Loss-Offset Restrictions, Bonus Taxation and Performance-Based Incentive Contracts

Rainer Niemann & Mariana Sailer

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Abstract

Tax legislation is characterized by asymmetries such as loss-offset restrictions for companies and progressive taxation for wages, which affect the type of contract offered in employment relationships. We investigate the effects of corporate taxation without and with loss-offset restrictions and proportional and progressive wage taxation on the optimal contract choice of company owners. They can either offer a bonus contract, a malus contract, an alternative fixed-remuneration contract or refrain from hiring at all. Both bonus and malus contract are performance-based incentive contracts. Bonus contracts reward the agent for generating a high outcome. Bonus payments are a common form of rewarding executives for good performance and bonus clauses are firmly established in most performance-based remuneration contracts. Malus clauses, penalizing the agent for generating a low outcome, are not nearly as widespread – even though they are demanded by the EU. Using a discrete principal-agent model with three different outcomes, we show that (1) neither symmetric corporate nor proportional wage taxation has an impact on the principal’s choice between bonus or malus contracts. (2) Symmetric corporate taxation shifts the owner’s choice in favor of the fixed-remuneration contract. (3) Asymmetric corporate taxation makes the fixed-remuneration contract less beneficial, indicating an aggravation of inefficiency. (4) Asymmetric corporate taxation does not systematically impair one of the performance-based remuneration contracts. However, progressive wage taxation seems to hit the malus contract more. Our results are helpful to employers who decide upon remuneration contracts and to tax authorities who try to anticipate economic consequences of tax law changes.


1 Introduction

Taxation can have a significant effect on recruitment and compensation decisions, so that the impact of taxes must be considered when designing incentive contracts. While taxation has been widely neglected in earlier publications on optimal incentive systems, it has received increasing attention since 2010. Tax treatment of company’s profits and losses and executive wages is often asymmetric. On the one hand loss-offset is often restricted, on the other hand wages are taxed progressively. Thus, the combination of full loss-offset for companies and proportional wage taxation is denoted as symmetric taxation. The simplest form of progressive wage taxation is a bonus tax, which is levied on variable remuneration components. It was surmised to be an instrument of curbing high salaries in the aftermath of the financial crisis lasting from 2007 to 2010.

Usually contracts with bonus clauses are proposed as an instrument to align the diverging interests of executives and company owners in the accounting literature and were widely established in corporate compensation practice. As the desired result, executives would not take advantage of informational asymmetries, which lead to adverse results in their working effort caused by moral hazard. For example, in Germany the remuneration of board members of listed companies is composed of fixed and performance-based elements. In 2016 almost all CEOs of the 30 DAX companies and 49 of 50 MDAX-CEOs obtained additional performance-based remunerations that were even clearly higher than the fixed remuneration payments in most cases. However, such widespread high bonus payments were perceived as one pull factor of the financial crisis and became the subject of an ongoing public debate. While bonus payments are supposed to reward managers for target achievement, malus clauses penalize for target failure. In 2013 the European Parliament announced directives concerning the variable elements of remuneration in credit institutions and investment firms and recommended the integration of malus and claw-back clauses. Still, these clauses are mostly absent in practice without obvious reason. They could potentially curb salary payments as the objective achievement is assumed to be the default case, which does not trigger additional rewards, whereas target failure is punished

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1 See Bauer et al. (2018), p. 37.
2 See Bauer et al. (2018), p. 37, Bauer, Kourouxous and Krenn (2018) provide an extensive review of the agency literature analyzing the link between bonus taxation and compensation for a risk-averse agent.
6 For example, the discussion in Germany about the limitation of the tax deductibility of management salaries above a certain amount (for example, Völmerbäumer 2012) and the adoption of this limitation in Austria in 2014.
7 In 2013 the European Parliament and the Council announced the directive 2013/36/EU on access to the activity and prudential supervision of credit institutions and investment firms. It demanded that up to 100% of total variable payment should be subject to malus or claw-back arrangements in case of subdued or negative financial performance (article 94(1)(n)). In 2015 the European Banking Authority issued a final report about the guidelines on sound remuneration policies and made clear that without prejudice to the general principles of national contract or labor law, institutions have to be able to follow article 94(1)(n) of that directive (15.7.1 malus and claw-back). In 2013 the directive was integrated in the German Remuneration Ordinance for Institutions (Institutionsvergütungsverordnung) clarifying that remuneration systems are not perceived as appropriate if executives can still receive variable pay despite a negative contribution (German Federal Law Gazette 2013 Part I No. 74, § 5 II).
with financial losses for the manager. Apart from corporate governance issues, this could reduce remuneration expenses for the company. Despite the institutional demand for malus clauses and the high impact of taxation on recruitment and compensation decisions, there is no combined analysis of the relative effect of (asymmetric) taxation on malus contracts compared to bonus contracts or fixed-remuneration contracts, which could potentially explain the underrepresentation of malus clauses in incentive schemes.

Hitherto, only Niemann (2011) analyzes the effects of asymmetric corporate taxation on the principal’s choice between performance-based and fixed remuneration contracts. He finds that contracts are offered less frequently under asymmetric than under symmetric corporate taxation and that fixed-remuneration contracts are penalized more heavily than performance-based contracts by tax asymmetries. Sailer (2017) confirms these findings in an extended version of the model used by Niemann. The impact of bonus taxation as a form of asymmetric tax wage treatment is more commonly discussed. So far, several countries have introduced bonus taxes on certain manager remunerations, such as Ireland, Italy and Greece. However, the findings show that the bonus tax mostly fails to achieve its objective to reduce high bonus payments. For example, Ehrlich and Radulescu (2017) provide empirical evidence that equity-based bonus payments substituted cash bonus payments in the UK. Dietl et al. (2013) as well as Radulescu (2012) find that a bonus tax could even raise the bonus rate contingent on the agent’s utility function. Meißner et al. (2014) analyze the effects of a bonus tax on variable remuneration components at the manager’s level and show that the bonus tax on the one hand ensures higher state tax revenues, but it less incentive compatible than a penalty tax at the principal’s level. Still, none of these papers sheds light on the impact of bonus taxation on the optimal contract choice taking malus clauses in consideration.

To reduce this research gap we use a discrete principal-agent model with three different outcomes, which allows us to implement a bonus and a malus contract, as well as a contract with fixed remuneration, of which the company owner (principal) can choose to offer the profit-maximizing contract to the manager (agent). This model enables us to show the relative effects of asymmetric taxation on the well-known bonus versus the malus contract and compared to the fixed-remuneration contract in order to draw conclusions for practice and policy. Our contribution is twofold. Primarily, our results are relevant for employers who are searching for the optimal remuneration contract in the presence of taxes – considering the use of malus clauses. In addition, our model provides guidance for tax legislators trying to anticipate the incentive effects of tax law changes, which is necessary for reliable estimations of tax revenues.

In line with prior research, we find that neither symmetric corporate nor proportional wage taxation alters the principal’s choice between both performance-based incentive contracts. However, any form of wage taxation makes the fixed-remuneration contract more attractive for the principal and can even

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8 Niemann (2011) provides an overview on literature on asymmetric taxation under symmetric information.

prevent a contract offer at all. Contrary, loss-offset restrictions at the principal’s level impair the fixed-
remuneration contract and also make it less attractive for the principal to hire an agent at all. In
contrast to proportional wage taxation, bonus taxation changes the principal’s choice between both
performance-based incentive contracts and seems to impair the malus contract. After all, we find, that
even in the presence of taxes, the choice to implement malus clauses can be beneficial in terms of
wage reduction and the malus contract is a considerable remuneration alternative.

The remainder of this paper is organized as follows: Section 2 introduces the after-tax principal-agent
model with three outcomes and determines the optimal remuneration. Section 3 points out the effects
of symmetric corporate and wage taxation in order to establish a benchmark-case. Section 4 shows the
effects of loss-offset restrictions on the principal’s contract choice, while section 5 deals with the
impact of bonus taxation. Section 6 summarizes and concludes.

2 The Basic Model and Symmetric Taxation

2.1 Model Design

In order to implement both a bonus and a malus contract as well as a fixed-remuneration contract in a
principal-agent model, we extend the model by Niemann (2011). A sole binary model would not
allow the implementation of two different performance-based incentive contracts and therefore
prevent the clear differentiation between bonus and malus clauses. Ownership and control are
separated, so that the risk-averse and effort-averse agent performs a task at the behest of the risk-
neutral, profit-maximizing principal. The timeline of interaction between principal and agent with
regard to taxation is illustrated below:

Figure 1 Timeline of interaction between principal and agent with regard to taxation

The agent’s effort influences the principal’s outcome (profit before remuneration costs), which can
either be low (1), medium (2) or high (3): $x_j \in \{x_1, x_2, x_3\}$, where $x_1 < x_2 < x_3$ and $x_3 > 0$. At least the
high outcome $x_3$ has to be strictly positive as otherwise any economic activity would be pointless. The
agent’s effort $e_j \in \{e_L, e_H\}$, with $e_L < e_H$, is binary, not verifiable and therefore cannot be contracted
upon. The probability distribution of outcomes is shown in the table below:

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10 The model is based on the moral hazard model by Macho-Stadler/Pérez-Castrillo (2001) and Ewert/Wagenhofer (2014).
Exerting high (low) effort more likely results in generating the highest (lowest) outcome than providing low (high) effort, so that $\phi_3^H > \phi_3^L$ (and $\phi_1^L > \phi_1^H$). The profit-maximizing principal generally wants to incentivize the agent to choose the high effort level $e_H$, because exerting a high effort by assumption results in a higher expected outcome $x_i \phi_i^H = \sum_{i=1}^{3} x_i \phi_i^H > \sum_{i=1}^{3} x_i \phi_i^L$.

Following Niemann (2011) we integrate symmetric corporate and symmetric wage taxes in the model in the first place, so that full loss-offset is possible and wage tax rates are proportional. At the principal’s level the corporate tax rate is $0 \leq s < 1$ and at the agent’s level the wage tax rate is $0 \leq t < 1$. Hence, at both levels tax rates are non-negative, including the pre-tax case $s = 0$ and $t = 0$, and are strictly lower than 100%, which would prevent any work incentive from the start.

The agent’s utility function $U(r_n, e_j) = u_n(r_n) - v_j(e_j) = (1-t)r_n - v_j^{11}$ is additively-separable with respect to the components remuneration $r_n > 0$ and effort $e_j$ and concave in the remuneration. The disutility of effort resulting from the choice of the respective effort level is denoted by $v_j \in \{v_L, v_H\}$, where $v_L < v_H$. Without loss of generality we assume $v_L = 0$. The agent’s reservation utility is given by $U = (1-t)r_a - v_a = (1-t)r_a > 0$. It is seen as opportunity costs, which result from rejecting the wage of an alternative employment $r_a$. For further analysis the disutility of effort caused by an alternative employment $v_a$ is assumed to equal zero without harming the interpretation of results. The reservation utility itself is always greater than zero, since the model simulates processes at the level of executive managers, where it is unlikely the agent was left without any alternate income $r_a$, which is subject to wage taxation.

The principal can choose from four options $o_k \in \{o_D, o_F, o_B, o_M\}$ to decide on employment and contract choice in order to maximize the value of his objective function $Z(o_k)$, which denotes

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11 The square-root utility function permits closed-form solutions, but does not pre-determine the results in a qualitative way.
12 See Niemann (2008), p. 284. The opportunity costs could also be seen as a transfer payment to secure a subsistence level, for example in case of unemployment, which we do not take in consideration given the agent’s managerial position.
expected profit less expected remuneration costs after corporate tax. The agent only accepts the contract if his participation constraint (PC) is satisfied by gaining at least his reservation utility. In order to incentivize the agent to provide high effort, the principal has to determine the remuneration according to the agent’s incentive constraint (IC), making sure the agent benefits at least equally from proving low or high effort. The agent chooses the effort level the principal prefers if he is indifferent between two levels. The principal’s options are

1. **non-hiring default option** $o_d$:

   The principal refrains from offering a contract if he does not expect to generate any profit. As a result, the value of the principal’s objective function is zero $Z(o_d) = 0$, which defines a lower bound of the principal’s optimal utility.

2. **fixed-remuneration contract option** $o_f$:

   The principal intentionally demands low effort and offers a contract with a fixed salary $r_f$ to the agent who will only provide low effort. The agent still accepts the contract if his PC is satisfied. In this case there is no information asymmetry since the agent by assumption cannot choose a lower effort level than $e_L$. Hence, a first best solution is enabled: $Z(o_f) \leq / \geq 0$. The expected outcome is $\sum_{i=1}^{3} x_i \phi_i = X_L$.

3. **performance-based incentive contracts option** $o_b$ and option $o_M$:

   The principal demands high effort and offers the agent a contract with a performance-based incentive scheme, satisfying his PC as well as his IC in expectation. This second-best scenario trades off risk and incentives: $Z(o_b) \leq / \geq 0$ and $Z(o_M) \leq / \geq 0$. The expected outcome for both performance-based incentive contracts before deducting remuneration costs is $\sum_{i=1}^{3} x_i \phi_i^H = X_H$.

   - **Bonus contract option** $o_b$ : For generating the high outcome $x_3$ the agent receives a salary plus an additional bonus resulting in a remuneration $r_B$ ($B =$ bonus), which exceeds the standard salary $r_{NB}$, ($NB =$ no bonus) he receives in case the outcome is either $x_1$ or $x_2$.
   - **Malus contract option** $o_M$ : The agent has to accept a (still positive) salary reduced by a malus, namely $r_M$ ($M =$ malus), in case the outcome is $x_1$. If the outcome is either $x_2$ or $x_3$ the agent receives a higher standard salary $r_{NM}$ ($NM =$ no malus).

Each of the performance-based incentive contracts is based on an individual incentive mechanism. In case the principal offers a malus contract he takes generating the low outcome $x_1$ as an indicator of

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failure resulting from low effort. In contrast, a bonus contract assumes generating the high outcome $x_3$ as an indicator of high effort resulting in success.

The principal maximizes his objective function by choosing the profit-maximizing option $Z^* = \max\{0, Z(o_F), Z(o_B), Z(o_M)\}$, where the remuneration levels in the different outcomes serve as decision variables. Neither corporate nor wage taxation affects the default option as the expected outcome equals zero since the agent does not exert any effort at all. Throughout the sections of the paper the principal’s general choices remain the same.

2.2 Optimal Remuneration Levels and Resulting Objective Functions

The optimal remuneration for the fixed-remuneration contract is determined by the participation constraint (PC) only and is given by:

$$r_F^* = \frac{1}{1-t} U^{2.15} \tag{1}$$

**Derivation:** See appendix

Hence, the principal’s utility is given by

$$Z(o_F) = \left(1-s\right)\left(X_L - \frac{U}{1-t}\right) \tag{2}$$

The optimal remuneration levels for the bonus contract can be derived from both the participation constraint and the incentive constraint and are given by:

$$r_{NB}^* = u_{NB}^{*2} = \frac{1}{1-t} \left[ U + v_H - \frac{v_H}{\phi^H_3 - \phi^L_3} \right]^2 \wedge r_B^* = u_B^{*2} = \frac{1}{1-t} \left[ U + v_H + \frac{v_H}{\phi^H_3 - \phi^L_3} \right]^2 \tag{3}$$

**Derivation:** See appendix

The agent’s bonus payment $r_B^*$ decreases in the difference $\phi^H_3 - \phi^L_3$, which means providing high effort more likely results in obtaining the high outcome $x_3$, so the agent has less risk to bear. Since $0 < v_H$ and $0 < \phi^L_3 < \phi^H_3 < 1$, it holds that $0 < r_{NB}^* < r_F^* < r_B^*$. Thus, the fixed remuneration $r_F^*$ is higher than the no-bonus remuneration level $r_{NB}^*$ of the bonus contract. The principal’s objective function is

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15 Asterisks * denote optimality.
16 We assume that $U \geq \frac{v_H \phi^L_3}{\phi^H_3 - \phi^L_3}$, so the agent’s utility is always positive and clear results are ensured.
The optimal remuneration levels for the malus contract can be derived similarly and are given by:

$$r_M^* = u_{M^2} = \frac{1}{1-t} \left[ U + v_H \cdot \frac{1 - \phi_i^H}{\phi_i^L - \phi_i^H} \right]^2$$

$$r_{NM}^* = u_{NM^2} = \frac{1}{1-t} \left[ U + v_H + v_H \cdot \frac{1 - \phi_i^H}{\phi_i^L - \phi_i^H} \right]^2. \tag{5}$$

**Derivation:** See appendix

The malus payment $r_M^*$ increases in the difference between $\phi_i^L$ and $\phi_i^H$, indicating that providing low effort more likely leads to the low outcome. Therefore, generating the low outcome can be more likely traced to low effort and the agent needs less severe extrinsic motivation via a financial impairment to work at the desired high effort level.

Similar to the bonus contract, the salary of the fixed-remuneration contract is higher than the remuneration less the financial malus, so that $0 < r_M^* < r_F^* < r_{NM}^*$, because $0 < v_H$ and $0 < \phi_i^H < \phi_i^L < 1$.

The resulting principal’s objective function is

$$Z(o_M) = \left(1-s\right) \left[ X_H - \frac{1}{1-t} \left( v_H + U \right)^2 + \frac{v_H^2 \left(1 - \phi_i^H\right) \phi_i^H}{\phi_i^L - \phi_i^H} \right]. \tag{6}$$

Obviously, the corporate tax rate $s$ does not affect the optimal remuneration levels. Furthermore, our findings show that a malus contract with $r_{NM}^* \geq r_F^*$ cannot be beneficial for the principal (see appendix). As a consequence, malus contracts can be an option to curb manager salaries that may be considered excessive.

### 3 Effects of Symmetric Taxation

First, we determine the effects of symmetric taxation, in order to have a reference case for the impact of asymmetric corporate and progressive wage taxation. In this section the principal can fully offset losses and the agent’s remuneration is taxed proportionally. The principal offers the agent the contract with the highest expected profit after expected remuneration costs.

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17 We assume that $U \geq \frac{v_H\left(1 - \phi_i^L\right)}{\phi_i^L - \phi_i^H}$, so the agent’s utility is always positive (see footnote 16).
Proposition 1: The principal’s choice between bonus and malus contract is unaffected by symmetric taxation.

Proof: The principal prefers the bonus contract over the malus contract, if

\[
Z(o_M) > Z(o_B) \quad \Rightarrow \quad \frac{1-s}{1-t} \left( v_H + U \right)^2 + \frac{v_H^2 (1-\phi_H^H) \phi_H^H}{(\phi_H^L - \phi_H^H)^2} > \frac{1-s}{1-t} \left( v_H + U \right)^2 + \frac{v_H^2 (1-\phi_H^M) \phi_H^M}{(\phi_H^M - \phi_H^L)^2}.
\]

Hence, the choice between both performance-based incentive contracts does not depend on either corporate tax rate \( s \) or the wage tax rate \( t \), but only on the probabilities of generating a low or high outcome under low or high effort. This means neither of these tax types can change the sign for the difference between the objective functions. □

Since symmetric corporate tax reduces the principal’s utility proportionally, it does not alter the principal’s contract choice compared to a hypothetical non-tax world.\(^{18}\) In contrast, the wage tax reduces the principal’s utility non-proportionally. In order to induce the agent to exert effort according to the principal’s demands, the principal has to anticipate the utility loss caused by wage taxation and has to raise the expected remuneration in order to preserve the agent’s pre-tax effort level (leakage effect of wage taxation; a proof is provided in the appendix).

Moreover, the wage tax does not only affect the optimal remuneration levels, but also the principal’s ultimate contract choice.

Proposition 2: The wage tax relatively favors the fixed-remuneration contract over performance-based contracts.

Proof: Whether a performance-based contract or a contract with a fixed salary is most beneficial for the principal, depends on the expected additional remuneration costs caused by expected performance-based salary relative to the expected additional outcome:

\[
Z(o_F) > Z(o_B) > 0
\]

\[
X_H - X_L > \frac{1}{1-t} \left( v_H (2U + v_H) + \frac{v_H^2 (1-\phi_H^H) \phi_H^H}{(\phi_H^H - \phi_H^L)^2} \right) > 0.
\]

For any \( t > 0 \) the right-hand sides of the inequalities in (8) become more restrictive compared to the hypothetical non-tax benchmark case with \( t = 0 \) due to the higher expected remuneration costs for

As a result, the principal is more likely to offer a contract with fixed remuneration when the wage tax rate increases. Wage taxation also makes the default option relatively more attractive since it reduces the expected profit resulting from the fixed-remuneration contract.

Therefore, the findings of Niemann (2011) do not only hold for the basic performance-based remuneration contract but also for the bonus and malus forms. Qualitatively, these results also hold for risk-neutral agents (proof is provided upon request). This means, that a firm owner, who neglects wage taxation, risks unprofitable employment decisions. From a fiscal perspective, it should also be considered that increased wage taxation reduces effort incentives. Wage tax revenues could therefore be lower than expected as the result of contract choice that differs from the one in a hypothetical non-tax world.

4 Model with Asymmetric Corporate and Symmetric Wage Taxation

In order to analyze the possible effects of asymmetric corporate taxation on the employment decision and contract design, a constant loss-offset parameter $0 \leq \gamma \leq 1$ is integrated in the model. Since the model is single-period, time effects of taxation have to be approximated by tax base effects. A parameter $\gamma = 0$ means that no loss-offset is possible. The setting $\gamma = 1$ is identical to symmetric taxation with full loss-offset, as discussed in the previous section. As a consequence, profits are subject to the corporate tax rate $s$, while losses induce a proportional loss-offset $\gamma s$, triggering an only partial tax reimbursement. A loss-offset with $0 < \gamma < 1$ always increases the principal’s potential tax burden non-proportionally so that a loss is harmful compared to the case with symmetric corporate taxation. As the restricted loss-offset does not have any impact on the agent’s PC or IC, the optimal remuneration levels remain as determined in section 2. Due to the non-linear nature of the principal’s objective function, closed-form solutions are not feasible.

With regard to loss-offset restrictions the basic version of the objective function resulting from the fixed-remuneration contract can be written as

$$Z_{\gamma}(o_F) = \phi_1 \left[(1 - \gamma s)\min\{0; x_1 - r_{f}^{*}\} + (1 - s)\max\{0; x_1 - r_{f}^{*}\}\right]$$
$$+ \phi_2 \left[(1 - \gamma s)\min\{0; x_2 - r_{f}^{*}\} + (1 - s)\max\{0; x_2 - r_{f}^{*}\}\right]$$
$$+ \phi_3 \left[(1 - s)(x_3 - r_{f}^{*})\right].$$

The fixed-remuneration contract must entail a profit at least for the high outcome $x_3$, because otherwise it would not be a potentially beneficial contract option at all.

The basic objective function resulting from the bonus contract is
and that resulting from the malus contract is

\[
Z_\gamma(o_M) = \phi(U)
\left[(1-\gamma{s})\min\{0; x_1 - r_{NB}\} + (1-s)\max\{0; x_1 - r_{NB}\}\right]
\]

\[+\phi_2(U)
\left[(1-\gamma{s})\min\{0; x_2 - r_{NM}\} + (1-s)\max\{0; x_2 - r_{NM}\}\right]
\]

\[+\phi_3(U)
\left[(1-\gamma{s})\min\{0; x_3 - r_{NM}\} + (1-s)\max\{0; x_3 - r_{NM}\}\right].
\]

(11)

Loss-offset restrictions affect the contracts differently, but generally impair a contract with higher expected losses to a larger extent. In contrast to symmetric corporate taxation, asymmetric corporate taxation can reduce the principal’s expected profit below zero. As a result, loss-offset restrictions make the default option more attractive for the principal so that he is more likely to refrain from offering a contract to the agent.

**Proposition 3**: Loss-offset restrictions impair the fixed-remuneration contract more than both the bonus contract or the malus contract in case they entail a loss for the low outcome \(x_1\).

**Proof**: See appendix

In line with Niemann (2011), this shows that loss-offset restrictions impair the fixed-remuneration contract more than the performance-based remuneration contracts in case of losses for a low outcome – even though the fixed remuneration contract can be seen as a first best solution. This leads to an inefficient and thus undesired distribution of risk.

Whereas symmetric taxation does not affect the choice between bonus and malus contracts (see Proposition 1), the impact of asymmetric corporate taxation is ambiguous. Due to the non-linearities of the principal’s objective functions (10) (bonus contract) and (11) (malus contract), this result cannot be shown analytically.

**Proposition 4**: A reduction of the loss-offset parameter \(\gamma\) can cause a change of the algebraic sign for the difference of the principal’s utility functions

\[
Z_\gamma(o_B) - Z_\gamma(o_M),
\]

so that either the bonus or the malus contract becomes the more beneficial performance-based incentive contract in case of losses.

**Proof**: To prove the existence of ambiguous results, it is sufficient to show at least one example for each direction.

**Example 1**: Loss-offset restriction impairs the bonus contract

With a disutility caused by providing high effort \(v_H = 0.5\), reservation utility \(U = 15\sqrt{1-t}\), corporate tax rate \(s = 0.5\), wage tax rate \(t = 0.2\) and the following distribution of probabilities
Table 2 Distribution of probabilities, example 1

<table>
<thead>
<tr>
<th>Outcome Level</th>
<th>Low Effort $e_L$</th>
<th>Medium Effort</th>
<th>High Effort $e_H$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Outcome</td>
<td>0.4</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Medium Outcome</td>
<td>0.3</td>
<td>0.25</td>
<td>0.4</td>
</tr>
<tr>
<td>High Outcome</td>
<td>0.3</td>
<td>0.25</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Table 2 shows the distribution of probabilities for low, medium, and high outcomes, with corresponding probabilities for low, medium, and high effort levels.

the optimal remuneration levels, expected losses and profits and expected remunerations are

<table>
<thead>
<tr>
<th></th>
<th>Bonus Contract $o_B$</th>
<th>Malus Contract $o_M$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Remuneration Level</td>
<td>$r_{NB}^* = 177.50$</td>
<td>$r_{MB}^* = 68.75$</td>
</tr>
<tr>
<td>Higher Remuneration Level</td>
<td>$r_{BH}^* = 357.71$</td>
<td>$r_{NH}^* = 379.16$</td>
</tr>
<tr>
<td>Loss for $x_1 = 50$ with $s = 0.5$ and $\gamma = 1$</td>
<td>$-63.75$</td>
<td>$-9.38$</td>
</tr>
<tr>
<td>Profit for $x_2 = 1000$ with $s = 0.5$ and $\gamma = 1$</td>
<td>$411.25$</td>
<td>$310.42$</td>
</tr>
<tr>
<td>Profit for $x_3 = 2000$ with $s = 0.5$ and $\gamma = 1$</td>
<td>$821.15$</td>
<td>$810.42$</td>
</tr>
<tr>
<td>Expected Profit with $s = 0.5$ and $\gamma = 1$</td>
<td>$408.96$</td>
<td>$398.49$</td>
</tr>
</tbody>
</table>

Table 3 Expected remuneration levels, costs, profits and losses, example 1

Figure 2 illustrates the impact of loss-offset restrictions on principal’s profit after taxes.

Figure 2 shows if loss-offset is highly restricted, meaning the parameter $\gamma$ is between zero and 45%, the malus contract is preferred by the principal, reversing the optimal choice in the pre-tax case and in
the case of symmetric corporate taxation. Moreover, the salary curbing effect of the malus contract is overridden. Sufficiently high loss-offset restrictions lead the principal to choose the malus contract even though \( r_B^* < r_{NM}^* \) – which does not happen under symmetric corporate taxation.

The second example illustrates the opposite case in which the malus contract is preferable under symmetric corporate taxation, but its choice is rather unlikely with increasing loss-offset restrictions.

**Example 2:** Loss-offset restriction impairs the malus contract

With a disutility caused by providing high effort \( v_H = 0.5 \), reservation utility \( U = 15 \sqrt{1-t} \), corporate tax rate \( s = 0.5 \), wage tax rate \( t = 0.2 \) and the following distribution of probabilities

<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( x_1 = 0 )</td>
<td>( x_2 = 200 )</td>
<td>( x_3 = 600 )</td>
</tr>
<tr>
<td>low effort ( e_L )</td>
<td>0.4</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>high effort ( e_H )</td>
<td>0.3</td>
<td>0.3</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Table 4 Distribution of probabilities, example 2

the optimal remuneration levels, expected losses and profits and expected remunerations are

<table>
<thead>
<tr>
<th></th>
<th>bonus contract ( o_B )</th>
<th>malus contract ( o_M )</th>
</tr>
</thead>
<tbody>
<tr>
<td>lower remuneration level</td>
<td>( r_{NB}^* = 177.50 )</td>
<td>( r_{NM}^* = 135.63 )</td>
</tr>
<tr>
<td>higher remuneration level</td>
<td>( r_{B}^* = 357.71 )</td>
<td>( r_{NM}^* = 297.08 )</td>
</tr>
<tr>
<td>profit for ( x_1 = 100 ) with ( s = 0.5 ) and ( \gamma = 1 )</td>
<td>(-88.75 )</td>
<td>(-67.81 )</td>
</tr>
<tr>
<td>profit/loss for ( x_2 = 200 ) with ( s = 0.5 ) and ( \gamma = 1 )</td>
<td>11.25</td>
<td>(-48.54 )</td>
</tr>
<tr>
<td>profit for ( x_3 = 600 ) with ( s = 0.5 ) and ( \gamma = 1 )</td>
<td>121.15</td>
<td>151.46</td>
</tr>
<tr>
<td>expected profit with ( s = 0.5 ) and ( \gamma = 1 )</td>
<td>25.21</td>
<td>25.67</td>
</tr>
</tbody>
</table>

Table 5 Expected remuneration levels, costs, profits and losses, example 2
Figure 3 illustrates the impact of loss-offset restrictions on the principal’s profit after taxes.

Figure 3 shows that the bonus contract is preferable until almost full loss-offset of 94.3% is possible. □

Hence, asymmetric corporate taxation can be harmful for the company owner and can induce him to choose a contract with higher remuneration costs compared to a case with symmetric taxation. This ultimately leads to offering contracts with increased higher remuneration levels. Loss-offset restrictions cannot only alter the principal’s contract choice compared to a case with symmetric corporate taxation, but – in extreme cases – can even keep the principal from offering a contract at all since the expected profit is reduced non-proportionally. However, as examples 1 and 2 show, asymmetric corporate taxation does not generally disadvantage the malus contract. However, it can cancel the salary curbing effect of the malus contract.

5 Model with Bonus Wage Taxation

An increased tax on certain salary components can be seen as penalty tax supposed to curb the amount of those payments to foster a socially desired wage policy with regard to the public debate mentioned in the introduction.\(^\text{19}\) To implement a bonus taxation, a special form of progressive wage taxation, a higher wage tax rate \(0 \leq t < b < 1\) is levied on the total higher remuneration levels \(r_B^*\) and \(r_{NM}^*\) (not only on parts of the remuneration). Although bonus taxes can be implemented quite differently in real-world tax systems, we assume that the higher remunerations are subject to the same tax rate, regardless of the income level to ensure closed-form solutions and comparability of the results. This would not be possible under a directly progressive tax schedule in which the average tax rate depends on the taxable income. For other implementation forms of bonus taxation, only one of the two performance-based

\(^{19}\) See Dietl et al. (2013).
contracts would be impaired, and the impact of the bonus tax on the optimal contract choice would be obvious.\(^{20}\)

The optimal higher remuneration levels of the performance-based remuneration contracts are:

\[
r_{B,b}^* = \frac{1}{1-b} \left[ U + v_H \left( \frac{1 - \phi_3^H}{\phi_3^H - \phi_L^H} \right) \right]^2 \quad \text{and} \quad r_{NM,b}^* = \frac{1}{1-b} \left[ U + v_H \frac{\phi_H}{\phi_1^L - \phi_H} \right]^2.
\] (12)

**Derivation:** See appendix.

It holds that \( r_{B}^* < r_{B,b}^* \) and \( r_{NM}^* < r_{NM,b}^* \) as higher wage taxes result in higher financial compensation for those remuneration levels in order to maintain the desired effort level (see leakage effect of wage taxation for higher remuneration levels in the appendix). We assume that the agent’s reservation utility is unaffected by the bonus tax. If it were, this would not alter the qualitative results.

The fixed remuneration is taxed at the lower standard wage tax rate \( t \), since \( r_F^* \) is a fixed salary, which the bonus tax does not affect by definition. As the lower remuneration levels of the performance-based incentive contracts are even lower than the fixed remuneration, \( r_{NB}^* < r_F^* \) and \( r_{M}^* < r_F^* \), also these remuneration levels are taxed at wage tax rate \( t \). The wage tax rate \( t \) is assumed to be the same tax rate as in the previous sections for reasons of comparability with the benchmark case. The corporate tax \( s \) is assumed to be symmetric again in order to separately determine the effects of bonus taxation.

In contrast to proportional wage taxation the increased bonus (penalty) tax can alter the principal’s choice between bonus and malus contract.

**Proposition 5:** An increase of the bonus tax rate \( b \) can change the algebraic sign of the difference of the principal’s objective functions \( Z(o_B) - Z(o_M) \).

**Proof:** Proportional wage taxation cannot reduce the difference of the principal’s objective functions to zero as it proportionally decreases the principal’s expected profit. However, progressive taxation can do so. Since the expected profits before remuneration costs \( X_H \) are identical for both bonus and malus contract, it is sufficient to investigate the impact of the bonus tax rate on the difference of the expected remuneration costs:

\[
E[RCB - RCM] = 0
\]

\[
\left[ (1 - \phi_3^H) r_{NB}^* + \phi_3^H r_{B,b}^* \right] = \left[ \phi_1^H r_M^* + (1 - \phi_1^H) r_{NM,b}^* \right],
\] (13)

which can be zero as shown in the following example.

\(^{20}\) For example, tax rate cuts for the malus contract would always impair the bonus contract in contract comparison. Implementing the same bonus tax rate \( b \) for both performance-based incentive contracts seems sensible as \( r_B^* \) and \( r_{NM}^* \) can be at a comparable level (see examples 1 and 2).
Example 3

With a disutility caused by providing high effort $v_H = 3$, reservation utility $U = 20\sqrt{1-t}$, corporate tax rate $s = 0.3$, a lower wage tax rate $t = 0.3$ and a distribution of probabilities

$$\text{low outcome } x_1 = 50$$
$$\text{medium outcome } x_2 = 1000$$
$$\text{high outcome } x_2 = 2000$$

<table>
<thead>
<tr>
<th>Effort</th>
<th>low effort $e_L$</th>
<th>high effort $e_H$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.4</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>0.4</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Table 6 Distribution of probabilities, example 3

the optimal remuneration levels and expected remunerations are

<table>
<thead>
<tr>
<th></th>
<th>bonus contract $o_B$</th>
<th>malus contract $o_M$</th>
</tr>
</thead>
<tbody>
<tr>
<td>lower remuneration</td>
<td>$r_{NB}^* = 269.43$</td>
<td>$r_{NM}^* = 85.43$</td>
</tr>
<tr>
<td>higher remuneration</td>
<td>$r_B^* = 1179.42$</td>
<td>$r_{NM}^* = 738.28$</td>
</tr>
<tr>
<td>expected profit</td>
<td>403.60</td>
<td>421.60</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>bonus contract $o_B$</th>
<th>malus contract $o_M$</th>
</tr>
</thead>
<tbody>
<tr>
<td>lower remuneration</td>
<td>$r_{NB}^* = \frac{825.60}{1-b}$</td>
<td>$r_{NM}^* = \frac{516.80}{1-b}$</td>
</tr>
<tr>
<td>higher remuneration</td>
<td>$r_B^* = \frac{733.84 - 231.17}{1-b}$</td>
<td>$r_{NM}^* = \frac{835 - 289.41}{1-b}$</td>
</tr>
<tr>
<td>expected profit</td>
<td>733.84 - 231.17</td>
<td>835 - 289.41</td>
</tr>
</tbody>
</table>

Table 7 Expected remuneration levels and profits, example 3

With regard to the expected profit, the malus contract is the most beneficial choice for the principal in case of proportional wage taxation. However, his choice between the performance-based incentive contracts changes if a bonus tax is levied with a rate higher than 42.45%, when the difference in expected remuneration costs equals zero. □

Corollary: Since the bonus tax only affects contracts with performance-based remuneration, the fixed-remuneration contract relatively benefits from the introduction of that tax.

Reusing the numbers in example 3, the principal chooses a contract with fixed remuneration $r_F^* = 400.00$ as soon as the bonus tax rate exceeds 47.25%:
However, the bonus tax seems to generally impair the malus contract. We did not find a single example where the bonus tax hits a bonus contract, which would be preferable in the benchmark case, more than the malus contract. For the bonus tax to impair the bonus contract to a larger extent than the malus contract in a relevant range, it must hold first

$$\frac{\partial E[RCB]}{\partial b} > \frac{\partial E[RCM]}{\partial b},$$

hence

$$\frac{\partial}{\partial b} \left( \phi_i^H r_{b, i}^* \right) > 1$$

(see equation (13)) so the expected remuneration costs of the bonus contract increase more on the bonus tax rate than those of malus contract. Second, \(\left( 1 - \phi_i^H \right) \phi_i^H \left( \phi_i^H - \phi_i^L \right)^2 - \left( 1 - \phi_i^H \right) \phi_i^H \left( \phi_i^L - \phi_i^H \right)^2 > 0\) must hold (see equation (7)), so the bonus contract is the preferable contract choice in the benchmark case. Solving equation (14) for \(\phi_i^H\) or \(\phi_i^H\) and substituting the results in equation (7) leads to equations, which are not interpretable. Still, there is no numerical example to satisfy both conditions.

Like in the case with asymmetric corporate taxation, this effect of bonus tax cancels the salary restricting effect of malus contracts.

On the one hand a bonus tax obviously tends to favor the fixed-remuneration contract and thereby actively curbs high salaries at the expense of the agent’s effort level, which is reduced. On the other hand, this tax policy fosters higher absolute managers salaries as the higher remuneration levels rise due to the necessary compensation of the agent’s wage tax payments if the principal wants to induce the high effort level. In case the bonus tax is intended to be a penalty tax with the intention to reduce salaries, it can actually fail its objective.
6 Summary and Conclusion

This paper examines the joint impact of different forms of corporate and wage taxation on a principal’s employment decision or contract choice in an agency relationship. We compare alternative remuneration schemes of a compensation contract by means of a discrete principal-agent model, which enables us to implement to different forms of incentive-based performance contracts. The principal can choose between four different options depending on his expected profit: Refusing to hire an agent at all, offering a contract with fixed remuneration, a bonus or a malus contract. Both bonus and malus contract are superior to a contract with fixed remuneration as long as the additional expected profits exceed the higher amount of expected wage payments.

Symmetric corporate taxation, which allows full loss-offset, is neutral with respect to the employment and the contract decision. This result holds for a risk-neutral as well as a risk-averse agent. Asymmetric corporate taxation restricts the possibility of loss-offset, resulting in a more severe impairment of the fixed-remuneration contract. Additionally, a loss-offset restriction makes it relatively more attractive for the principal to choose the default option and hire no agent at all. As a consequence, asymmetric corporate taxation violates the neutrality property.

Due to the leakage effect, wage taxation in general reduces the principal’s expected profit in a non-linear fashion for both risk-averse and risk-neutral agents. Therefore, both the default option and a contract with fixed remuneration become more attractive. Still, symmetric wage taxation, which taxes wages proportionally, does not affect the choice between bonus and malus contract. Bonus taxation, a form of progressive and therefore asymmetric wage taxation, misses its initial purpose to restrict high managers salaries. It ultimately causes the principal to either pay even higher salaries or to offer a fixed-remuneration contract, which is unaffected by bonus taxation, but incentives the agent to provide only low effort.

In a hypothetical no-tax world, under symmetric taxation or asymmetric corporate taxation, the malus contract is not dominated by the bonus contract. It can even limit high absolute managers salaries while providing the same incentivizing effect for the agent as the bonus contract as long as no loss-offset restrictions exist. However, progressive wage taxation can alter the contract choices compared to the case with proportional wage taxation, which again violates the neutrality property. Additionally, the bonus tax seems to generally impair the malus contract to larger extent, which could explain the less frequent use of malus clauses in performance-based incentive schemes.

The tax effects derived from our model show that neglecting either corporate or wage taxation can induce harmful decisions on employment and contract choice. Whereas symmetric corporate taxation can be ignored in our one-period setting, wage taxation always has the potential to alter employment decisions. Choosing a contract design without taking corporate loss-offset restrictions into account can also lead to non-optimal decisions. Overall, we find a contract with malus clauses a considerable option to implement incentive schemes.
Our model is subject to several caveats. First, we do not derive generally optimal incentive contracts. Rather, the aim of this paper is to analyze the tax effects on two prominent types of performance-related contracts. We do not state the optimality of either contract, we only explain whether bonus or malus contract are more attractive in the presence of taxes. Second, all taxes are borne by the principal in our model. This result is due to the assumption that the agent is always left with their reservation utility and does not earn economic rents. Therefore, the emerging results could be different in a model with bargaining power of the agent. Third, the one-period setting of our model limits its explanatory power since the time effects of loss-offset restrictions have to be approximated by tax base effects. However, a main advantage of this approach is the availability of closed-form solutions. Multi-period principal-agent models with taxes have not yet been introduced in the literature.

The discrete structure of our model is an additional restriction in favor of analytical solutions. Although a model with a continuous state space such as the widespread LEN model would be desirable, the implementation of asymmetric corporate taxation or progressive wage taxation would violate the linearity assumption of the LEN model. One perspective for future research could be to circumvent those restrictions by a different presentation of preferences and examine the principal’s contract choices in a continuous model. Another perspective could be to analyze the combined effects of asymmetric corporate and progressive wage taxation. For an empirical approach it could be interesting to examine the impact of malus and claw-back clauses on firm performance for companies, which already integrated them in their incentive plans.

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21 See Krenn (2017).
Appendix

Derivation of the remuneration levels with regard to symmetric wage taxation

Fixed-remuneration contract:

For option $o_F$, the principal’s utility

$$Z(o_F) = (1 - s)\left( X_L - u^2_F \right)$$  \hspace{1cm} (15)

is maximized subject to the participation constraint (PC)

$$u_F \geq \frac{U}{\sqrt{1-t}}.$$  \hspace{1cm} (16)

Since the principal is profit-maximizing, the PC holds with equality and determines the optimal remuneration level $u^2_F = r_F$. If the reservation utility is assumed to be tax-dependent, the wage tax rate does not impact the remuneration level, which does not alter the qualitative results. □

Bonus contract:

For option $o_B$, the principal maximizes his objective function

$$\max_{u_B, u_N} Z(o_B) = \left( 1 - s \right) \left( X_H - \min \left( \left( 1 - \phi^H_3 \right) u^2_N + \phi^H_3 u^2_B \right) \right)$$  \hspace{1cm} (17)

subject to PC

$$\sqrt{1-t} \cdot \left( \left( 1 - \phi^H_3 \right) u^2_N + \phi^H_3 u^2_B \right) \geq v_H + U,$$  \hspace{1cm} (18)

and IC

$$\sqrt{1-t} \cdot \left( \left( 1 - \phi^L_3 \right) u^2_N + \phi^L_3 u^2_B \right) - v_H \geq \sqrt{1-t} \cdot \left( \left( 1 - \phi^H_3 \right) u^2_N + \phi^H_3 u^2_B \right).$$  \hspace{1cm} (19)

The equations (18) and (19) hold with equality\(^\text{22}\) so that the resulting linear equation system can be solved for $u^2_{NB} = r_{NB} = \frac{1}{1-t} \left[ U + v_H - \frac{v_H \cdot \phi^H_3}{\phi^H_3 - \phi^L_3} \right]^2$ and $u^2_B = r_B = \frac{1}{1-t} \left[ U + v_H + \frac{v_H \cdot \left( 1 - \phi^H_3 \right)}{\phi^H_3 - \phi^L_3} \right]^2$. □

Malus contract:

For option $o_M$, the principal maximizes his objective function

$$\max_{u_M, u_{NM}} Z(o_M) = \left( 1 - s \right) \left( X_H - \min \left( \phi^H_1 u^2_M + \left( 1 - \phi^H_1 \right) u^2_{NM} \right) \right)$$  \hspace{1cm} (20)

subject to PC

$$\sqrt{1-t} \cdot \left( \phi^H_1 u^2_M + \left( 1 - \phi^H_1 \right) u^2_{NM} \right) \geq v_H + U.$$  \hspace{1cm} (21)

and IC
\[ \sqrt{1-t} \cdot \left( \phi_1^H u_M + (1-\phi_3^H) u_{NM} \right) - v_H \geq \sqrt{1-t} \cdot \left( \phi_1^L u_M + (1-\phi_3^L) u_{NM} \right). \] (22)

The equations (21) and (22) hold with equality\(^\text{23}\) so that the resulting linear equation system can be solved for \( u_M^2 = r_M = \frac{1}{1-t} \left[ U + v_H - \frac{v_H \cdot (1-\phi_3^H)}{\phi_1^L - \phi_3^L} \right] \) and \( u_{NM}^2 = r_{NM} = \frac{1}{1-t} \left[ U + v_H + \frac{v_H \cdot \phi_1^H}{\phi_1^L - \phi_3^L} \right]^2. \]

□

Proof that a malus contract with \( r_{NM}^* \geq r_B^* \) cannot be beneficial for the principal

The malus contract would not generally enable a restriction of high managers’ salaries if a malus contract with \( r_{NM}^* \geq r_B^* \) could still be beneficial for the principal. If \( r_{NM}^* \geq r_B^* \), then the agent’s expected utility resulting from the higher remuneration level of the malus contract would equal or exceed that of the bonus contract \( u_{NM}^* \geq u_B^* \). This would be the case if

\[ \phi_1^L > \phi_3^H = \frac{(1-\phi_3^H)}{1-\phi_3^L} > 0 \] (23)

Substituting equation (23) in equation \( \left( 1-\phi_3^H \right) \phi_1^H \left( \phi_3^L - \phi_3^L \right)^2 - (1-\phi_3^H) \phi_3^H \left( \phi_1^L - \phi_3^L \right)^2 > 0 \) (see equation (7)), which holds if the bonus contract is the preferable performance-based incentive contract, results in \( \left( 1-\phi_3^H \right) \phi_1^H \left( \phi_3^L - \phi_3^L \right)^2 \phi_3^H > 0. \) As a consequence, the expected remuneration costs resulting from the malus contract always exceed those of the bonus contract and a malus contract with \( r_{NM}^* \geq r_B^* \) is never favorable for the principal. Thus, he refrains from offering such a contract. However, in this unfavorable case the lower remuneration level of the bonus contract exceeds that of the malus contract: If \( r_M^* < r_{NB}^* \), then \( u_{NB}^* < u_{NB}^* \) always holds with regard to equation (23):

\[ u_{NB}^* - u_M^* = \frac{\phi_3^H v_H}{\phi_1^L \left( \phi_3^L - \phi_3^L \right)} > 0. \]

Hence, the malus contract does not foster high managers’ salaries. These results are not affected by either symmetric corporate or wage tax since these taxes have the same relative impact on both performance-based remuneration contracts. This indicates that neither of these taxes relatively drives excessive manager salaries. The results remain the same if wages are taxes proportionally, which indicates that even in this case the malus contract is capable of curbing manager salaries. \( \square \)

Proof of the leakage effect of wage taxation

In case the reservation utility depends on the wage tax, the lower remuneration levels of both performance-based remuneration levels decrease in the wage tax rate.\(^{24}\) In these cases the respective first derivatives with respect to \(t\) are always negative due to the necessary assumptions \(U \geq \frac{v_H \cdot \phi_i^L}{\phi_i^H - \phi_i^L}\) (bonus contract) and \(U \geq \frac{v_H \cdot (1 - \phi_i^L)}{\phi_i^L - \phi_i^H}\) (malus contract), which ensure positive utility (see footnotes 16 and 17):

\[
r_{NB}^* = \frac{1}{1-t} \left[ U + v_H - \frac{v_H \cdot \phi_i^L}{\phi_i^H - \phi_i^L} \right]^2
\]
\[
\frac{\partial r_{NB}^*}{\partial t} = \frac{v_H^2 \cdot (1 - \phi_i^L)^2}{(\phi_i^H - \phi_i^L)^2} - \frac{U \cdot v_H \cdot (1 - \phi_i^L)}{(\phi_i^H - \phi_i^L)^2} \leq 0.
\]

(24)

Still, the higher remuneration levels increase in the wage tax rate \(t\):

\[
r_{B}^* = \frac{1}{1-t} \left[ U + v_H + \frac{v_H \cdot (1 - \phi_i^H)}{\phi_i^L - \phi_i^H} \right]^2
\]
\[
\frac{\partial r_{B}^*}{\partial t} = \frac{v_H^2 (1 - \phi_i^L)^2}{(\phi_i^L - \phi_i^H)^2} + \frac{U \cdot v_H \cdot (1 - \phi_i^L)}{(\phi_i^L - \phi_i^H)^2} > 0.
\]

(25)

Overall, the expected remuneration costs increase in the wage tax rate \(t\). The expected bonus contract remuneration costs (see equation (4)) and the first derivative with respect to \(t\) are

\[^{24}\text{In case the reservation utility is not dependent on wage taxation, all remuneration levels unambiguously increase in the wage tax rate.}\]
\[
E[R_{CB}] = \frac{1}{1-t} \left[ (v_H + U)^2 + \frac{v_H^2 (1-\phi_H^H) \phi_H^H}{(\phi_H^H - \phi_H^L)^2} \right]
\]

\[
\frac{\partial E[R_{CB}]}{\partial t} = \frac{v_H}{(1-t)^2} \left[ \sqrt{1-t} U + \frac{\phi_H^H - 2\phi_H^L \phi_H^H + (\phi_H^L)^2}{(\phi_H^H - \phi_H^L)^2} v_H \right] > 0
\]

and therefore always increase in the wage tax rate \( t \), since \( \phi_H^H - 2\phi_H^L \phi_H^H + (\phi_H^L)^2 \) can only become

negative for \( \frac{(\phi_L^L)^2}{2\phi_H^L - 1} > \phi_H^H \) for \( \phi_H^L < 0.5 \), which never holds as \( 0 < \phi_L^L < \phi_H^H < 1 \).

Also the first derivative with respect to \( t \) of the expected malus contract remuneration costs (see equation (6)) is always positive:

\[
E[R_{CM}] = \frac{1}{1-t} \left[ (v_H + U)^2 + \frac{v_H^2 (1-\phi_H^L) \phi_H^H}{(\phi_H^L - \phi_H^H)^2} \right]
\]

\[
\frac{\partial E[R_{CM}]}{\partial t} = \frac{v_H}{(1-t)^2} \left[ \sqrt{1-t} U + \frac{\phi_H^L - 2\phi_H^L \phi_H^H + (\phi_H^H)^2}{(\phi_H^H - \phi_H^L)^2} v_H \right] > 0,
\]

because \( \phi_H^H - 2\phi_H^L \phi_H^H + (\phi_H^L)^2 \) can only become negative for \( \frac{(\phi_L^L)^2}{2\phi_H^L - 1} > \phi_H^H \) for \( \phi_H^L > 0.5 \), which never holds as \( 0 < \phi_H^L < \phi_H^H < 1 \). As a result, even though the lower remuneration levels decrease in the wage tax \( t \), the increase of the higher remuneration levels overcompensates for that, resulting in increased expected remuneration costs for the principal due to the leakage effect of wage taxation. \( \square \)

**Proof of proposition 3:**

We only take a look at cases that entail losses, where the effects of loss-offset restrictions become relevant.

**Bonus contract:**

It holds that \( 0 < r_{nb}^* < r_f^* < r_b^* \), \( \phi_H^L > \phi_H^H \) and \( \phi_H^H > \phi_H^L \). As a result, loss-offset restrictions impair the fixed-remuneration contract more than the bonus contract if it entails a loss for the low outcome \( x_1 \), \( \phi_H^L (x_1 - r_f^*) < \phi_H^H (x_1 - r_{nb}^*) \). The same applies if the fixed-remuneration contract entails losses for both
low and medium outcomes \( x_i \) and \( x_2 : \phi^*_1 \left( x_i - r_F^- \right) + \phi^*_2 \left( x_i - r_F^- \right) < \phi^*_1 \left( x_i - r_{NB}^- \right) + \phi^*_2 \left( x_i - r_{NB}^- \right) < 0 \). This is because not only the absolute losses are higher for the contract with fixed remuneration, but also the probability of generating: \( \left( \phi^*_1 \left( x_i - r_F^- \right) + \phi^*_2 \left( x_i - r_F^- \right) \right) > \left( \phi^*_1 \left( x_i - r_{NB}^- \right) + \phi^*_2 \left( x_i - r_{NB}^- \right) \right) \).

If, however, only the bonus contract is penalized by loss-offset restrictions because it entails a loss for the high outcome \( x_3 \) while the fixed-remuneration contract entails a profit, the fixed-remuneration contract becomes relatively more attractive, due to \( \phi^*_1 \left( x_i - r_F^- \right) > \phi^*_1 \left( x_i - r_{NM}^- \right) \). Still, in case the high outcome \( x_3 \) entails a loss for the bonus contract, it is logically pointless to incentivize the agent to exert high effort anyway.

**Malus contract:**

It holds that \( 0 < r_M^- < r_F^- < r_{NM}^- \), \( \phi_1^s > \phi^*_1 \) and \( \phi^*_2 > \phi^*_1 \), so that loss-offset restrictions have greater impact on the fixed-remuneration contract in case of losses for the low outcome \( x_1 \) regardless of the malus contract’s profit or loss: \( \phi^*_1 \left( x_i - r_F^- \right) < \phi^*_1 \left( x_i - r_{NM}^- \right) \). Nevertheless, if the malus contract entails losses for the medium outcome \( x_2 \) and high outcome \( x_3 \), loss-offset restrictions impair the malus contract more: \( \phi^*_2 \left( x_i - r_F^- \right) + \phi^*_3 \left( x_i - r_F^- \right) > \phi^*_2 \left( x_i - r_{NM}^- \right) + \phi^*_3 \left( x_i - r_{NM}^- \right) \). In this case not only losses for the malus contract are higher, but also the probability of generating: \( \left( \phi^*_2 + \phi^*_3 \right) = \left( 1 - \phi^*_1 \right) < \left( \phi^*_2 + \phi^*_3 \right) = \left( 1 - \phi^*_1 \right) \). However, in this case offering either a malus or a fixed-remuneration contract is logically pointless. □

**Derivation of the remuneration levels with regard to bonus taxation**

In order to determine the optimal remuneration levels under bonus taxation, the PC and IC for both bonus and malus contract are set up and the resulting linear equation system is solved for the respective utilities, which define the optimal remuneration levels.

**Bonus contract:**

For option \( o_B \) the principal maximizes his objective function

\[
\max_{u_{NB}^*, u_{B}^*} \left( 1 - s \right) X_H - \min \left( \left[ \left( 1 - \phi^*_3 \right) u_{NB}^* + \phi^*_3 u_{B}^* \right] \right)
\]

subject to PC

\[
\sqrt{1 - t \cdot \left( 1 - \phi^*_1 \right) u_{NB}^* + \sqrt{1 - b \cdot \phi^*_1 u_{B}} \cdot \min \left( \left[ \left( 1 - \phi^*_3 \right) u_{NB}^* + \phi^*_3 u_{B}^* \right] \right) \leq v_H + \frac{1}{t}
\]

\[
(28)
\]

\[
(29)
\]
\[
\sqrt{1-t\cdot(1-\phi^{H})}u_{NB} + \sqrt{1-b\cdot(\phi^{H}u_{B,\beta})} - v_{H} \geq 0
\]
and IC
\[
\sqrt{1-t\cdot(1-\phi^{L})}u_{NB} + \sqrt{1-b\cdot(\phi^{L}u_{B,\beta})}.
\]  

(30)

The equations (29) and (30) hold with equality\(^{25}\) so that the resulting linear equation system can be solved for
\[
u_{NB}^{2} = r_{NB} = \frac{1}{1-t} \left[ U + v_{H} - \frac{\phi^{H} \cdot v_{H}}{\phi_{1}^{H} - \phi_{1}^{L}} \right]\]
and
\[
u_{B,\beta}^{2} = r_{B,\beta} = \frac{1}{1-b} \left[ U + v_{H} + \frac{(1-\phi^{H}) \cdot v_{H}}{\phi_{1}^{H} - \phi_{1}^{L}} \right].
\]

Malus contract:

For option \(o_{M}\) the principal maximizes his objective function
\[
\max_{\nu_{M}, \nu_{NM}} Z(o_{M}) = (1-s) \left[ X_{H} - \min(\phi^{H}u_{M}^{2} + (1-\phi^{H})u_{NM,B}^{2}) \right]
\]
subject to PC
\[
\sqrt{1-t\cdot(\phi^{H}u_{M})} + \sqrt{1-b\cdot(1-\phi^{H})u_{NM,B}} \geq v_{H} + U
\]
and IC
\[
\sqrt{1-t\cdot(\phi^{L}u_{M})} + \sqrt{1-b\cdot(1-\phi^{L})u_{NM,B}} \geq 0
\]

(32)

The equations (32) and (33) hold with equality\(^{26}\) so that the resulting linear equation system can be solved for
\[
u_{M}^{2} = r_{M} = \frac{1}{1-t} \left[ U + v_{H} - \frac{\phi_{1}^{H} \cdot v_{H}}{\phi_{1}^{H} - \phi_{1}^{L}} \right]\]
and
\[
u_{NM,B}^{2} = r_{NM,B} = \frac{1}{1-b} \left[ U + v_{H} + \frac{\phi_{1}^{H} \cdot v_{H}}{\phi_{1}^{H} - \phi_{1}^{L}} \right].
\]

\(\Box\)

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References


