Bailouts, Bonuses and Bankers' Short-Termism

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Bailouts, Bonuses and Bankers’ Short-Termism

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Abstract

Using a principal-agent model with two-periods, we analyze the effects of both bailouts and bonus taxation on managerial compensation and short-termism. In our model, short-termism increases expected short-term profits at the expense of expected long-term profits and is harmful not only for society, but also for the bank itself. By neglecting the costs of failure, an anticipated bailout induces the bank to tolerate short-termist behavior more often. In addition, existing excessive short-termism increases further in the anticipated bailout payment, while compensation shifts from long-term towards short-term compensation. However, an appropriate tax on short-term bonuses can induce the bank to internalize the costs of a bailout. Consequently, our model offers a rationale for such a tax when banks anticipate bailouts and adjust their compensation payments accordingly.

Keywords: Bonus Tax; Executive Compensation; Bonuses; Short-Termism; Bailout; Systemic Risk

JEL Codes: H24; J3; M52; G38;

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1 Introduction

When governments in the recent financial crisis had little choice but to avoid contagion and to rescue banks by using public money, politicians and policymakers started looking for the underlying causes of the financial crisis. In compensation payments for bankers they found one key factor for the excessive risk culture in some banks. Especially high bonuses were thought of inducing bankers to take on too much risk and to focus on short-term profits rather than on sustainable long-term profits.\(^1\) As a consequence and to address this issue for the future, policymakers around the world responded to the heated public debate by limiting compensation payments of executives or by revising the tax treatment of bonus payments. Notwithstanding its effects on long-term profits, it is fully rational that bankers adjust their investment decision to their offered compensation structure. When banks largely base their bankers’ compensation on short-term profits, bankers will prefer projects with higher expected profits in the short-run over projects with higher expected long-term profits. However, the question regarding the determinants of incentive provision in banking remains.

In the following, we offer a two period principal-agent model that deals with this question and that combines three aspects of the financial crisis: (i) the time-horizon of investments, (ii) the systemic risk of financial institutions and (iii) bonus taxation. First, we analyze the determinants of compensation payments and the time-horizon of investments when the bank is faced with moral hazard both with respect to effort and managerial short-termism. In a second step, we introduce the externality of a bailout. This allows us to focus on whether a bailout policy affects the composition of short-term and long-term compensation and whether banks tolerate or even incentivize (higher) short-termism of their bankers. Finally, we pick up the discussion on reforms of the tax treatment of managerial compensation and analyze the effects of a tax specifically on short-term bonuses.

Much attention has been paid to the role of bonuses within the financial services industry. As Suntheim (2011) finds, mean total compensation for chief executive officers (CEO) in the financial services industry is $3.6 million, with roughly 60% paid as bonuses. While bonuses have an advantageous effect on the alignment of interests and are therefore a heavily used compensation

\(^1\)In the UK, for example, the Treasury Committee of the House of Commons asserted that the “‘bonus culture’ in the City of London(...) contributed to excessive risk-taking and short-termism and thereby played a contributory role in the banking crisis” (UK House of Commons, 2009).
instrument within this industry, they also come at a cost. For instance, the UK Financial Services Authority (2008) states in a letter to CEOs on remuneration policies that “in many cases the remuneration structures of firms may have been inconsistent with sound risk management”. Even banks themselves know about the effects of compensation: In an industry survey on compensation practices among wholesale banking businesses, 98% of respondents affirm the Institute of International Finance (2009) that compensation practices were an underlying factor for the financial crisis. This is especially true for cash bonuses which in the financial sector are well above the cash bonus payments in non-financial firms (Von Ehrlich and Radulescu, 2012). De facto, Livne et al. (2013) empirically identify that cash bonuses to CEOs are positively correlated with the bank’s intensity of short-term investments. We cover this aspect in a theoretical framework by modeling moral hazard both with respect to effort and short-termism, and by giving the bank two incentive instruments: short-term bonuses and long-term bonuses. However, the bank faces a tradeoff. While short-term bonuses provide incentives for short-termism, long-term compensation is more costly as the manager discounts the future. This tradeoff changes if banks can anticipate a bailout if they fail.

In fact, banks are more likely to receive a bailout than non-financial firms. Smith (2014) constructs a dataset of financially distressed firms across industries and countries, and identifies that the likelihood of receiving a bailout strongly increases in firm size and when the firm is active in the financial sector. In addition, DeYoung et al. (2013) measure with respect to risk-taking that banks exploit their too-big-to-fail incentives and therefore set incentives in a way that managers increase risk taking. In our model, we analyze how a bailout affects the composition of managerial compensation and the time-horizon of investments. By bailing out a bank that is too-big-to-fail, the government averts further damage from the economy and the financial system. At the same time, this policy can be anticipated by banks of a certain size. If banks know that their imminent bankruptcy prompts the government to act, they may adjust their incentive structures already beforehand. Our findings demonstrate that banks indeed change their compensation structure towards higher short-term payments in most cases. This action does not only increase the likelihood of harmful short-termist behavior in general. It is also accompanied by a further increase in existing, already excessive short-termism.
However, in a third step, we show how the specific taxation of short-term bonuses can reverse the negative effects a bailout entails for short-termism and compensation. In the midst of the financial crisis, several countries introduced a tax on managerial bonuses to raise tax revenue and to appease the public.\(^2\) While the UK imposed a 50\% tax on cash bonuses for all bankers, other countries made their bonus tax contingent on governmental aid.\(^3\) To this effect, Ireland introduced a 90\% bonus tax in 2011, and the US House of Representatives in 2009 voted for a 90\% bonus tax for banks under the Troubled Asset Relief Program (TARP).\(^4\)

Combining the possibility of short-termism with a bailout, this paper shows how a bailout guarantee by governments changes equilibrium compensation and short-termist behavior. Harmful short-termism is more likely to occur or even increases in the presence of a bailout. In most cases, a bailout makes it profitable for a bank to change its compensation structure towards higher short-term payments, tolerating the negative consequence of short-termism. Moreover, the paper explains the observation that the financial sector pays higher short-term bonuses than other sectors.\(^5\) It shows that one reason for this could be the systemic externality of banks. However, for a government that anticipates these negative consequences, the paper provides an argument for a tax on short-term compensation. This leads the banks to internalize the costs of short-termism and sets incentives to reduce short-term bonuses and short-termism.

2 Related Literature

In order to model the effects of bailouts and bonus taxation on executive compensation and short-termism, we draw on the literature of optimal contracting or agency theory. In the presence of an information asymmetry, firms need some kind of incentive instrument in order to align the manager’s interests with their own interests (Jensen and Meckling 1976, Holmstrom 1979, and

\(^2\)See Shackelford et al. (2010), Keen (2011) and Devereux (2011) for other proposals regarding the regulation of the financial sector.

\(^3\)Under the UK Finance Act 2010 (Schedule 1), the so-called UK bank payroll tax for the fiscal year 2009-2010 was levied on bonus payments higher than 25,000 GBP.

\(^4\)See “Ireland to reintroduce 90\% bank bonus tax” (guardian.co.uk 2011, Jan 26) and “Bonus Tax Heads to Senate After House Passes 90\% Levy” (bloomberg.com 2009, Mar 20).

Grossman and Hart 1983, among others). Adding multiple periods to the analysis, the literature on short-term and long-term compensation extends the standard agency theory by targeting the issue of the time-horizon of the managers’ investment decisions. Starting with works by Narayanan (1985), Stein (1989) and Von Thadden (1995), the literature has shown that managers may inflate current profits to raise their own reputation (Narayanan, 1985), to polish the forecast of future firm value (Stein, 1989), or to reduce the likelihood of project termination (Von Thadden, 1995). Even though harmful for the firm, optimal executive compensation is found to emphasize short-termism when stock markets are speculative (Bolton et al., 2006) or when information about short-term performance is very noisy (Peng and Röell, 2014). In addition to internal reasons to accept short-termism, Thanassoulis (2013) presents an externality that leads to short-termism and an optimal contract tolerating it. Within a competitive labor market for managers, he finds that firms exert a negative externality towards each other in driving up managers’ outside options. Under certain conditions, industry may partition such that large firms pay high short-term bonuses and tolerate short-termism, while smaller firms use compensation methods that prevent short-termism.

In terms of methodology, this paper is particularly related to Thanassoulis (2013) whom we follow with respect to the managers business decisions and the instruments for executive compensation. However, we depart from Thanassoulis (2013) in omitting the competitive labor market and in simplifying the assumption of the manager’s effort costs. While Thanassoulis (2013) suggests effort costs for the manager to depend on his income (à la Edmans et al., 2009), we use a linear functional form with fixed exogenous effort costs independent of income as commonly used in literature. Keeping the manager’s outside option exogenous allows us to focus in a simple model on the effects we want to study: the effects of bailouts and a bonus tax on executive compensation and short-termism. Therefore we allow the manager to have a continuous choice of short-termism rather than

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\(^6\)While in this literature a manager finds himself within a competitive market for employees that drives down compensation payments, the managerial power approach sees managers to be powerful in the wage-setting process and able to extract rents (Bebchuk et al. 2002, Bebchuk and Fried 2003 and Bebchuk and Fried 2004). Glazer and Konrad (1999) and Rothschild and Schaefer (2011) analyse the taxation of rent-seeking activities, while Frydman and Jenter (2010) and Murphy (2013) provide overviews for contributions both within the managerial power approach and the efficient contracting literature.

\(^7\)In contrast to the view of inefficient short-termism, Laux (2012) suggests a beneficial effect of short-term investments: When managers can be replaced, such investment allows an early assessment of the manager’s fit to the firm and thus a more efficient replacement process.

\(^8\)See, e.g. Laïffont and Martimort (2002).
only a binary one as in Thanassoulis (2013). In addition, we extend Thanassoulis’ work by adding the possibility of a bailout and a bonus tax.

Literature has already dealt with the effects of a bailout on managerial compensation and its effects on risk-taking for a one-period case. Both Besley and Ghatak (2013) and Hakenes and Schnabel (2014) analyze how bonuses change when bailouts can be anticipated by systemic banks and both show that risk-taking increases in the anticipation of a bailout. The same result has been shown by Hilmer (2014), who, in contrast to Besley and Ghatak (2013) and Hakenes and Schnabel (2014), focused on collective moral hazard when banks receive bailouts only if they fail together. All these papers make clear that banks that can anticipate a bailout are likely to change their incentive payments in such a way that risk-taking is encouraged while social costs are neglected. However, they only present results for a single period and ignore longer lasting compensation components as observed in reality. With this paper, we fill this gap and offer insights into the effects of a bailout on the intertemporal composition of executive pay like cash bonuses and stock options. Moreover, our two-period principal-agent model allows us to study a so far unconsidered element in this literature: the effects of a bailout on managerial short-termism rather than risk-taking.

Besides the effects of a bailout, this paper deals with the effects of a tax on short-term bonus payments. In this respect, our work is related to the literature on bonus taxation.\footnote{In addition, this paper is related to the literature on taxation of risk-taking activities. See Buchholz and Konrad (2014) for a recent survey on this topic.} Part of this literature analyzes the effects of a bonus tax on compensation payments and effort incentives. Both Dietl et al. (2013) and Hilmer (2013) find that effort decreases in the bonus tax while bonus payments to the manager might increase or decrease.\footnote{Von Ehrlich and Radulescu (2012) estimate the effects of the UK bank payroll tax and find a reduction in bonuses of 40% caused by the tax. However, banks one-to-one increased other pay components not subject to the tax.} In addition, Hilmer (2013) identifies effects to be similar for a bonus tax and a limited deductibility of bonus payments from the corporate income tax and highlights the positive welfare effects of a subsidy for bonus payments. Grossmann et al. (2012), Besley and Ghatak (2013) and Hilmer (2014) study the effects of a bonus tax on risk-taking. While the findings by Grossmann et al. (2012) imply risk-taking to be increasing in a bonus tax for a risk-averse manager, Besley and Ghatak (2013) and Hilmer (2014) find the opposite effect for a risk-neutral manager in the presence of a bailout. Both of them emphasize the positive effects
of a bonus tax that leads banks to internalize part of the social costs a bailout entails, also when the bonus tax is introduced unilaterally (Hilmer, 2014). Even though Besley and Ghatak (2013) and Hilmer (2014) examine the effects of both a bailout and bonus taxation in their frameworks, this is the first paper that addresses the optimal taxation of bonus pay in a setting that includes short-term and long-term incentive payments in its analysis. This allows us to introduce potential short-termism and to generate new insights with respect to the effects of bailouts and bonus taxes on the composition of incentive pay between periods and managerial short-termism.

In the following section, we introduce the model and derive the equilibrium compensation contracts and the resulting levels of short-termism. In Section 4, the effects of a governmental bailout on managerial compensation and short-termism are analyzed, while Section 5 then illustrates how a bonus tax reverses the negative incentives a bailout entails. Section 6 concludes.

3 The Model

3.1 Banks, Managers and Business Decisions

Consider a situation with a risk-neutral bank-shareholder (principal) who delegates the task of running its operations to a risk-neutral bank-manager (agent). In $t = 0$, the bank offers a take-it-or-leave-it contract to the manager, whose payoff is subject to a limited liability constraint and who has an exogenous outside option $u \geq 0$ and zero initial wealth. If the manager accepts the contract, he makes a business decision at the beginning of period $t = 1$ about an investment that contains an effort choice $e \in \{0, 1\}$ and a degree of short-termist behavior $a \geq 0$. Depending on his business decision, the investment generates returns both at the end of period $t = 1$ and at the end of $t = 2$.

**Business Decisions** The realization of firm profit is independent across periods and can take one of two values in each period: high profit $\pi_H$ or low profit $\pi_L$ (with $\pi_H > \pi_L \geq 0$). If the manager does not exert effort, then the investment will fail for sure and low profit $\pi_L$ will be realized in

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11 Thanassoulis (2012) and Radulescu (2012) emphasize the role of the managers’ outside option. When competition for bankers entails a negative externality to other banks, Thanassoulis (2012) finds no effects of bonus taxes on the default risk that excessive bonuses cause. According to Radulescu (2012), also a manager with relocation possibilities reduces effort when faced with a bonus tax, but may earn a higher bonus when his risk aversion is high enough.
both periods (see Table 1). By exerting effort $e = 1$, the manager increases the probability of the high profit $\pi_H$. In this case, profit $\pi_H$ will be realized with probability $x$ in each period. In addition to effort, the manager may take a short-termist action $a$. Following Thanassoulis (2013), we model short-termism as increasing the probability of high short-term profit at the expense of the probability of high long-term profit.\footnote{Our concept of modelling short-termism holds for several real-world interpretations of short-termism. Examples are unfavorable and unobservable borrowing against future earnings (Stein, 1989), excessive exposure to derivatives (as futures or swaps) that provide no additional long-term value (Foster and Young, 2010) or lax lending standards to inflate the balance sheet (Shin, 2009). Nevertheless, our agent is fully rational. In that respect we differ from the behavioural literature on myopic loss aversion (Benartzi and Thaler 1995, Thaler et al. 1997, among others).} By focusing on short-term results, i.e. choosing $a > 0$, profit in period $t = 1$ will be $\pi_H$ with probability $x + a$ rather than $x$ (and $\pi_L$ with probability $1 - (x + a)$). However, in period $t = 2$, the probability for the high profit $\pi_H$ will only be $x - \delta a$ instead of $x$ for the case without short-termism. By assuming $\delta > 1$, action $a > 0$ not only shifts probability mass for the high profit $\pi_H$ from period $t = 2$ to period $t = 1$. Moreover, $\delta > 1$ ensures that the model captures short-termism for the bank, i.e. any short-termist action $a \neq 0$ is harmful for the bank and, in addition, socially undesirable. In that sense, $\delta$ denotes the bank’s cost of the short-termist action that arises as the manager increases short-term results at the expense of long-term results.\footnote{By interpreting the short-termist action $a$ as degree of earnings manipulation, this model is also related to the literature of costly state falsification (see Crocker and Slemrod 2007 or Laux 2014, among others). In Laux (2014), the agent can manipulate the financial report (at a cost) on which the principal bases his decision about continuing or terminating a certain project (corresponds to $a > 0$). As a result of manipulation, the principal may then not terminate an unprofitable project and destroy long-term value (corresponds to $\delta > 1$).}

<table>
<thead>
<tr>
<th></th>
<th>Profit at $t = 1$</th>
<th>Profit at $t = 2$</th>
</tr>
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<tbody>
<tr>
<td>Manager exerts effort (&amp; myopia)</td>
<td>$\begin{cases} \pi_H &amp; \text{with prob. } x + a \ \pi_L &amp; \text{with prob. } 1 - (x + a) \end{cases}$</td>
<td>$\begin{cases} \pi_H &amp; \text{with prob. } x - \delta a \ \pi_L &amp; \text{with prob. } 1 - (x - \delta a) \end{cases}$</td>
</tr>
<tr>
<td>Manager exerts zero effort</td>
<td>$\pi_L$</td>
<td>$\pi_L$</td>
</tr>
</tbody>
</table>

Table 1: Project Returns

Both effort and short-termism are assumed to be costly for the manager. While high effort comes at a fixed nonmonetary investment cost $I > 0$ (and zero costs if the manager chooses $e = 0$), costs of the short-termist action are assumed to be quadratic, i.e. $C(a) = k/2a^2$, with $k > 0$.\footnote{This convex characterization implies that costs for the short-termistic action are small in the beginning but increase in the level of short-termism. As short-termism is not in the bank’s interest, the manager might need to camouflage short-termism, or, as in Laux (2014), better manipulation may be more expensive.} In order to focus on the incentive effects of a bailout and/or a bonus tax on short-termism, we assume...
that it is always profitable for the bank to offer a contract to the manager that induces high effort.\textsuperscript{15}

We model moral hazard in that the choice of effort ($e = 0$ or $e = 1$) and short-termism ($a \geq 0$) is private information to the manager and not observable by the bank. To guarantee that the manager’s effort choice cannot be traced back by the bank, we assume that the probability of any outcome is strictly between zero and one, i.e. $0 < x - a\delta \leq x \leq x + a < 1$. Ex post, realized profits in period $t = 1$ and $t = 2$ are observable and verifiable.

**Compensation Payments** Managers are assumed to receive profit-contingent compensation with three possible payment instruments used by the bank. At the end of period $t = 1$, the manager may receive a fixed wage $A \geq 0$ and a short-term bonus $b_s \geq 0$. While the fixed wage is paid independent of realized returns in any period, the short-term bonus $b_s$ is paid only if the realized profit in $t = 1$ is $\pi_H$. In the long run, at the end of period $t = 2$, the manager may receive vested or deferred pay (i.e. a long-term bonus component) $b_l \geq 0$ if the realized profit in $t = 2$ is $\pi_H$.\textsuperscript{16} Both the bank and the manager are assumed to discount future. While the bank discounts at rate $r \geq 0$, the manager has a discount rate $\rho \geq r$.\textsuperscript{17} Thus, at the end of $t = 1$, the manager’s net present value (NPV) of the long-term bonus $b_l$ is $\frac{b_l}{1 + \rho}$.

\textsuperscript{15}This implies an implicit assumption on effort costs $I$ and the outside option $u$. In particular, for $e = 1$ being more profitable than $e = 0$ for all possible $a$, effort costs $I$ have to be sufficiently small such that $(2x + \bar{a} - \delta \bar{a}) (\pi_H - \pi_L) - \frac{x + \bar{a}}{1 + \rho} [I + C (\bar{a})] \equiv \Omega > 0$, with $\bar{a} = \frac{1}{k} (\sqrt{2kI + k^2x^2} - kx)$. In order that the principal obtains non-negative equilibrium profits, $\Omega + 2\pi_L - u \geq 0$ must hold in addition. Consequently, an equilibrium in which the bank incentivizes effort $e = 0$ does not exist. In particular, there cannot be an equilibrium with $e = 0$ and $a > 0$. For $e = 0$, the manager has no advantage from $a > 0$ (as for example increasing the probability of a certain outcome), but incurs costs $C (a)$.

\textsuperscript{16}For the bonus payment $b_l$, the principal could also use the information he gained meanwhile. Making $b_l$ next to profit in $t = 2$ also conditional on past profit realization in $t = 1$ alters the manager’s marginal analysis. Nevertheless, the qualitative effects with respect to the bailout and bonus taxation do not change. We therefore follow the literature (e.g. Thanassoulis, 2013) and stick to this simpler contract structure with deferred payments being conditional only on current profit realization. While to our knowledge there is no literature on the optimal contract with the specification used here, there exist papers (Lambert 1983, Rogerson 1985, Edmans et al. 2012) showing that optimal contracts exhibit memory of past outcomes when the agent chooses effort in each period. Particularly with regard to short-termism, Edmans et al. (2012) present closed-form solutions in a model with risk-aversion and private saving. Still, also their complex optimal contract of a rebalanced account contains deferred pay.

\textsuperscript{17}As will be discussed later (p. 13), there are good arguments to allow for $\rho > r$. Managers not only resist high long-term payments because of their desire for portfolio diversification or liquidity concerns (Walker, 2010). But also, the uncertainty of long-term payments and the unpredictability of personal events may make short-term compensation more favorable for managers. We will later discuss the implications of $\rho = r$ or $\rho > r$ when analyzing the equilibrium.
3.2 First Best and Welfare Maximum

Before we turn to the principal-agent problem with information asymmetry between bank and manager, we first identify the first-best solution and solve for the welfare maximum. As the bank can observe the manager’s effort choice and the level of short-termist action, it will maximize payoff by directly contracting upon the manager’s choice variables. Total compensation must cover the manager’s outside option \( y \) and his costs for effort, \( I \), and for the short-termist action, \( \frac{k}{2}a^2 \).

Dependent on the manager’s discount rate, the bank will prefer compensation payments in period \( t = 1 \) weakly (with strict preference if \( \rho > r \)) to paying a long-term bonus that may be less valued by the manager. Taking the necessary compensation \( y + I + \frac{k}{2}a^2 \) into account and given our assumption that inducing effort \( e = 1 \) is always profitable, the principal maximizes expected payoff

\[
E(U_P) = (x + a)(\pi_H - b_s) + (1 - x - a)\pi_L - A + (x - \delta a)\left(\frac{\pi_H - b_a}{1 + r}\right) + (1 - x + \delta a)\frac{\pi_L}{1 + r}
\]

by choosing short-termist action \( a \).

For the welfare analysis, we assume that a benevolent social planner maximizes overall efficiency and define welfare as the sum of manager’s expected payoff \( E(U_A) = A + (x + a) b_s + (x - \delta a) \frac{b_l}{1 + r} - I - C(a) \) and the bank’s expected payoff \( E(U_P) \) in the absence of any externality. As both bank and manager are risk neutral, all wage payments except \( b_l \) have only distributional impacts and do not affect welfare. Expected welfare is therefore given by

\[
E(W) = (x + a)\pi_H + (1 - x - a)\pi_L + (x - \delta a)\frac{\pi_H}{1 + r} + (1 - x + \delta a)\frac{\pi_L}{1 + r} - I - C(a).
\]

**Lemma 1.** In first best, short-termism is chosen welfare maximizing according to

\[
a^{FB} = \max \left\{ 0, \frac{\pi_H - \pi_L}{k} \left( 1 - \frac{\delta}{1 + r} \right) \right\}.
\]

*Proof.* All proofs are contained in the appendix. \( \square \)

Lemma 1 is intuitive. Suppose the bank does not discount future, i.e. \( r = 0 \). As short-termism is harmful for the bank, i.e. \( \delta > 0 \), short-termism is inefficient both from the bank’s perspective and from a welfare perspective. Therefore, it should be avoided and both the bank in first best

\[\text{Footnote 18: As we will later introduce a bailout and a bonus tax, both would affect } E(U_P). \text{ However, in our optimal welfare function that maximizes efficiency we abstract from those effects as they only have distributional impacts.} \]

\[\text{Footnote 19: Due to our assumption } \rho \geq r, b_l \text{ negatively affects welfare and therefore will not be used by the social planner.} \]
as well as the social planner always want to have the short-termist action \( a = 0 \). However, if the bank discounts period \( t = 2 \) profits more than short-termism harms expected payoffs, i.e. \( 1 + r > \delta \), then, short-termism is actually beneficial. By paying the manager to focus on short-term results, probability mass is shifted from the highly discounted and therefore less valuable period \( t = 2 \) profits to undiscounted period \( t = 1 \) profits.\(^{20}\) In the following, we will focus on cases where short-termism is inefficient and unprofitable. That is, we assume \( 1 + r \leq \delta \).

### 3.3 Second-Best without Bailouts

In presence of the agency problem, the manager and the bank will choose actions that maximize their expected income and their expected profit, respectively. We solve the model by backward induction and start with the manager’s maximization problem, followed by the bank’s optimization.

The manager chooses effort \( e \) and the short-termist action \( a \) so as to maximize his expected payoff \( E(U_A) \). Provided that \( e = 1 \), this defines the optimal amount of short-termism

\[
a^* = \arg \max_a A + (x + a) b_s + (x - \delta a) \frac{b_l}{1 + \rho} - I - \frac{k}{2} a^2,
\]

which, in combination with the restricted domain \( a \geq 0 \), denotes the manager’s first-order condition:\(^{21}\)

\[
a^* = \max \left\{ 0, \frac{1}{k} \left( b_s - \delta \frac{b_l}{1 + \rho} \right) \right\}
\] (1)

When offering a contract to the manager, the bank considers the manager’s optimality condition (1) and maximizes expected profit \( E(U_P) \) by choosing the conditionally optimal compensation components \( A, b_s \) and \( b_l \):

\[
\max_{A, b_s, b_l} \left( \begin{array}{c} \text{exp. short-term profit} \\ \text{NPV of exp. long-term profit} \\ \text{fixed wage} \end{array} \right) = \left( \begin{array}{c} \pi_H - b_s + (1 - x - a) \pi_L + \frac{1}{1 + r} (x - \delta a) (\pi_H - b_l) + (1 - x + \delta a) \pi_L - \frac{k}{2} a^2 \\ A \end{array} \right) 
\] (2)

\[
\text{s.t.} \quad \begin{align*}
A + (x + a) b_s + (x - \delta a) \frac{b_l}{1 + \rho} - I - \frac{k}{2} a^2 & \geq u \\
(x + a) b_s + (x - \delta a) \frac{b_l}{1 + \rho} - I - \frac{k}{2} a^2 & \geq 0
\end{align*}
\] (3) (4)

\(^{20}\)As \( 1 + r > \delta \), the benefits of this shift outweigh the inefficiency of short-termism in general.

\(^{21}\)Note that the SOC for a maximum w.r.t. \( a \) is satisfied.
Equation (3) is the manager’s participation constraint that has to be fulfilled in order for him to accept the bank’s contract offer. Expected income in $t = 1$ units must remunerate the manager at least for his outside option $u$ and his costs for effort and identifying projects with a high probability of short-term profits. Moreover, the bank has to incentivize the manager to exert effort $e = 1$. Condition (4) makes sure that the manager does not shirk with respect to effort. Finally, as explained above, the manager will choose short-termism according to (1). The bank has to take into account the three constraints above together with the non-negativity constraint on compensation payments.

**Equilibrium**

In order to incentivize high effort, the bank must either pay a short-term bonus $b_s$ and/or a long-term bonus $b_l$ to the manager (see (4)). For the bank, this creates a tradeoff between two different effects that short-term and long-term bonuses induce.

**Lemma 2.** For $a > 0$, there are two opposing effects with respect to effort inducing bonus payments. (i) The level of short-termism is declining in the level of long-term bonus pay. (ii) Compensation costs increase in the use of the long-term bonus if $\rho > r$; the cost increase is stronger, the larger $\rho$ is compared to $r$.

On the one hand, the bank prefers paying a long-term bonus to the manager to induce high effort as compared to paying a short-term bonus. In contrast to a short-term bonus, a long-term bonus better targets sustainable bank profit in the short and in the long run, and thus better aligns the bank’s and the manager’s interests. Suppose, for example, the bank concentrates on paying only a long-term bonus to induce high effort. In this case, interests between the bank and the manager are perfectly aligned. While short-termism is always harmful for the bank by assumption $\delta > 1 + r$, paying only long-term bonuses makes short-termism also unprofitable for the manager. Any level of short-termism $a \neq 0$ causes not only costs $C(a) > 0$ for the manager, but also reduces the probability of a high period $t = 2$ profit and thus the probability of receiving the bonus $b_l$.

On the other hand, a long-term bonus increases the bank’s compensation costs weakly more than a short-term bonus. As the manager discounts the long-term bonus necessary to incentivize effort at rate $\rho \geq 0$, long-term bonus payments are only worth $\frac{b_l}{1+\rho}$ for the manager, in contrast to
a short-term bonus that is worth $b_s$. As long as the bank’s and the manager’s discount rates differ, $\rho > r$, the difference in the manager’s valuation of short-term and long-term bonuses also creates a difference in the bank’s compensation costs.

This wedge in the bank’s compensation costs scales down the closer the two discount rates are to each other. In the special case where the discount rates are just the same, i.e. $\rho = r$, the bank discounts future profits and payments just as much as the manager does. In this case, the second effect stated in Lemma 2 disappears, and short-term and long-term bonuses become just equally expensive for the bank. As, by assumption $1 + r \leq \delta$, short-termism is unprofitable for the bank, the bank will indeed pay effort incentives in such a way that it prevents short-termism. According to condition 1, this is the case whenever $b_s \leq \frac{\delta b_l}{1 + \rho}$.

**Lemma 3.** Suppose the discount rates of the bank and the manager coincide, i.e. $\rho = r$. Then, it is optimal for the bank to prevent short-termism, i.e. $a = 0$ by means of compensation payments. Both bank and manager are indifferent between any compensation structure that pays a fixed wage $A = u$ and bonuses $b_s \leq \frac{\delta b_l}{1 + \rho}$ and $b_l = (1 + \rho) \left( \frac{1}{x} - b_s \right)$.

In contrast to coinciding discount rates, empirical evidence both from natural and field experiments (Warner and Pleeter 2001, Harrison et al. 2002) suggests individuals’ discount rates to be far above the risk-free borrowing rates of firms. As is standard in the literature on dynamic models of the principal-agent relationship, we will therefore assume in the following that the agent’s discount rate exceeds the market-interest rate that the principal faces (DeMarzo and Sannikov 2006, De Marzo and Fishman 2007, Biais et al. 2007, Biais et al. 2010). This makes the manager more impatient than the bank and generates incentives for the bank to pay short-term bonuses as well as long-term bonuses.\footnote{Although Lemma 3 states that short-term bonuses $b_s > 0$ are an equilibrium, those equilibria would be eliminated whenever costs for short-term bonuses increase (e.g. by charging a tax on short-term bonuses).} For the sake of convenience, we follow Thanassoulis (2013) and normalize the bank’s discount rate to zero and thus continue with the assumption $\rho > r = 0$.\footnote{Note that the assumption $\rho > r$ influences equilibrium formation. Nevertheless, as will be shown later, comparative statics results regarding bailout and bonus tax are not qualitatively driven by the difference in discount rates, given that those equilibria emerge.}

There are two possible situations for the short-termist action $a$: either the manager does not search for projects with a high likelihood of short-term profits ($a = 0$), or he does ($a > 0$). Let us
first analyze the conditions under which short-termism will be ruled out and continue by identifying the conditions under which short-termism takes place.

**Proposition 1.** When the manager’s discount rate is low, \( \rho \leq \rho \equiv \frac{(\pi H - \pi L)(\delta - 1)(1+\delta)}{\bar{M} + \bar{k}} \), then the manager is incentivized such that he avoids short-termism \( (a = 0) \). As compensation, the manager receives a fixed wage \( A = u \), a short-term bonus \( b_s = \frac{\delta I}{(1+\delta)x} \) and a long-term bonus \( b_l = \frac{(1+\rho)I}{(1+\delta)x} \).

According to Lemma 2, the use of long-term bonuses will reduce short-termism but at the same time increase compensation costs. For the bank, this tradeoff is not too severe if the manager’s discount rate is low. Whenever \( \rho \leq \rho \), effect (i) of Lemma 2 impacts bank profits stronger than effect (ii) of the same Lemma: The benefit of the long-term bonus in avoiding short-termism is larger than the additional costs for the long-term bonus that arise because of its discounted value. Overall, the bank is better off if it incentivizes the manager in such a way that he exerts high effort, but totally avoids short-termism. In addition, effort incentives are induced by a combination of long-term and short-term bonus. Consider condition (1) that states the manager’s optimal level of short-termism. In order that \( a = 0 \) can be an equilibrium, \( b_s \leq \delta \frac{b_l}{1+\rho} \) must hold. Nevertheless, \( b_s < \delta \frac{b_l}{1+\rho} \) cannot be an equilibrium outcome for the bank. By increasing the short-term bonus and simultaneously decreasing the, since discounted, more expensive long-term bonus, the bank could still induce effort and avoid short-termism. Beyond that, this action would reduce total compensation costs and increase bank profit. Therefore, both short-term and long-term bonus will be chosen such that both the manager’s incentive constraint with respect to effort (4) as well as his first order condition with respect to short-termism (1) are binding. Finally, the fixed wage \( A \) is independent of the manager’s choice of effort and short-termism and perfectly covers his reservation wage to make the participation constraint (3) binding at the optimum.

While Proposition 1 shows under which circumstances, especially \( \rho \leq \rho \), short-termism can be ruled out, it can also be in the bank’s interest to allow for short-termist behavior. Consider again condition (1). According to this condition, \( b_s > \delta \frac{b_l}{1+\rho} \) is necessary in order that the manager chooses \( a = \frac{1}{k} \left( b_s - \delta \frac{b_l}{1+\rho} \right) > 0 \). It is easy to see, that for \( b_s > \delta \frac{b_l}{1+\rho} \) the level of short-termism is increasing in the level of short-term bonus \( b_s \) and decreasing in the level of long-term compensation \( b_l \). Thus, as short-termism is unprofitable for the bank, the cost effect of the long-term bonus described in
part (ii) of Lemma 2 must outweigh the short-termism avoiding effect denoted in part (i) of the
same Lemma so that the bank is willing to accept \( a > 0 \). Depending on the degree of the manager’s
impatience, two equilibria exist:

**Proposition 2.** When the manager’s discount rate is high, \( \rho \geq \bar{\rho} \equiv \frac{\varphi_H - \varphi_L}{(x + a) k} \delta \), then
the bank tolerates a high level of short-termism with \( a = \bar{a} \equiv \left( \sqrt{2kI + k^2x^2 - kx} \right) > 0 \). As compensation, the manager
receives a fixed wage \( A = \bar{u} \) and a short-term bonus \( b_s = \frac{akx + \delta I - \delta \frac{a^2}{2}}{(1 + \delta)x} \). The bank abstains from paying a long-term bonus, i.e. \( b_l = 0 \).

There exists a threshold for the manager’s discount rate \( \bar{\rho} \) above which the bank will fully
focus on a short-term bonus to incentivize effort. For \( \rho > \bar{\rho} \), the manager discounts the long-term
payment \( b_l \) so strongly, that its use to incentivize effort is more costly for the bank than accepting
short-termist behavior by the manager. Moreover, it is even cheaper to tolerate a very high degree
of short-termism, i.e. \( a = \bar{a} \), than reducing short-termism below \( \bar{a} \) by substituting at least some
short-term bonus with long-term pay \( b_l \).

This latter finding changes when the discount rate \( \rho \) decreases. Then, the cost effect of the
long-term bonus denoted in part (ii) of Lemma 2 weakens while the positive effect of \( b_l \) on reducing
short-termism stays unchanged. Whenever the discount rate belongs to the medium range \( \bar{\rho} < \rho < \bar{\rho} \),
reducing the manager’s incentives for short-termism becomes profitable:

**Proposition 3.** When the manager’s discount rate is in a medium range, \( \bar{\rho} < \rho < \bar{\rho} \), then the bank
tolerates some degree of short-termism \( a \in (0, \bar{a}) \). Optimal short-termism is implicitly defined by

\[
\begin{align*}
(A) & \quad \frac{-(\pi_H - \pi_L)(\delta - 1)}{\rho} - \frac{akx + \delta I - \delta \frac{a^2}{2}}{(1 + \delta)x} \delta + \frac{I - akx - \frac{k^2a^2}{2}}{(1 + \delta)x} (1 + \rho) + \frac{(x + a)(x - \delta a)k}{x(1 + \delta)} = 0 \\
(B) & \quad (\text{increasing in the discount rate } \rho) \\
(C) & \quad (\text{and increasing in the discount rate } \rho) \\
(D) & \quad (\text{and increasing in the discount rate } \rho)
\end{align*}
\]

and increasing in the discount rate \( \rho \). As compensation, the manager receives a fixed wage \( A = \bar{u} \),
a short-term bonus \( b_s = \frac{akx + \delta I - \delta \frac{a^2}{2}}{(1 + \delta)x} \) and a long-term bonus \( b_l = \frac{I - akx - \frac{k^2a^2}{2}}{(1 + \delta)x} (1 + \rho) \).

Both in Proposition 2 and Proposition 3, the bank wishes to prevent any short-termist behavior
by the manager, but has to cope with the manager’s impatience. While for \( \rho \geq \bar{\rho} \) long-term
bonus payments that could reduce short-termism below \( a = \bar{a} \) are not profitable for the bank, it
is profitable for the bank to tolerate only some degree of short-termism \( a < \bar{a} \) and to avoid higher

15
Figure 1: Short-termism $a$ as a function of discount rate $\rho$ with threshold levels in the absence of bailout and bonus tax ($\rho$ and $\bar{\rho}$), in the presence of a bailout ($\rho^\beta$ and $\bar{\rho}^\beta$) and in the presence of both bailout and bonus tax ($\rho^t$ and $\bar{\rho}^t$).

short-termism by paying a long-term bonus $b_l > 0$ if $\rho < \rho < \bar{\rho}$. Thereby, the bank equalizes the marginal costs an increase in short-termism would cause on expected profits (A) and on expected short-term payments (B) with the marginal benefits it would create. On the one hand the likelihood that the bank has to pay the long-term bonus decreases (C), on the other hand the bank can save compensation costs for the marginal unit short-termism when paying a short-term bonus rather than a discounted long-term bonus (D).

The costs of preventing short-termism are increasing in the discount rate $\rho$, and so is short-termism until $\rho = \bar{\rho}$ and $a = \bar{a}$. Beyond that point, a more short-termist behavior is not profitable anymore for the manager. For $a = \bar{a}$, marginal costs of the short-termist action $ka$ just equal the marginal benefit of receiving the short-term bonus $b_s$ with higher probability. For $a > \bar{a}$, the manager’s marginal costs further increase by parameter $k$, while the incentive payment $b_s$ is independent of the manager’s impatience and short-termism. Therefore, short-termism $a > \bar{a}$ does not pay off for the manager, independent of his impatience.

Figure 1 shows the different equilibria that emerge depending on the manager’s discount rate $\rho$. 
Going from the left to the right, the figure displays the following: If the manager discounts future income relatively little, i.e. $\rho \leq \bar{\rho}$, the bank will pay both a bonus in period $t = 1$ and a bonus in period $t = 2$ in case of success. Nevertheless, it will not tolerate any degree of short-termism other than $a = 0$. This changes if the manager is more impatient, i.e. $\rho < \rho < \bar{\rho}$. Then, the bank will still pay both short-term and long-term bonuses, but is willing to tolerate some short-termist behavior $a > 0$. The more the manager discounts the future, the more the bank will focus on the short-term bonus rather than long-term payments, leading to a higher degree of short-termism. Finally, if the manager’s impatience is very high, i.e. $\rho \geq \bar{\rho}$, then the bank fully stops paying long-term compensation and tolerates a high degree of harmful short-termism $a = \bar{a}$ in its investments.

4 Effects of a Bailout

Having specified the possible equilibria, we can now turn to the implications of a bailout. Following Besley and Ghatak (2013) for the case of a bailout, we will extend possible returns by introducing a bailout payment $\beta$, with $\pi_H > \beta > \pi_L$. Whenever profit realization is $\pi_L$, the bank would not be able to survive on its own and would harm the economy with its bankruptcy. In order to avoid negative contagion effects caused by a bank that is too-big-to-fail, the government pays a bailout $\beta$ if the bank was not successful. For simplification, we normalize $\pi_L = 0$, and define $\beta$ as the difference between the return in case of a public bailout and the return in case of failure.

The anticipation of a bailout c. p. increases the bank’s profit in case of failure and therewith total expected payoff. Simultaneously, it also changes the bank’s maximization problem from (2) to

$$\max_{A, b_s, b_l} (x + a) (\pi_H - b_s) + (1 - x - a) \beta + [(x - \delta a) (\pi_H - b_l) + (1 - x + \delta a) \beta] - A, \quad (6)$$

while the constraints (1), (3) and (4) with respect to the manager’s incentives do not alter. As a bailout has the same effects as an increase in $\pi_L$, one can immediately see by looking at Propositions 1 - 3 that a possible bailout does not directly affect compensation payments in any of the given equilibria. Rather, it affects the thresholds $\rho$ and $\bar{\rho}$ that determine the actual equilibrium and the bank’s profit denoted by equation (2). Receiving a bailout $\beta > \pi_L$ reduces the bank’s downside
and thus its costs of the short-termist action \( a \). Although any short-termist behavior \( a \neq 0 \) still is harmful for the bank, the expected loss attributed to this action decreases as \( \beta \) increases. As a consequence, the bank’s tradeoff between creating sustainable bank profit by paying long-term bonuses and reducing compensation costs by paying short-term bonuses changes:

**Proposition 4.** Suppose the government pays a bailout \( \beta > \pi_L \). This bailout leads to thresholds \( \underline{\rho}^3 \) and \( \bar{\rho}^3 \) that separate equilibria, with \( \underline{\rho}^3 < \underline{\rho} \) and \( \bar{\rho}^3 < \bar{\rho} \). It

1. induces an increase in short-term bonuses, a decrease in long-term compensation, and higher levels of short-termism if \( \rho \in (\underline{\rho}^3, \bar{\rho}) \),

2. and, has neither an effect on compensation payments nor on short-termism if \( \rho \leq \underline{\rho}^3 \) or \( \rho \geq \bar{\rho} \).

If a bank can reckon with a governmental bailout in case of a bad outcome, it changes its contract offers to managers and thereby compensation composition and incentives. By changing its contract, the bank’s costs of the manager’s short-termist behavior decrease as the bank in case of failure does not lose \( \pi_H - \pi_L \) anymore in comparison to success, but only \( \pi_H - \beta \). This leads to changes both with respect to equilibrium selection (extensive margin) as well as with respect to choices for a given equilibrium (intensive margin) as shown in Figure 1.

On the extensive margin, the thresholds for the manager’s impatience that determine equilibria decline from \( \underline{\rho} \) to \( \underline{\rho}^3 \) and \( \bar{\rho} \) to \( \bar{\rho}^3 \). This decline in thresholds leads to a situation where the two equilibria with short-termism \( a > 0 \) (denoted in Propositions 2 and 3) are more likely to occur, i.e. in addition to \( \rho > \underline{\rho} \) also for \( \rho \in (\underline{\rho}^3, \bar{\rho}) \). Especially, the equilibrium with very high harmful short-termism \( a = \bar{a} \) (Proposition 2) is more likely to occur, i.e. the range increases by \( \rho \in (\bar{\rho}^3, \bar{\rho}) \).

In addition to higher short-termism, this shift in the equilibrium for those ranges of \( \rho \) leads to an increase in short-term bonuses, e.g. for \( \rho \in (\underline{\rho}^3, \bar{\rho}) \) from \( b_s = \frac{\delta I}{(1+\delta)x} \) to \( b_s = \frac{akx+\delta l-\delta \frac{1}{2}a^2}{(1+\delta)x} \), and to a reduction in long-term bonuses, e.g. for \( \rho \in (\underline{\rho}^3, \bar{\rho}) \) from \( b_l = \frac{I-akx-\frac{1}{2}a^2}{(1+\delta)x} (1+\rho) \) to \( b_l = 0 \). In the absence of a bailout, it is not profitable for the bank to tolerate (high) short-termism for these ranges of \( \rho \). In the presence of a bailout in case of failure, this changes. The bank is willing to tolerate (higher) short-termism in order to save compensation costs that arise due to the manager’s impatience. Thereby, it fully neglects the negative external effects it imposes on the government that pays the bailout.
On the intensive margin, similar effects on the composition of incentive pay and tolerated short-termism can be observed for discount rates $\rho \in (\bar{\rho}, \rho^\beta)$. For this range, both without and with a bailout the equilibrium denoted in Proposition 3 applies. Again, the bank equalizes marginal benefits and marginal costs of an increase of short-termism. However, the only change to (5) arises in the marginal costs an increase in short-termism would cause on expected profits ($A$) for which the absolute value decreases for $\beta > \pi_L$. Consequently, comparative statics on (5) show that the bank tolerates higher levels of harmful and inefficient short-termism for $\beta > \pi_L$ and that it changes incentive payments. It reduces compensation costs by lowering the long-term bonus, while it increases the short-term bonus to maintain effort incentives. That this action alters the manager’s short-termist behavior is neglected by the bank as the government carries over part of the possible loss via the bailout.

However, if $\rho$ is small or large enough, i.e. $\rho \leq \rho^\beta$ or $\rho \geq \bar{\rho}$, the according equilibrium denoted either in Proposition 1 or 2 does not change for this particular discount rate. Short-termism stays either zero (for $\rho \leq \rho^\beta$ ) or $a = \bar{a}$ (for $\rho \geq \bar{\rho}$). In both cases neither compensation payments nor short-termism change as the tradeoff for the bank stays the same. For $\rho \leq \rho^\beta$, the benefit from the bailout is still lower than the remaining costs that short-termism entails. Therefore, it is still more profitable for the bank to give effort incentives via a high long-term bonus while preventing the yet harmful short-termism. In case that $\rho \geq \bar{\rho}$, the manager’s discount rate is just too high for it could become profitable to reduce short-termism by paying a long-term bonus. As the cost structure of the short-termist action does not change, short-termism stays unchanged.

Overall, a bailout may or may not affect incentive payments and short-termism. While a bailout does not influence payments and short-termism for very high or very low discount rates, it distorts incentive payments towards short-term bonuses and increases short-termism for a large range of discount rates. Moreover, a bailout makes it more likely in general that the bank focuses on short-term bonuses rather than giving incentives by long-term payments to its manager and that it tolerates inefficiently high short-termism.
5 Effects of a Bonus Tax

Anticipating the negative external effects a bailout imposes on short-termism in banking, the government in \( t = 0 \) may introduce a bonus tax \( t_b \in (0, 1) \) on short-term bonuses. At first sight, a bonus tax which is imposed on the manager’s short-term bonus and which has to be paid by the manager does not hit the bank as the bank’s maximization problem (6) does not change. Nevertheless, implicitly it also affects the bank as it impacts the constraints the bank faces. The manager only cares about his net-compensation consisting of the fixed wage \( A \), the short-term bonus net of taxes \((1 - t_b) b_s \) and the long-term bonus \( b_l \). This changes the manager’s participation constraint from (3) to (7), his incentives towards exerting effort from (4) to (8), and the first order condition of undertaking short-termism from (1) to (9), respectively.

\[
A + (x + a) (1 - t_b) b_s + (x - \delta a) \frac{b_y}{1 + \rho} - I - \frac{k}{2} a^2 \geq u \\
(x + a) (1 - t_b) b_s + (x - \delta a) \frac{b_y}{1 + \rho} - I - \frac{k}{2} a^2 \geq 0 \\
a^* = \max \left\{ 0, \frac{1}{k} \left[ (1 - t_b) b_s - \delta \frac{b_y}{1 + \rho} \right] \right\}
\]

For given compensation payments, a bonus tax lowers the manager’s net compensation and will make him reject the contract he would accept without bonus tax. Otherwise, if the bank wants to incentivize the manager to exert high effort, it has two options to draw on: either it incentivizes the manager to exert effort by increasing the short-term bonus \( b_s \) in a way such that the manager is fully compensated for the bonus tax, or it ensures high effort by changing the composition of compensation payments towards the discounted long-term bonus \( b_l \). Either way, a bonus tax is associated with higher compensation payments and thus higher costs for the bank in expectation: either because of compensating the manager for the bonus tax, or by inducing a suboptimal compensation composition.

**Proposition 5.** Suppose the government pays a bailout \( \beta > 0 \), but imposes a bonus tax \( t_b \in (0, 1) \) on short-term bonuses \( b_s \). Then, a bonus tax leads to thresholds \( \bar{\rho} \) and \( \bar{\rho}^t \) that separate equilibria, with \( \bar{\rho} > \rho^t \) and \( \bar{\rho} > \bar{\rho}^t \), and has effects opposed to those of a bailout. For \( \rho \in (\rho^t, \bar{\rho}^t) \), it induces a reduction of net short-term bonuses accompanied by an increase of long-term payments.
high taxes, \(t_b \geq \frac{\rho}{\bar{\rho} \equiv t^*_b}\), no short-term bonuses are paid.

Likewise to the anticipation of a bailout, the bank also changes its contract offers to managers when a bonus tax is introduced. While a bailout decreases the bank’s cost of the manager’s short-termist behavior, a tax on short-term bonuses increases the costs of paying a short-term bonus to the manager. For the bank, this changes the tradeoff between short-term and long-term compensation.

However, the bank anticipates that the composition of compensation payments directly influences the manager’s first order condition with respect to short-termism. Through this channel, a bonus tax also affects equilibrium short-termism tolerated by the bank and has effects on the extensive margin of equilibrium selection as well as on equilibrium choice on the intensive margin as shown in Figure 1.

**Proposition 6.** Suppose the government pays a bailout \(\beta > 0\), but imposes a bonus tax \(t_b \in (0, 1)\) on short-term bonuses \(b_s\). Then,

1. the bonus tax reduces harmful short-termism for a broad range of discount rates \(\rho \in (\rho^\beta, \bar{\rho})\) and has no effect for very high (for \(\rho \geq \bar{\rho}\)) or very low discount rates (for \(\rho \leq \rho^\beta\)).

2. The bonus tax \(t_b\) necessary to shift back the lower threshold \(\rho^\beta\) to its second best level \(\bar{\rho}\) differs from the bonus tax \(\bar{t}_b\) necessary to shift back the upper threshold, i.e. \(t_b|_{\rho^\beta=\rho^\beta} \neq \bar{t}_b|_{\bar{\rho}=\bar{\rho}}\).

A comparison between the effects that a bailout imposes (Proposition 4) with the effects a tax on short-term bonuses implies (Propositions 5 and 6) shows the opposing impacts both have on compensation payments and short-termism.\(^{24}\)

On the extensive margin, the increase of the threshold from \(\rho^\beta\) to \(\rho^\beta\) makes the situation without short-termism, i.e. \(a = 0\) more likely to occur and, at the same time, the shift from \(\bar{\rho}\) to \(\bar{\rho}\) reduces the likelihood of a situation with very high short-termism \(a = \bar{a}\). In this respect, a bonus tax imposes an opposing effect than the bailout on the bank, and increases not only the costs of short-term bonuses, but also the costs of short-termism per se. By internalizing some of the costs a bailout

\(^{24}\)For welfare as defined in subsection 3.2, a bailout increases welfare reducing (as inefficient) short-termism while a bonus tax can serve as a converse instrument that increases welfare. Apart from efficiency concerns, a government with redistributive objectives might use the fact that a bailout naturally increases \(E(U_P)\) while a bonus tax just has the opposite effect on \(E(U_P)\). Regarding the manager, both a bailout and a bonus tax do not affect his expected rents as the participation constraint (7) is always binding.
entails, the government can induce the bank to set its incentives in such a way that short-termism is going to be avoided in the presence of a tax where it is strictly positive in the absence of a tax: with taxation, short-termism will be avoided not only for $\rho \in (0, \rho^\beta]$, but will be set to $a = 0$ also for $\rho \in (\rho^\beta, \rho^\ell]$ in equilibrium.

However, a bonus tax may strongly affect the composition of incentive payments. Especially for $\rho \in (\rho^\beta, \rho^\ell]$, where in absence of a bonus tax short-termism is strictly positive in equilibrium, the bonus tax makes short-termism unprofitable. In order to prevent short-termism, the long-term compensation has to increase, which makes it possible for the bank to reduce the short-term bonus net of taxes that the manager receives while it maintains effort incentives. Nevertheless, as the manager has to be compensated for the bonus tax, the gross short-term bonus paid to the manager may even increase due to the tax duty, depending on the bonus tax.

For very high bonus taxes, paying a short-term bonus may even not be an equilibrium anymore. For the range in which short-termism is set at $a = 0$ in equilibrium, i.e. $\rho \leq \rho^\ell$, there exists another threshold $t^+_b \equiv \frac{\rho}{1+\rho}$ which specifies whether $b_s = 0$ or $b_s > 0$. For the first case, consider a very small discount rate, and a small but sufficiently large bonus tax, such that short-term bonuses become more expensive than long-term bonuses. In this case, the bank will not make the manager’s incentive constraint with respect to short-termism $a$ binding anymore, but will concentrate only on the long-term bonus. In detail, whenever $t_b \geq t^+_b$, the short-term bonus is more expensive than a long-term bonus, and so the principal will pay only an increased long-term bonus $b_l = \frac{(1+\rho)I}{x}$ and will abstain from paying any short-term bonus at all, i.e. the short-term bonus decreases to $b_s = 0$.\footnote{Note that in the limit, there must exist some discount rates $\rho > 0$ for which any tax $t_b > 0$ is above the threshold $t^+_b$. Therefore, there exist discount rates $\rho$ for which any tax $t_b > 0$ yields an equilibrium short-term bonus $b_s = 0$.} For the second case $b_s > 0$, a short-term bonus is in spite of the bonus tax $t_b < t^+_b$ still cheaper than the discounted long-term compensation. Therefore, the bank will pay a short-term bonus $b_s = \frac{\delta I}{(1-t_b)(1+\delta)\rho}$ and a long-term compensation $b_l = \frac{(1+\rho)I}{(1+\delta)\rho}$. While the short-term bonus increases gross and stays constant net of the bonus tax, the long-term bonus $b_l$ does not change.

On the intensive margin, i.e. for $\rho \in (\rho^\ell, \rho^\beta)$, short-termism decreases as a consequence of the bonus tax. Higher costs for the short-term bonus induce the bank to shift compensation towards more long-term bonuses. This in turn gives less incentives to the manager for short-termist
behavior who therefore decreases short-termism below the level in the absence of a bonus tax. For compensation payments, the shift towards the long-term bonus enables the bank to lower the net short-term bonus. However, the gross short-term bonus may decrease or increase, depending on the strength of two effects. On the one hand, the tax duty causes a positive direct effect by which the manager will ask for a higher gross short-term bonus in order to be equally well off net of taxes. On the other hand, as the bonus tax makes short-termism less profitable for the bank, the bank will incentivize less short-termist behavior. This indirect effect causes the negative effects on the net short-term bonus, which itself affects the gross bonus payment.

Despite its reduced likelihood due to $\bar{\rho}^t > \bar{\rho}^\beta$, there still exists the equilibrium with very high short-termism if $\rho \geq \bar{\rho}^t$. Even with a bonus tax, tolerating short-termism $a = \bar{a}$ is still more profitable for the bank than paying a higher long-term bonus $b_l$. As a result, net compensation will stay constant both for the short-term bonus at $(1 - t_b)b_s = \sqrt{2kI + k^2x^2} - kx$ and the long-term bonus $b_l = 0$. However, the gross short-term bonus increases proportionately to the bonus tax in order to compensate the manager for the tax expenses and causes higher costs for the bank.

6 Conclusion

In this paper, we modeled a principal-agent structure with two periods in order to analyze moral hazard both with respect to effort and managerial short-termism. This was used to study the effects of both a bailout and a tax on short-term bonuses on short-termism and managerial compensation.

We find that banks may already tolerate harmful and inefficient short-termism in a second-best equilibrium in the absence of a bailout. This allows a bank to reduce compensation costs for incentivizing the manager to act in its interest. When banks in addition anticipate a future bailout in case of bankruptcy, in most cases it is profitable for them to change compensation structure towards higher short-term payments. So, the bank on the one hand can save on more expensive long-term compensation, while on the other hand it does not have to bear its cost of increased managerial short-termism. As a result, a governmental bailout does not only increase the likelihood of short-termist behavior in general, it also raises existing excessive short-termism even further.

In such a situation, the model suggests the introduction of a tax specifically based on short-term
bonuses. Ceteris paribus, the manager will ask for a higher short-term bonus gross of taxes to be compensated for the additional tax burden, leading to higher compensation costs for the short-term bonus. In addition, a bonus tax makes managerial short-termism even less attractive for the bank and thereby induces the bank to tolerate less of it. It turns out that a bonus tax can reverse the negative effects a bailout entails on short-termism and compensation. Furthermore, it can be used in order that banks internalize the social costs their moral hazard causes in the presence of a bailout.

For real world policy, the results of the model suggest that one reason why we observe managerial short-termism in banking may be banks’ anticipating governmental bailouts in case of failure. For banks that can anticipate a bailout, especially if they are too-big-to-fail, the model also explains the bonus culture we observe in the financial industry where bankers get paid high cash bonuses based on short-term results. However, a tax on short-term bonuses may help to reverse the negative effects a bailout entails. It is useful in reducing the overall likelihood of harmful short-termism and in reducing excessive short-termism below its level in the absence of a bonus tax. In that sense, a bonus tax is a good instrument for the government to create a situation where necessary bailouts can credibly be carried out, but where the anticipation of bailouts does not lead to increased moral hazard on the banks’ side. In addition, a bonus tax also influences compensation payments to bankers and thus can be used to reduce the often discussed short-term payments of bankers.

Appendix

Proof of Lemma 1

In first-best, the bank maximizes

$$\max_{a} (x + a)(\pi_H - b_s) + (1 - x - a)\pi_L + (x - \delta a)\left(\frac{\pi_H - b_l}{1 + r}\right) + (1 - x + \delta a)\frac{\pi_L}{1 + r} - A$$  \hspace{1cm} (10)

s.t.

$$A + (x + a) b_s + (x - \delta a) \frac{b_l}{1 + r} \geq u + I + \frac{k}{2}a^2$$  \hspace{1cm} (11)

By paying total expected compensation $u + I + \frac{k}{2}a^2$ as fixed wage, short-term bonus or a combination of both, the manager’s participation constraint (11) is binding. Maximizing (10) w.r.t.
and considering the restricted domain $a \geq 0$ yields $a^{FB} = \max \left\{ 0, \frac{\pi_H - \pi_L}{k} \left( 1 + \frac{r - \delta}{1 + r} \right) \right\}$. Note that the second order condition of (10) w.r.t. $a$ for a maximum is satisfied.

For the welfare maximization, $b_l$ will not be used as it is the only compensation method that negatively affects welfare. Maximizing $E(W) = (x + a) \pi_H + (1 - x - a) \pi_L + (x - \delta a) \frac{\pi_H}{1 + r} + (1 - x + \delta a) \frac{\pi_L}{1 + r} - I - C(a)$ w.r.t. $\alpha$ yields the first-best result $\alpha^{FB}$.

**Proof of Lemma 2**

Suppose compensation payments are chosen such that the participation constraint (3) and the incentive constraint for effort (4) are binding (which will be shown to be optimal in the proofs of Propositions 1 to 3). Equations (3) and (4) imply $A = u$ and

$$b_s = \frac{I + k a^2 - x \frac{1 + \delta}{1 + \rho} b_l}{x + a}. \quad (12)$$

For (i): Intuitively, as $x - \delta a > 0$ by assumption, (12) directly shows that the short-term bonus $b_s$ necessary to induce high effort declines in the level of the long-term bonus $b_l$. Substituting (12) in the manager’s FOC w.r.t. short-termism gives us:

$$I - \frac{k}{2} a^2 - \frac{x (1 + \delta)}{1 + \rho} b_l - xak = 0.$$

Using the implicit function theorem yields

$$\frac{\partial a}{\partial b_l} = -\frac{x (1 + \delta)}{k (x + a) (1 + \rho)} < 0.$$

For (ii): Using $A = u$ and (12), we can compute the bank’s costs of compensating the manager for effort as a function of $b_l$:

$$V(b_l) = u + I + \frac{k}{2} a^2 + (x - \delta a) \frac{\rho - r}{(1 + r) (1 + \rho)} b_l \quad (13)$$

Ceteris paribus, especially leaving $a$ unchanged, compensation costs are increasing in the long-term bonus if $\rho > r$, i.e. $\frac{\partial V}{\partial b_l} > 0$ if $\rho > r$. Moreover, the increase is stronger, the larger $\rho$ is compared to $r$, i.e. $\frac{\partial^2 V}{\partial \rho^2} > 0$. 

25
Proof of Lemma 3

Using $\rho = r$ in (13), compensation costs become independent of $b_l$. As part (i) of Lemma (2) does not change, using a long-term bonus to induce effort has no effect on compensation costs anymore, but still decreases short-termism. As $\delta > 1$ by assumption, $a = 0$ is optimal for the bank. The bank is indifferent between paying $A = u$ (from (3)) together with only a long-term bonus $b_l = \frac{(1+\rho)I}{x}$, or paying a combination of short-term and long-term bonus that satisfies both $b_s \leq \frac{\delta b_l}{1+\rho}$ (from (1)) and $b_l = (1 + \rho) \left( \frac{I}{x} - b_s \right)$ (from (4)).

Proof of Propositions 1 to 3

In order to show the derivation of equilibria only once, the following proofs contain the parameters $\pi_L$ to analyze the implications of a bailout (by replacing $\pi_L$ with $\beta$) and $t_b$ for the analysis of a bonus tax.

The bank maximizes his expected payoff by choosing $A$, $b_s$ and $b_l$:

$$\max_{A,b_s,b_l} (x + a) (\pi_H - b_s) + (1 - x - a) \pi_L - A + [(x - \delta a) (\pi_H - b_l) + (1 - x + \delta a) \pi_L]$$

subject to the short-termism constraint

$$ak = (1 - t_b) b_s - \delta \frac{b_l}{1 + \rho},$$  
(14)

the effort incentive constraint

$$(x + a) (1 - t_b) b_s + (x - \delta a) \frac{b_l}{1 + \rho} - I - \frac{k}{2} a^2 \geq 0,$$  
(15)

the participation constraint

$$A + (x + a) (1 - t_b) b_s + (x - \delta a) \frac{b_l}{1 + \rho} - I - \frac{k}{2} a^2 \geq u,$$  
(16)

and the nonnegativity constraints $A$, $b_s$, $b_l \geq 0$.

The Lagrangian is then as follows
\[ \mathcal{L} = (x + a) (\pi_H - b_s) + (1 - x - a) \pi_L - A + [(x - \delta a) (\pi_H - b_l) + (1 - x + \delta a) \pi_L] \\
+ \lambda \left[ A + (x + a) (1 - t_b) b_s + (x - \delta a) \frac{b_l}{1 + \rho} - I - \frac{k}{2 a} - u \right] \\
+ \gamma \left[ (x + a) (1 - t_b) b_s + (x - \delta a) \frac{b_l}{1 + \rho} - I - \frac{k}{2 a} \right] \\
+ \sigma \left[ (1 - t_b) b_s - \delta \frac{b_l}{1 + \rho} - ak \right], \quad (17) \]

where \( \lambda, \gamma, \) and \( \sigma \) are the Lagrangian multipliers w.r.t. the participation constraint, the effort incentive constraint, and the short-termism constraint, respectively.

In order to fulfill the effort incentive constraint, variable pay is necessary. In addition, as argued on page 14, \( b_s < \delta \frac{b_l}{1 + \rho} \) and especially \( b_s = 0 \) can never be an equilibrium outcome for the bank if \( \rho > 0 \). By increasing \( b_s \) and simultaneously decreasing \( b_l \), the bank could still induce effort and avoid short-termism, but would reduce total compensation costs and increase bank profit.\(^{26}\)

Thus, there are three possible solutions to the Lagrangian above.

**Proposition 1 and 3:** Suppose that in the optimal solution \( A > 0, b_s > 0 \) and \( b_l > 0 \) hold. This implies \( \frac{\partial \mathcal{L}}{\partial A} = \frac{\partial \mathcal{L}}{\partial b_s} = \frac{\partial \mathcal{L}}{\partial b_l} = 0 \), which yields Lagrangian multipliers

\[ \lambda = 1 \]
\[ \gamma = \frac{\rho (x - \delta a)}{x (1 + \delta)} + \frac{t_b (x + a) \delta}{1 - t_b x (1 + \delta)} \]
\[ \sigma = \frac{(x + a) (x - \delta a)}{(1 + \delta) x} \left( \frac{t_b}{1 - t_b} - \rho \right). \]

For \( \frac{t_b}{1 - t_b} \neq \rho \), all constraints must bind.

**Proposition 1:** Suppose \( a = 0 \). Algebraic manipulation delivers the optimal contract with \( A = u, b_s = \frac{I}{x (1 + \delta) (1 - t_b)} \) and \( b_l = \frac{I + \rho}{x (1 + \delta)} \). Substituting the optimal payments and (18) and (19) into \( \frac{\partial \mathcal{L}}{\partial a} \leq 0 \) yields

\[ \frac{\partial \mathcal{L}}{\partial a} = (\pi_H - \pi_L) (1 - \delta) + \left( \rho - t_b - t_b r \right) \frac{\delta I}{x (1 + \delta) (1 - t_b)} - \sigma k \leq 0. \]

\(^{26}\)This is true as long as \( t_b = 0 \). For \( t_b > 0 \), a more general proof can be found in the proof of Proposition 5.
Substituting (20) in (21), \( \frac{\partial C}{\partial a} \leq 0 \) is satisfied if and only if

\[
\rho \leq \frac{(\pi_H - \pi_L)(\delta - 1)(1 + \delta)}{\frac{\delta I}{x} + xk} + \frac{t_b}{1 - t_b} \equiv \rho^t. \tag{22}
\]

For \( t_b = 0 \), (22) gives the threshold

\[
\rho \equiv \frac{(\pi_H - \pi_L)(\delta - 1)(1 + \delta)}{\frac{\delta I}{x} + xk}, \tag{23}
\]

for which the specification given in Proposition 1 indeed is an equilibrium.

**Proposition 3:** Suppose \( a > 0 \). Algebraic manipulation delivers the optimal contract with

\[
A = u, \quad b_s = \frac{akx + \delta I - \delta \frac{k}{2} a^2}{(1-t_b)(1+\delta)x} \text{ and } b_l = \frac{1-akx - \frac{k}{2} a^2}{(1+\delta)x} (1 + \rho). \]

Substituting the optimal payments and (18), (19) and (20) into \( \frac{\partial C}{\partial a} = 0 \) yields

\[
(\pi_H - \pi_L)(1 - \delta) - \frac{akx + \delta I - \delta \frac{k}{2} a^2}{(1-t_b)(1+\delta)x} + \delta I - \frac{akx - \frac{k}{2} a^2}{(1+\delta)x} (1 + \rho)
\]

\[
- \frac{(x + a)(x - \delta a)k}{x(1 + \delta)} \left( \frac{t_b}{1 - t_b} - \rho \right) = 0 \tag{24}
\]

For \( t_b = 0 \), (24) simplifies to (5) and yields the optimal \( a \) for the equilibrium specified in Proposition 3.

Applying the implicit function theorem on (5), \( \frac{\partial a}{\partial \rho} > 0 \) can be shown.

**Proposition 2:** Suppose that in the optimal solution \( A > 0, b_s > 0 \) and \( b_l = 0 \) hold. This implies \( \frac{\partial C}{\partial A} = \frac{\partial C}{\partial b_s} = 0 \) and \( \frac{\partial C}{\partial b_l} \leq 0 \), which yields Lagrangian multipliers

\[
\lambda = \frac{\rho (x - \delta a) + \delta \frac{t_b}{1-t_b} (x + a)}{x (1 + \delta)} \tag{25}
\]

\[
\gamma \leq \frac{t_b}{1-t_b} (x + a) - \gamma (x + a). \tag{26}
\]

For \( \frac{t_b}{1-t_b} \neq \gamma \), all constraints must bind. For \( b_s > 0 \) and \( b_l = 0 \), \( a > 0 \) holds due to (14).

Algebraic manipulation delivers the optimal contract with \( A = u, b_s = \sqrt{2kI + k^2x^2 - kx} \) and \( b_l = 0 \). Short-termism is given by \( a = \bar{a} \equiv \frac{1}{k} \left( \sqrt{2kI + k^2x^2 - kx} \right) \). In order that \( a > 0 \) is optimal, \( \frac{\partial C}{\partial a} = 0 \) must hold. Using the optimal compensation and (25) and (26), \( \frac{\partial C}{\partial a} \) is given by:
\[
\frac{\partial L}{\partial a} = (\pi_H - \pi_L) (1 - \delta) - \frac{ak}{(1 - t_b)} - \frac{tb}{1 - t_b} (x + a) k + \gamma (x + a) k = 0. \tag{28}
\]

Solving (28) for \( \gamma \) and substituting in (26), \( \frac{\partial L}{\partial a} = 0 \) is only satisfied if

\[
\rho \geq \frac{x (1 + \delta) \frac{ak}{x - \delta a} + (\pi_H - \pi_L) (\delta - 1)}{(x + a) k} + \frac{tb}{1 - t_b} \equiv \bar{\rho}^t. \tag{29}
\]

For \( t_b = 0 \), (29) gives the threshold

\[
\bar{\rho} \equiv \frac{x (1 + \delta) \frac{ak}{x - \delta a} + (\pi_H - \pi_L) (\delta - 1)}{(x + a) k},
\]

for which the specification given in Proposition 2 indeed is an equilibrium.

**Proof of Proposition 4**

A bailout of size \( \beta \) is modeled as comparative statics analysis of an increase in \( \pi_L \). Applying comparative statics on (23) and (30) with respect to \( \pi_L \) yields

\[
\frac{\partial \rho}{\partial \pi_L} = -\frac{(\delta - 1)(1 + \delta)}{\frac{2}{1 + xk}} < 0 \quad \text{and} \quad \frac{\partial \bar{\rho}}{\partial \pi_L} = -\frac{x(1 + \delta)}{x - \delta a} \frac{\delta - 1}{(x + a)k} < 0, \quad \text{with} \quad \frac{\partial^2 \rho}{\partial \pi_L^2} = \frac{\partial^2 \bar{\rho}}{\partial \pi_L^2} = 0. \quad \text{Note that for} \quad \frac{\partial \bar{\rho}}{\partial \pi_L},
\]

\( \bar{a} \) is independent of \( \pi_L \). Thus, both threshold are linearly decreasing in the size of the bailout.

A change from \( \rho \) to \( \bar{\rho}^\beta \) and \( \bar{\rho} \) to \( \bar{\rho}^\beta \) leads to new thresholds that separate the equilibria denoted in Propositions 1 - 3. For both cases \( \rho \leq \bar{\rho}^\beta \) and \( \rho \geq \bar{\rho} \), the equilibrium does not change with a bailout. As both compensation and short-termism denoted in Propositions 1 and 2 are independent of \( \pi_L \), neither compensation payments nor short-termism changes. This proves part 2.

For part 1, three effects can be distinguished.

1. For \( \rho \in (\bar{\rho}^\beta, \bar{\rho}) \), the equilibrium without a bailout was characterized by Proposition 1 with short-termism \( a = 0 \) and compensation \( A = u \), \( b_s = \frac{I}{x (1 + \delta)} \) and \( b_l = \frac{I + \rho}{1 + \delta} \). As \( \rho \) decreases to \( \bar{\rho}^\beta \) in presence of a bailout, for discount rates \( \rho \in (\bar{\rho}^\beta, \bar{\rho}) \) now the equilibrium specified in Proposition (3) applies, where short-termism is strictly positive. For \( a > 0 \), the long-term bonus \( b_l = \frac{I - akx - \delta a^2}{(1 + \delta)k^2} (1 + \rho) \) defined in Proposition (3) is smaller than \( b_l = \frac{I + \rho}{1 + \delta} \) in absence of a bailout. To make the effort incentive constraint (4) binding, \( b_s \) has to increase. as defined by equation (5).

2. For \( \rho \in (\bar{\rho}^\beta, \bar{\rho}) \), the equilibrium without a bailout was characterized by Proposition 3 with short-termism \( a \in (0, \bar{a}) \) and bonuses \( b_s = \frac{akx + \delta a^2}{(1 + \delta)k^2} > 0 \) and \( b_l = \frac{I - akx - \delta a^2}{(1 + \delta)k^2} (1 + \rho) > 0 \).
With a bailout, the equilibrium as defined in Proposition 2 applies with \( a = \bar{a}, \ b_s = \sqrt{2kI + k^2x^2 - kx} \) and \( b_l = 0 \), where \( b_s \) is higher due to its sole effort incentive function.

3. For \( \rho \in (\rho, \bar{\rho}) \), without and with a bailout, the equilibrium denoted in Proposition 3 applies. Here, using the implicit function theorem on (5), comparative statics show \( \frac{\partial a}{\partial \pi_L} = \frac{(\delta - 1)(1+\delta)x}{3k\rho + (2\rho + 1+\delta - \rho)kx} > 0 \). For compensation, \( \frac{\partial b_s}{\partial \pi_L} = \frac{\partial b_l}{\partial \pi_L} = \frac{-k(1+\rho)}{x(1+\delta)} (x + a) \frac{\partial a}{\partial \pi_L} < 0 \) applies as, by assumption, \( x - \delta a > 0 \).

Proof of Proposition 5

Part 1: Comparative statics on \( \rho^l \) and \( \rho^l \) defined in equations (22) and (29), respectively show that both threshold levels are increasing in a bonus tax, i.e. \( \frac{\partial \rho^l}{\partial t_b} = \frac{1}{(1-t_b)^2} > 0 \) and \( \frac{\partial \rho^l}{\partial t_b} = \frac{\partial \rho^l}{\partial a} \frac{\partial a}{\partial t_b} = \frac{1}{(1-t_b)^2} + \frac{(1+\delta)x(1+\delta)}{(x-\delta a)(x+a)(1-t_b)} > 0 \). Note that \( \frac{\partial^2 \rho^l}{\partial t_b^2} > 0 \) and \( \frac{\partial^2 \rho^l}{\partial t_b^2} > 0 \).

Part 2:

1. For \( \rho \geq \rho^l \), the equilibrium is given in the proof of Proposition 2 with \( a = \bar{a} \). As for \( b_s = \frac{\sqrt{2kI + k^2x^2 - kx}}{(1-t_b)} \) comparative statics show \( \frac{\partial b_s}{\partial t_b} = \frac{b_s}{(1-t_b)} > 0 \), the gross short-term bonus proportionally increases with the bonus tax \( t_b \), while the net-bonus \( (1-t_b) b_s = \sqrt{2kI + k^2x^2 - kx} \) stays unchanged.

2. For \( \rho \leq \rho^l \), the proof of Proposition 1 includes the effects of a small tax. For a higher tax, the argument that \( b_s = 0 \) can never be an equilibrium (as stated on pages 14 and 27) is not true anymore. As long as the costs of the short-term bonus are smaller as those of the long-term bonus, the equilibrium will be given by \( A = \underline{a}, \ b_s = \frac{l}{x(1+\delta)(1-t_b)} \) and \( b_l = \frac{l}{x(1+\delta)} \) as denoted in the proof of Proposition 1 and the short-term bonus will increase gross of taxes but stay constant net of taxes.

For taxes above a threshold \( t_b^+ \), the long-term bonus becomes cheaper than the short-term bonus. Formally, to determine \( t_b^+ \), we use the Lagrangian from equation (17) and search for a threshold where \( \frac{\partial C}{\partial A} = \frac{\partial C}{\partial b_l} = 0 \) and \( \frac{\partial C}{\partial b_s} < 0 \). Moreover, as for \( \rho \leq \rho^l \) equilibrium short-termism is given by \( a = 0 \), we can choose the choice of short-termism and set \( a = \sigma = 0 \). \( \frac{\partial C}{\partial A} = 0 \) yields \( \lambda = 1 \),
which we can use with \( \frac{\partial C}{\partial bt} = 0 \) to get \( \gamma = \rho \). Inserting \( \lambda \) and \( \gamma \) in \( \frac{\partial C}{\partial b_s} \leq 0 \) yields the threshold for which \( b_s = 0 \) is an equilibrium, i.e. if and only if

\[
t_b \geq \frac{\rho}{1+\rho} \equiv t_b^+.
\]

Algebraic manipulation delivers the optimal contract with \( A = u, b_s = 0 \) and \( b_l = \frac{(1+\rho)l}{x} \). The bonus tax leads to a short-term bonus of zero and a higher long-term bonus compared to a no-tax scenario.

3. For \( \rho^t \leq \rho \leq \bar{\rho}^t \), the equilibrium is given in the proof of Proposition 3 with

\[
b_s = \frac{akx+k\delta l-\delta k a^2}{(1-t_b)(1+\delta)x}
\]

and

\[
b_l = \frac{1-akx-k^2 a^2}{(1+\delta)x} (1 + \rho). \]

Comparative statics show

\[
\frac{\partial b_s(a)}{\partial t_b} = \frac{\partial b_s(a)}{\partial a} \frac{\partial a}{\partial t_b} = \frac{a k x + \delta l - \delta k a^2}{(1-t_b)(1+\delta)x} \frac{\partial a}{\partial t_b} \geq 0, \quad (31)
\]

\[
\frac{\partial b_l(a)}{\partial t_b} = \frac{\partial b_l(a)}{\partial a} \frac{\partial a}{\partial t_b} = - \frac{(1+\rho)k}{(1+\delta)x} (x + a) \frac{\partial a}{\partial t_b} > 0. \quad (32)
\]

As \( \frac{\partial a}{\partial t_b} < 0 \) for \( t_b < t_b^+ \) (as will be shown in the Proof of Proposition 6), the long-term bonus \( b_l \) is increasing in the bonus tax. For the gross short-term bonus, two opposing effects influence its reaction on the bonus tax: a positive direct effect (first term) and a negative indirect effect (second term). For the short-term bonus net of taxes, only the indirect effect matters.

**Proof of Proposition 6**

**Part 1:**

1. For \( \rho \geq \bar{\rho}^t \), the equilibrium is given in the proof of Proposition 2 with \( a = \bar{a} \).

2. For \( \rho \leq \rho^t \), the equilibrium is given in the proof of Proposition 1 with \( a = 0 \). For the range of parameters \( \rho \in (\rho^t, \bar{\rho}^t] \), a bonus tax changes equilibrium short-termism from \( a > 0 \) in the absence of a tax to \( a = 0 \) under taxation.

3. For \( \rho^t < \rho < \bar{\rho}^t \), the equilibrium is given in the proof of Proposition 3. Using the implicit
function theorem on (24) yields

$$\frac{\partial a}{\partial t_b} = \frac{1}{(1-t_b)^2} \left[ \frac{akx+\delta I - \delta \frac{b}{2}a^2}{(1+\delta)x} + \frac{(x+a)(x-\delta a)k}{(1+\delta)x} \right].$$

As the numerator is clearly positive (note that \(\frac{akx+\delta I - \delta \frac{b}{2}a^2}{(1+\delta)x} = (1-t_b)b_s \geq 0\)), the sign of the denominator determines the sign of \(\frac{\partial a}{\partial t_b}\). The denominator is negative, whenever \(t_b < \frac{x(1+\delta)+2\delta\rho x-\rho x+3\delta\rho^2}{2x\delta-x+3\delta a+2\delta\rho x-\rho x+3\delta\rho} \equiv t_b^*\) holds and especially at \(t_b = 0\). Note that for the denominator to be positive, \(t_b > t_b^+\) is a necessary condition.

Moreover, for the range of parameters \(\rho \in [\bar{\rho}^\beta, \bar{\rho}^\beta]\), a bonus tax changes equilibrium short-termism from \(a = \bar{a}\) in the absence of a tax to \(a < \bar{a}\) under taxation.

**Part 2:** Using (22) and (29) and setting \(\pi_L = t_b = 0\), we get the threshold levels \(\rho\) and \(\bar{\rho}\) in the absence of a bailout and a bonus tax.

1. By setting \(\bar{\rho}^\beta\) equal to \(\bar{\rho}\), we can derive the bonus tax that is necessary in order that the bank fully internalizes the costs of the bailout, i.e. \(t_b = \frac{(\delta-1)(1+\delta)\beta}{x^2+xk+(\delta-1)(1+\delta)\beta}\).

2. Similarly, by setting \(\rho^\beta\) equal to \(\bar{\rho}\), we can derive the bonus tax that is necessary in order that the bank fully internalizes the costs of the bailout, i.e. \(t_b^* = \frac{(\delta-1)(1+\delta)\beta}{2\delta I-x\beta-\delta kx^2+2x\sqrt{k^2x^2+2Ik+k}\beta^2}\).

3. Under our assumptions, \(t_b = t_b^*\) iff \(\frac{\delta}{2} + xk + (\delta - 1)(1+\delta) \beta = 2\delta I - x\beta - \delta kx^2 + 2x\sqrt{k^2x^2+2Ik+k} + x\beta^2\). This is only the case by strongly constraining \(\delta, \beta, I, x\) or \(k\) on certain parameter values.

**References**


33


