bonus tax decreases the agent's net bonus and brings him to reduce effort. The firm anticipates this reaction in equilibrium and incentivizes a lower effort level by adjusting the gross bonus paid to the agent. Weighing up the principal's (reduced) desired effort and (higher) bonus tax costs, this gross bonus payment can be higher or lower than it would be without a bonus tax. If the difference in potential operating profits is sufficiently high, a bonus tax increases bonus payments to the agent.

Limited deductibility of bonuses from the corporate income tax base has no direct effect on the gross- and/or net bonus payment and, thus, on the agent's incentives. Because limiting the tax deductibility of bonuses makes bonus payments more costly to the principal, in equilibrium he offers a lower bonus rate. This leads to lower effort exerted by the agent in equilibrium.

This negative effect on effort cannot be found under a corporate income tax with full deductibility of bonuses thereof. In our setup, this tax has neither an effect on managerial incentives nor on the design of the incentive contracts used in equilibrium.

In terms of welfare, this makes the corporate income tax superior compared to the other tax instruments as it does not distort the equilibrium effort induced by the principal beyond the adjustment due to moral hazard. Bonus taxation as well as limited deductibility of bonuses from the corporate income tax are close substitutes in their distortionary effects when it comes to the decision of how much effort to incentivize. In spite of different mechanisms, both reduce effort to an inefficiently low level and therewith lead to lower welfare compared to the situation in which only the CIT is used for tax revenue.

In contrast to reforms of tax treatments of managerial compensation conducted by politicians, the model suggests a corrective tax system which, despite moral hazard, increases welfare towards the first best solution. This can be reached by subsidizing bonus payments to the agent either via a negative bonus tax or via a deductibility of bonuses higher than 100 percent and a simultaneous increase in the corporate income tax financing the subsidy. By doing this, the government can reduce the principal's marginal expected employment costs and thereby increase equilibrium effort and welfare.

Finally, one can state that both a bonus tax and a limitation of deductibility can be used if the government has distributional objectives towards firm owners and managers. Limited deductibility or a bonus tax should only be used if the

objective is to reduce both the managers' and firm owners' rents. This is additional to the disadvantage of inefficiently low welfare. If welfare is to be maximized, a subsidy on managerial compensation should be paid to the companies. This results in a higher rent for managers and a lower rent for firm owners.

Appendix

A1. Proof of Proposition 1

Due to the limited liability constraint the agent is faced with, the principal cannot pay a negative fixed wage. Thus the constraint will be binding for x_2 such that $A^{SB} = 0$. Taking this and the result of a non-binding participation constraint (5) due to the assumption $e^{SB}C'(e^{SB}) - C(e^{SB}) \geq \underline{u}$, the optimal effort induced by the principal indirectly is given by

$$\frac{(1-t)}{(1-\alpha t)} - b^{SB} - e^{SB} \frac{C''(e^{SB})}{(1-t_b)(\pi_1 - \pi_2)} = 0.$$

Rearranging yields the optimal bonus parameter denoted in equation (8):

$$b^{SB} = \frac{(1-t)}{(1-\alpha t)} - \frac{e^{SB}C''(e^{SB})}{(1-t_b)(\pi_1 - \pi_2)}.$$

Together with the agent's optimal effort choice according to (9), effort can be expressed as

$$e^{SB} = \frac{(1-t)(1-t_b)(\pi_1 - \pi_2)}{(1-\alpha t)C''(e^{SB})} - \frac{C'(e^{SB})}{C''(e^{SB})}. \quad (16)$$

Note that the second order condition for a maximum is satisfied whenever

$$C'''(e^{SB}) > -\frac{2C''(e^{SB})}{e^{SB}}, \quad (17)$$

which by assumptions $C''(e) > 0$ and $C'''(e) > 0$ is always the case. Existence and uniqueness can be proven by combining the agent's and the principal's optimality conditions (8) and (9), which can be rearranged to

$$\frac{(1-t)(1-t_b)}{(1-\alpha t)}(\pi_1 - \pi_2) = C'(e) + e^{SB}C''(e^{SB}).$$

By the imposed Inada condition on the cost function, the right hand side is zero for $e = 0$, whereas the left hand side is positive by assumption. According to (17) the right hand side is monotonically increasing in e . Together with the Inada condition $\lim_{e \rightarrow 1} C'(e) = \infty$, there is exactly one intersection for the unique equilibrium $e = e^{SB}$.

A2. Proof of Corollary 2

By using (8) and (9), we obtain

$$\begin{aligned} f_1(e^{SB}, b^{SB}(\pi_1 - \pi_2), t_b) &= C'(e) - (1 - t_b)b^{SB}(\pi_1 - \pi_2) \\ f_2(e^{SB}, b^{SB}(\pi_1 - \pi_2), t_b, t, \alpha) &= (1 - t)(1 - t_b)(\pi_1 - \pi_2) - (1 - \alpha t)(1 - t_b)b^{SB}(\pi_1 - \pi_2) - \\ &\quad (1 - \alpha t)e^{SB}C''(e^{SB}) \end{aligned}$$

with the total differential

$$\begin{aligned} f_{1e}de^{SB} + f_{1b}db^{SB}(\pi_1 - \pi_2) + f_{1t_b}dt_b &= 0, \\ f_{2e}de^{SB} + f_{2b}db^{SB}(\pi_1 - \pi_2) + f_{2t_b}dt_b + f_{2t}dt + f_{2\alpha}d\alpha &= 0. \end{aligned}$$

where

$$\begin{aligned} f_{1e} &= \frac{\partial f_1}{\partial e^{SB}} = C''(e^{SB}), \\ f_{1b} &= \frac{\partial f_1}{\partial b^{SB}(\pi_1 - \pi_2)} = -(1 - t_b), \\ f_{1t_b} &= \frac{\partial f_1}{\partial t_b} = b^{SB}(\pi_1 - \pi_2), \\ f_{2e} &= \frac{\partial f_2}{\partial e^{SB}} = -(1 - \alpha t)[C''(e^{SB}) + e^{SB}C'''(e^{SB})], \\ f_{2b} &= \frac{\partial f_2}{\partial b^{SB}(\pi_1 - \pi_2)} = -(1 - \alpha t)(1 - t_b), \\ f_{2t_b} &= \frac{\partial f_2}{\partial t_b} = -(1 - t)(\pi_1 - \pi_2) + (1 - \alpha t)b^{SB}(\pi_1 - \pi_2), \\ f_{2t} &= \frac{\partial f_2}{\partial t} = \alpha e^{SB}C''(e^{SB}) - (1 - t_b)(\pi_1 - \pi_2)[1 - \alpha b^{SB}], \\ f_{2\alpha} &= \frac{\partial f_2}{\partial \alpha} = t[e^{SB}C''(e^{SB}) + (1 - t_b)b^{SB}(\pi_1 - \pi_2)]. \end{aligned} \tag{18}$$

From this we get

$$\begin{aligned} [f_{1e}f_{2b} - f_{1b}f_{2e}]de^{SB} &= [f_{1b}f_{2t_b} - f_{2b}f_{1t_b}]dt_b + [f_{1b}f_{2t}]dt + [f_{1b}f_{2\alpha}]d\alpha \\ [f_{1b}f_{2e} - f_{1e}f_{2b}]db^{SB}(\pi_1 - \pi_2) &= [f_{1e}f_{2t_b} - f_{2e}f_{1t_b}]dt_b + [f_{1e}f_{2t}]dt + [f_{1e}f_{2\alpha}]d\alpha. \end{aligned} \tag{19}$$

Keeping the corporate income tax and deductibility constant ($dt = d\alpha = 0$), the effect of t_b on e^{SB} and $b^{SB}(\pi_1 - \pi_2)$ can be expressed by

$$\frac{de^{SB}}{dt_b} = \frac{\frac{1-t}{1-\alpha t}(\pi_1 - \pi_2)}{-[2C''(e^{SB}) + e^{SB}C'''(e^{SB})]} < 0$$

and

$$\frac{db^{SB}(\pi_1 - \pi_2)}{dt_b} = \frac{-\frac{1-t}{1-\alpha t} C'''(e^{SB})(\pi_1 - \pi_2) + b^{SB}(\pi_1 - \pi_2)\delta}{(1-t_b)\delta} \geq 0,$$

with $\delta = [2C'''(e^{SB}) + e^{SB}C''''(e^{SB})]$. According to the second order condition for a maximum (17), $\delta > 0$, such that $\frac{de^{SB}}{dt_b} < 0$, as the denominator always is negative while the numerator is positive. For $\frac{db^{SB}(\pi_1 - \pi_2)}{dt_b}$, the denominator is always positive. From this follows that $\frac{db^{SB}(\pi_1 - \pi_2)}{dt_b} > 0$ if the numerator is positive, i.e. $b^{SB}(\pi_1 - \pi_2)\delta > \frac{1-t}{1-\alpha t} C'''(e^{SB})(\pi_1 - \pi_2)$ or, rearranged, if and only if $\pi_1 - \pi_2 > C'''(e^{SB}) \left[\frac{1-\alpha t}{(1-t)(1-t_b)} e^{SB} + \frac{1}{\delta} \right]$ is fulfilled.

A3. Proof of Corollary 3

We use equations (18) and (19) to prove the effects of both a CIT and limited deductibility.

Keeping the bonus tax and limited deductibility constant ($dt_b = d\alpha = 0$), the effect of t on e^{SB} and $b^{SB}(\pi_1 - \pi_2)$ can be expressed by

$$\frac{de^{SB}}{dt} = \frac{[\alpha e^{SB} C'''(e^{SB}) - (1-t_b)(\pi_1 - \pi_2)(1-\alpha b^{SB})]}{(1-\alpha t)\delta} \leq 0 \quad (20)$$

and

$$\frac{db^{SB}(\pi_1 - \pi_2)}{dt} = \frac{C'''(e^{SB}) [\alpha e^{SB} C'''(e^{SB}) - (1-t_b)(\pi_1 - \pi_2)(1-\alpha b^{SB})]}{(1-t_b)(1-\alpha t)\delta} \leq 0. \quad (21)$$

Note that for both equations the denominator is positive.

Proof of Part (i):

With full deductibility ($\alpha = 1$) of bonus payments as business expenses, equation (20) can be simplified. Inserting the principal's optimality condition (8) then yields $\frac{de^{SB}}{dt} = 0$. The same is true for the effect of the CIT on the bonus payment, i.e. equation (21) becomes $\frac{db^{SB}(\pi_1 - \pi_2)}{dt} = 0$.

Proof of Part (ii):

$\frac{de^{SB}}{dt}$ and $\frac{db^{SB}(\pi_1 - \pi_2)}{dt}$ are negative if and only if

$\alpha e^{SB} C''(e^{SB}) < (1 - t_b)(\pi_1 - \pi_2)(1 - \alpha b^{SB})$. Inserting (8) shows that this is the case whenever $\alpha < 1$:

$$\frac{de^{SB}}{dt} < 0 \Leftrightarrow \alpha < 1,$$

$$\frac{db^{SB}(\pi_1 - \pi_2)}{dt} < 0 \Leftrightarrow \alpha < 1.$$

Less deductibility increases the marginal effect of the CIT if

$$\frac{\partial}{\partial \alpha} \frac{de^{SB}}{dt} = \frac{e^{SB} C''(e^{SB}) + (1 - t_b)(\pi_1 - \pi_2)(b^{SB} - t)}{(1 - \alpha t)^2 \delta} > 0 \text{ and}$$

$$\frac{\partial}{\partial \alpha} \frac{db^{SB}(\pi_1 - \pi_2)}{dt} = \frac{C''(e^{SB})}{1 - t_b} \frac{e^{SB} C''(e^{SB}) + (1 - t_b)(\pi_1 - \pi_2)(b^{SB} - t)}{(1 - \alpha t)^2 \delta} > 0. \text{ It follows that}$$

$$\frac{\partial}{\partial \alpha} \frac{de^{SB}}{dt} > 0 \text{ if } \frac{1 - t}{1 - \alpha t} > t,$$

$$\frac{\partial}{\partial \alpha} \frac{db^{SB}(\pi_1 - \pi_2)}{dt} > 0 \text{ if } \frac{1 - t}{1 - \alpha t} > t.$$

Proof of Part (iii):

For limited deductibility, keeping the CIT and the bonus tax constant ($dt = dt_b = 0$), the effects of α on e^{SB} and $b^{SB}(\pi_1 - \pi_2)$ can be expressed by

$$\frac{de^{SB}}{d\alpha} = \frac{(1 - t_b)t [e^{SB} C''(e^{SB}) + (1 - t_b)b^{SB}(\pi_1 - \pi_2)]}{(1 - t_b)(1 - \alpha t)\delta} \geq 0 \quad (22)$$

and

$$\frac{db^{SB}(\pi_1 - \pi_2)}{d\alpha} = \frac{C''(e^{SB})t [e^{SB} C''(e^{SB}) + (1 - t_b)b^{SB}(\pi_1 - \pi_2)]}{(1 - t_b)(1 - \alpha t)\delta} \geq 0 \quad (23)$$

with $\frac{de^{SB}}{d\alpha} = \frac{db^{SB}(\pi_1 - \pi_2)}{d\alpha} = 0$ if $t = 0$. From this follows

$$\frac{de^{SB}}{d\alpha} > 0 \Leftrightarrow t > 0,$$

$$\frac{db^{SB}(\pi_1 - \pi_2)}{d\alpha} > 0 \Leftrightarrow t > 0.$$

A higher CIT increases the marginal effect of limited deductibility if $\frac{\partial}{\partial t} \frac{de^{SB}}{d\alpha} > 0$ and $\frac{\partial}{\partial t} \frac{db^{SB}(\pi_1 - \pi_2)}{d\alpha} > 0$. As

$$\frac{\partial}{\partial t} \frac{de^{SB}}{d\alpha} = \frac{e^{SB} C''(e^{SB}) + (1 - t_b) b^{SB}(\pi_1 - \pi_2)}{(1 - \alpha t)^2 \delta} > 0,$$

$$\frac{\partial}{\partial t} \frac{db^{SB}(\pi_1 - \pi_2)}{d\alpha} = \frac{C''(e^{SB})}{1 - t_b} \frac{e^{SB} C''(e^{SB}) + (1 - t_b) b^{SB}(\pi_1 - \pi_2)}{(1 - \alpha t)^2 \delta} > 0,$$

this is always the case.

A4. Proof of Proposition 4

The proof will be done by comparing the welfare maximizing effort characterized by $\pi_1 - \pi_2 = C'(e^*)$ with the second best effort induced by the principal which is indirectly defined through equation (11) and rearranged as $(\pi_1 - \pi_2) = \frac{1 - \alpha t}{(1 - t)(1 - t_b)} [C'(e^{SB}) + e^{SB} C''(e^{SB})]$. As the welfare function is concave in e , effort below e^* reduces welfare. Thus, as long as $e^{SB} < e^*$, an increase in effort is welfare improving. According to (17) the right hand side is monotonically increasing in e such that the government can influence the optimal effort induced by the principal by adjusting the tax structure $\left(\frac{1 - \alpha t}{(1 - t)(1 - t_b)}\right)$ towards the lowest possible level.

Proof of Part (i):

Follows directly from Corollary (2), Part (i) and Corollary (3), Part (i).

Proof of Part (ii):

With an exogenously given CIT $\bar{t} < t^*$, the government cannot raise the desired

tax revenue solely by the CIT, but has to use either limited deductibility or a bonus tax or both to fulfill $T(t_b, t, \alpha) = B$. As the tax revenue constraint (13) will be binding, we can use equation (12) in order to express α as function of t_b , $\alpha = \alpha(t_b)$. Inserting this expression in the effort (16) incentivized by the principal shows that t_b cancels out. Therefore, effort e^{SB} is independent of t_b (and of α as is was expressed by t_b) if the shift in t_b has to be compensated by a shift in α .

$$e^{SB} = \frac{(1 - \bar{t})(\pi_1 - \pi_2)}{C''(e_{\bar{t}})} \frac{1}{1 + \frac{B}{e_{\bar{t}}C'(e_{\bar{t}})} - \frac{\bar{t}}{e_{\bar{t}}C'(e_{\bar{t}})} [\pi_2 + e_{\bar{t}}(\pi_1 - \pi_2)]} - \frac{C'(e_{\bar{t}})}{C''(e_{\bar{t}})}.$$

Proof of Part (iii):

When using $\alpha^* = 1$, $t_b^* = 0$ and $t^* = \frac{B}{\pi_2 + e^{SB}(\pi_1 - \pi_2)(1 - b^{SB})}$ as proposed in Part (i) of the proposition, effort e_t^* remains lower than the welfare maximizing effort e^* as the principal desired effort level is adjusted for the agent's limited liability rent. Thus, a higher effort level is welfare increasing. This can be reached by raising the desired tax revenue $T(t_b, t, \alpha) = B$ with a tax structure that makes $\left(\frac{1 - \alpha t}{(1 - t)(1 - t_b)}\right) < 1$. Starting from $\alpha^* = 1$, $t_b^* = 0$ and $t^* = \frac{B}{\pi_2 + e^{SB}(\pi_1 - \pi_2)(1 - b^{SB})}$, welfare can be increased by slightly increasing the CIT towards $t^{sub} > t^*$ and at the same time reducing the principal's marginal expected employment costs either by paying a bonus subsidy (negative bonus tax) $t_b^{sub} < t_b^* = 0$ or by granting a higher deductibility of corporate expenses $\alpha^{sub} > \alpha^* = 1$.

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