Government Distortions, Bankers’ Pay and Excessive Risk

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Abstract

This paper studies executive risk-taking under optimal pay contracts when firms’ debt is accurately priced after executives make their investment decisions. In our model the discipline of debt markets prevents standard risk-shifting concerns. However, the government distortions of debt interest tax deductibility and too-big-to-fail cause bank executives remunerated in equity-linked bonus to choose excessively risky projects. We use the model to evaluate the existing proposals for remuneration regulation to curb excessive risk-taking. Rewarding in debt does not alter the distortions as the expected return on debt is invariant to project risk. Executives’ incentives can be corrected by re-basing pay away from return on equity or by deferring pay with a clawback clause. By contrast, bonus caps as a proportion of fixed wages disincentivise project selection effort and can lead to worse outcomes.

Keywords: Executive compensation; bankers’ bonuses; risk taking; financial regulation; Return on Equity; clawback; deferral; theoretical policy analysis.

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1 Introduction

In the recent global financial crisis, a number of banks accumulated large losses while their CEOs and other senior employees were paid extraordinary bonuses up to that point. The fact that these losses in some cases led to bank failures requiring support from taxpayers led many to call for a review of bank executives’ pay structure. In particular, it has been argued that bonus pay linked to equity could encourage bank executives to take excessive risks and focus on short-term performance.\footnote{See for example the report of the UK Parliamentary Commission on Banking Standards 2013.} This has led to pressure for reform, perhaps most prominently voiced by the Financial Stability Board’s Principles for Sound Compensation Practices which was endorsed by the G20. This stated that executive pay should “create incentives aligned with long-term value creation and the time horizons of risk.”\footnote{See Financial Stability Board (2009), in particular paragraph 8, page 3.} Regulators around the world are seeking ways to make this objective a reality through deferrals, bonus caps and other means.

This paper studies executive risk-taking under optimal pay contracts when firms’ debt is accurately priced after executives make their investment decisions. In our principal-agent model, shareholders offer an equity-linked bonus to the executive in order to incentivise him to exert costly effort to search for and select projects that maximise their return. Specifically, an executive can privately observe the expected returns of alternative projects by exerting costly personal effort. Once the project is selected, the executive raises the required debt and equity finance. The investors can observe the riskiness of the chosen project, so that debt can be appropriately priced. The executive is paid before the payoffs from the project are fully realised: this captures the difference in time scale between remuneration and the economic life-span of real world projects. Using this model, we demonstrate that the privately optimal compensation contracts do not necessarily deliver the socially optimal project choice when equity values are distorted by two government-induced distortions: the tax deductibility of interest payments (the so-called debt tax shield), and the implicit subsidy arising from the government’s incentive for bailouts, which is particularly relevant for large and systemically important banks. Indeed, both of these distortions induce equity-remunerated executives to take socially excessive risks. We then use this model to evaluate the alternative proposals for remuneration regulation to curb such excessive risk-taking incentives.

A large part of the existing literature on executive remuneration takes Jensen-Meckling’s (1976) risk-shifting rationale as given and argues that equity-linked pay fails to deliver optimal risk choice when the debt market cannot observe the riskiness of the chosen project. However, we will argue below that executives, at major banks at least, are exposed to the discipline of informed debt markets, which mitigates standard risk-shifting concerns. In this paper, we demonstrate that equity-linked bonuses do not necessarily lead to ex-
cessive risk-taking when debt markets can efficiently price risks: they only do so when interest payments are tax deductible, or when the debt price is distorted due to an implicit government guarantee against default.

In the absence of such government-induced distortions, efficient debt markets imply that when an executive selects a project, the price of debt and equity adjust so that the value of equity fully captures the risk of the cash flows, as noted in the path-breaking work of Modigliani and Miller (1958). In such a world, equity-based pay can lead to first best project selection. However, we demonstrate that, when interest payments are tax deductible and offer equity holders a debt tax shield, executives are over-incentivised to select risky projects. Riskier projects increase the interest payable on debt financing, but the debt tax shield acts to subsidise this increased interest cost. The equity holders therefore benefit from selecting an overly risky project, and the equity-rewarded executive is incentivised to choose such overly risky projects. This distortionary effect of debt is strongest when the debt raised will subsequently be repaid – for instance, in the cases of the financing of mergers and acquisitions, project finance, or leveraged buyouts. The distortionary effect also rises as the bank becomes more leveraged.

When the debt market is distorted due to the possibility of government bailouts (e.g. due to the too-big-to-fail (TBTF) effect) then we identify a second effect which interacts with the debt tax shield and results in executives being over-incentivised to select risky projects. When there is a positive probability that a bank may be bailed out, creditors are willing to finance risky projects at low interest rates. Thus, the possibility of government bailouts effectively subsidises risk-taking and hence induces bank executives remunerated in equity-linked bonus to take socially excessive risk. This incentive is only partly offset by the reduction in the value of the debt tax shield caused by the increased probability of bailouts: as the bailout becomes more certain, the interest rate payable – and hence the value of tax shield – fall. Thus, we demonstrate that, overall, executives’ incentive to take risks becomes stronger as government bailouts become more likely.

We use this model to examine alternative proposals for deterring bank executives from taking excessive risks:

**Include Debt in Compensation** We demonstrate that, if the debt market efficiently prices risks, introducing debt into the executive’s compensation will not deter him from taking socially excessive risks. This is because the expected return to debt holders will be independent of the project choice, as the interest rate adjusts to risk in an efficient debt market. Hence the presence of debt in the executive’s remuneration does not alter his project selection incentives. And this is true even if he is obliged to hold the debt to maturity.

**Drop Return on Equity (RoE): Use Return Net of Tax Shield and TBTF Guarantee**

It has already been noted by regulators that measuring performance against RoE
discourages bank executives from issuing new equity. We identify a further problem of RoE. In particular, we demonstrate that an executive rewarded based on a raw RoE measure has an incentive to take excessive risks so as to increase the value of the tax shield and any too-big-to-fail subsidy. If regulators changed the structure of permitted compensation so that senior executives, such as the CEO, had to be judged against improvements in the value of equity less the debt tax shield and TBTF subsidy, then risky projects which were only optimal because of these government distortions would now be dropped. This policy may be difficult to implement in practice due to the challenges associated with measuring the value of the implicit government guarantee and the value of the debt tax shield; but recent empirical studies have made some progress here and suggest that these two distortions could alter the enterprise value of the firm by roughly 10%.

**Forced Deferral of Pay** We demonstrate that mandating pay deferral in executive compensation can also be used to return executive project selection back towards the first best. It is already known that forced deferral can help prevent short-termism whereby executives push risks into the future to try to drive up current pay. Here we provide a new result that deferred pay with a clawback clause mitigates excessive risk-taking incentives caused by the too-big-to-fail and debt tax shield distortions by ensuring that the executive will lose his deferred pay if the bank either goes bust or is bailed out. However, we also show that too much deferral can push the pendulum too far and lead to executives being excessively risk averse in their project choice.

**Bonus Caps As A Multiple Of Wages** The European Union is the first major jurisdiction to enforce bonus caps as a multiple of the individual’s base pay in regular financial regulation. This approach has been criticised for potentially driving up the base pay, which in turn could end up increasing banks’ fixed costs and hence their financial fragility. We demonstrate that a bonus cap could potentially disincentivise an executive from searching for projects with a high reward and low risk: bonus caps will at best have no effect on project choice, and at worse distort project choice by lowering executive effort in project search in favour of selecting overly risky projects that are easy to find.

The paper is structured as follows. A review of related literature is offered in Section 2. Section 3 outlines the structure of our baseline model. Section 4 derives analytical results for a fully equity-funded firm, and shows that equity linked executive pay will induce socially optimal risk-taking. We then demonstrate that the two types of government-induced distortions in the debt market lead the equity-rewarded executive to select overly risky projects. Section 5 examines the distortion due to the debt tax shield, while Section 6 analyses the distortion due to the possibility of government bailouts. Section 7
then examines alternative proposals for regulating executives’ pay in order to correct the excessive risk-taking. Section 8 surveys the econometric evidence as to the magnitude of these distortions. Section 9 concludes with proofs not in the main text contained in Appendix A.

2 Literature Review

This paper seeks to contribute to the policy debate over how bank executives’ compensation should be designed in order to prevent them from taking excessive risks. Jensen and Meckling (1976) have shown that an executive who is compensated in equity has the incentive to choose riskier investments if the debt holders cannot control his project choice after debt has been issued. They speculated that, if the executive is obliged to hold an equal proportion of the firm’s equity and debt outstanding, then the agency costs of debt could be eliminated. The key question that this seminal analysis raised is the extent to which the price of debt responds to a firm’s project choice. If a manager can first secure debt, then enact a project of his choice with no need to re-access debt markets, or if the riskiness of projects selected are unobservable, then the scope for risk-shifting to debt-holders presents itself. We believe that in the case of a large potentially systemically important bank, or of a multinational firm, this is not a good benchmark assumption. Such large firms’ debt is tradeable, actively followed by analysts, and many such firms are also covered by credit default swap (CDS) contracts which explicitly estimate the default probability. Furthermore, such large firms repeatedly need to re-access the debt markets to roll-over existing debt contracts. Indeed, Figure 1 offers evidence that over the last decade the global systemically important banks (G-SIBs) – as defined by the FSB – accessed debt markets with new issuances of debt more frequently than once a quarter and sought to borrow over $800 million each time on average. This is likely to understate the normal frequency of debt issuance due to the difficulties in accessing capital markets during the height of the financial crisis.\(^4\) Efficient capital markets would imply that investors would explore the credit worthiness of such large firms, and so the interest payable on the firms’ debt would reflect the riskiness to the creditors of the projects chosen. This link between the price of debt and the risk profile of the firm has explicit empirical support in the case of banks (Flannery and Sorescu (1996), Jagtiani, Kaufman,

\(^4\)During the financial crisis banks had more urgent need of capital and so one might be concerned that Figure 1 would over-estimate, and not understate as claimed, the frequency with which banks accessed the debt markets. Interrogation of the data indicates that this is not the case. Banks on average accessed the debt markets in normal times (2000Q1 to 2007Q4) 1.5 times a quarter, and so even more frequently than the 1.2 times a quarter indicated in Figure 1. Thus the debt markets are repeatedly asked to make a call on the value of fresh debt issued by banks, justifying the premise of this analysis.
and Lemieux (2002)). Hence, the Jensen-Meckling (1976) risk-shifting channel to private sector creditors would be much reduced and may not apply. As we are primarily interested in systemically important banks, we take this view and so allow the debt to be priced after project decisions are taken. We show that the distortions in project choice created by executive pay arise from a different avenue: debt tax shields and the distortion of too-big-to-fail.

Figure 1: Frequency and Size of New Debt Issuance For G-SIBs

Notes: The graph presents the frequency and average size of new debt issuance by the G-SIBs for which data were available. The bars represent the frequency of deal issuance and demonstrate an average return to the debt markets more than once a quarter. For some banks the deal frequency was twice this. The points on the graph represent the average issuance size and are measured on the right hand axis. The average issuance was over $800 million. These data demonstrate that bank executives are repeatedly exposed to the judgment of the market, and so interest rates payable will adjust to reflect the decisions banks take. This offers justification for our focus on a functioning debt market which evaluates firm risk after project decisions are taken. Data from Dealogic Primary Issue data for 2000Q1 through to 2013Q3.

The implications of agency problems, management compensation and risk-taking in banking were hardly analysed prior to the financial crisis. The analysis which has followed has largely built on the assumption that bank executives can shift risks to debt holders who are assumed to be unable to price the project risk. Bolton, Mehran and Shapiro

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Though Krishnan, Ritchken and Thomson (2005) caution that bank risk only accounts for a small part of changes in the price of debt – more important are changes to the cost of capital due to the macroeconomic and industry environment.
(2014) and Hakenes and Schnabel (2014) are both in this tradition. They consider a
manager who secures debt at a market rate of interest, but is free to secretly select a
project or its risk characteristics. The debt of the firm cannot be repriced in response to
project choice. In this setting, the manager shifts risk on to the initial creditors. Bolton
et al. (2014) look to CDS contracts to try to correct this distortion. They argue that
investors who trade CDS contracts will study a firm and be able to observe and assess
its riskiness. We agree and note that the price of debt closely tracks the CDS-implied
default probabilities (Blanco, Brennan, Marsh (2005), Hull, Predescu and White (2004))
suggesting that, when the firm returns to the market to issue debt, its price will reflect
the riskiness of the project choice. If so, the risk-shifting channel in Bolton et al.’s study
would be shut down as the value of equity would adjust to reflect the riskiness of the firm
(Modigliani Miller). In contrast to these existing papers, our work demonstrates that
equity-linked pay can induce excessive risk-taking even when debt markets can efficiently
price risks if government-induced distortions – tax deductibiltiy of interest payment and
the possibility of bailouts – are present. To our knowledge, ours is the first to study the
impact of remuneration structure on risk-taking incentives when the executive is exposed
to the discipline of well-informed debt markets.

Our work is also distinguished from that of Edmans and Liu (2011) as they too consider
the case of a manager able to secure debt and then subsequently make a project choice.
Using a framework which assumes that the debt price is insensitive to project risk, Edmans
and Liu argue that the manager can be forced to internalise the riskiness of their decisions
if they are obliged to hold some debt to maturity. We demonstrate that, when the debt
market can accurately price risks, making a manager hold the firm’s debt will have no
impact on his risk-taking incentives and hence project selection. By contrast, pay deferral
and clawback can effectively mitigate risk-taking incentives even when the debt market is
efficient.

This work is part of a general study of how executive compensation affects decision
taking in banking and finance which has come to the fore following the recent global
financial crisis. In earlier work John, Saunders and Senbet (2000) explore the relationship
between management compensation and the FDIC’s insurance premium scheme. They
argue that banks’ risk taking can be improved by making the insurance premiums that
a bank pays a direct function of the parameters of the compensation contract. This is
a form of behavioural regulation. In this paper, we explore the benefits of altering the
structure of pay by mandating, for example, deferral, rebasing, or the use of debt. Thus,
our concern is on optimal structural regulation of compensation in finance. A related
analysis of regulation and compensation is offered by Freixas and Rochet (2013). These
authors argue that when a bank is guaranteed to be bailed out, the owners will exploit
the taxpayer by tolerating risk shifting so as to lower the required levels of compensation.
In response, regulation must intervene to control the level of bonus and possible grace
periods. Foster and Young (2010) caution that in finance generally one needs to be careful of all compensation rules as they can be gamed and lead to risk being pushed into the tails. For example, and in support of this thesis, Tzioumis and Gee (2013) note empirically that loan officers are more lenient towards the end of the month when exposed to non-linear pay arrangements which can be made more personally lucrative by issuing more loans. In our analysis we explore the optimal response of the executive to any changes in pay arrangements to ensure we understand the consequences of structural pay regulation.

Our study also contributes to the part of the compensation literature which studies whether private firms would offer too little deferred pay from society’s perspective. Thanassoulis (2013) links the level of deferral to market pay levels and industry structure and argues that deferral can be too slight in concentrated markets or ones where pay levels are high (such as in banking). However, Laux (2012) argues that a firm would optimally avoid using deferred pay if an executive can be fired in the light of short-term results. Deferred pay in such a setting would induce excessively risk-averse behaviour as the executives seek to retain their jobs long enough to get their bonus. Other authors have considered whether even if a manager could risk-shift, they would wish to. For example Hirshleifer and Thakor (1992) argue that the need to foster a good reputation will ensure that managers do not take excessive risks. Our contribution to this broader effort is to demonstrate that even if the debt market is efficient, distortions in project choice arise because of the debt tax shield and the implicit government guarantees. We demonstrate that structural alterations to compensation, including pay deferral, can correct for their effects and return project choice to the first best.

Finally, our study also contributes to the wider literature on optimal financial regulation to counter excessive risk-taking incentives caused by government-induced distortions. A vast body of work has noted that mispriced deposit protection insurance and implicit government guarantees for systemic institutions can both encourage banks to take excessive risks. Capital adequacy regulation – which requires each bank to hold a minimum amount of capital relative to its assets weighted by their riskiness (minimum risk-weighted capital ratio) – has been traditionally used to curb such risk-taking incentives. However, the recent financial crisis has undermined the notion that capital adequacy regulation alone is sufficient to curb banks’ risk-taking incentives, not least because risk weights used to calculate the risk-weighted capital ratios were inadequately capturing the risks that banks were exposed to (Admati, DeMarzo, Hellwig and Pfleiderer (2013)). This paper therefore ex-

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7 The theoretical justification for this approach was historically expressed in the form of the Pyle-Hart-Jaffee model. See Pyle (1971) and Hart and Jaffee (1974).

8 Rochet (1992) notes that the risk weights for a security should reflect systemic risk, while Iannotta and Pennacchi (2012) argue empirically they do not.
amines whether remuneration regulation can complement the capital adequacy regulation to curb excessive risk-taking by bank executives.

3 The Model

In order to analyse the optimal compensation structure, we develop a principal-agent model in which the firm owner is the principal and the executive is the agent. The timing of the game is as follows. At $t = 0$ the firm owner offers a compensation contract $\{f, b\}$ to the executive with a promise to pay him at $t = 1$. The parameter $f \geq 0$ is a fixed (dollar) salary and $b \geq 0$ is an equity share of the $t = 1$ market value of the firm. We will subsequently consider the case of adding different types of debt instrument to this compensation structure. We will also discuss the class of fully optimal compensation contracts – some of which can be generated solely with these two instruments: $(f, b)$. The executive accepts or rejects the compensation package, and his reservation utility is given by $u$.\(^9\)

If he accepts the contract, the executive at $t = 0$ chooses between two projects: a risky project and a safe project. The project size is normalised to 1. At $t = 1$, the executive invests in the selected project, and this project choice is publicly observed. A risky project will succeed at $t = 2$ with probability $\chi$ and generate a return of $\rho > 1$; it fails with probability $1 - \chi$ and will generate 0. The net present value of the risky project is denoted $Z := \chi\rho$.

We assume that at $t = 0$ the executive can observe this probabilistic return structure of the risky project without effort, but he can exert costly effort to determine the exact future return of the safe, alternative project, $r$. The executive decides at $t = 0$ whether to exert this ‘project search effort’ or to shirk and choose a project under partial ignorance. If the executive shirks, he derives a private benefit of $B > 0$ but remains ignorant of the exact future return of the safe project. We capture this most simply by supposing that the prior distribution of the safe project return is given by a return drawn from a uniform distribution, $r \sim U[1, \bar{r}]$. The costly effort does not allow the randomness inherent in the return of the risky project to be refined. To create a relevant project choice for the executive, we assume the highest possible payoff from the risky project are higher than from the safe project, that the safe payoff can sometimes be greater than the expected payoff of the risky project, and that the expected payoff of the risky project exceeds the uninformed expected payoff of the safe project:

\[
1 < E(r) < \chi\rho = Z < \bar{r} < \rho.
\]  \(1\)

\(^9\)The reservation utility, $u$, is exogenous here as we consider just one bank and take the wider executive labour market as exogenous. For a study endogenising pay levels in banking see Thanassoulis (2012).
We assume that the debt market can observe the risk-return characteristics of the project chosen, equally as well as the informed executive when the firm issues debt, but cannot verify whether the project chosen has a higher net present value (NPV) than an unchosen alternative. This simple information structure allows us to study a project choice decision in which the executive might choose the risky project when it actually has a lower NPV than the safe project, with market participants unable to discern whether or not this is the case.

The socially optimal, first best project choice is for the executive to select the risky project if it has the highest NPV: $Z > r$. Hence, the maximum expected payoff at $t = 0$ attainable by an efficiently run firm, gross of any executive remuneration costs, is given by

$$S \equiv \frac{Z - 1}{\bar{r} - 1} \cdot Z + \int_{r=Z}^{\bar{r}} \frac{r}{\bar{r} - 1} dr = \frac{(\bar{r} - Z)^2}{2(\bar{r} - 1)} + Z$$ (2)

After the executive selects the project at $t = 0$, the investment in the selected project occurs at $t = 1$. At this time, debt $D$ may be raised, and equity owners complement this with sufficient equity $E$ to fund the investment and the compensation costs for the executive. As the market observes the riskiness of the project undertaken at $t = 1$, the price of debt is actuarially fair, given the risks. Thus, we capture the case that, after a project choice decision is taken, investors will have an opportunity to buy debt at a price commensurate with the risks they are taking (see the discussion around Figure 1).

As noted, the executive is paid at $t = 1$, in advance of the profits being realised. At $t = 2$, project returns are realised and any debt is repaid. Executive compensation being paid in advance of the profits being realised is particularly realistic in the case of banking where many investments are long term, particularly when compared to the typical tenure of executives. For example, the average tenure of UK bank directors is 3.6 years and yet the credit cycle is estimated as being 13 years in length (Aikman, Haldane, and Nelson (2014)). We explore the benefits of some pay deferral to after results are realised ($t = 2$) in our study of possible structural changes to the compensation regime.

4 The No Debt Benchmark

We now examine the optimally chosen remuneration contract used to hire the executive, incentivise effort, and align the risk choices with those of the equity owners under the benchmark in which projects are fully funded by equity. The equity owners therefore provide financing both for investing in the project and for compensating the executive. If the executive selects the safe project then at $t = 1$, the future payoff of $r$ is observed by the market, and the executive is paid $f + br$. If the executive selects the risky project then at $t = 1$, the market observes the expected return of the project, $Z$, so that the executive
is paid \( f + bZ \). Given this compensation structure, the expected increase in bonus for the executive from searching for good projects over selecting the risky project under partial ignorance is given by \( b(S - Z) \). We can show that:

**Lemma 1** If the equity-linked bonus is high enough the executive will exert project search effort and will make the efficient project choice: select the risky project if and only if \( Z > r \). To incentivise effort we require

\[
b \geq \frac{B}{S - Z}
\]  

(3)

**Proof.** Substantial technical proofs are collected in the technical appendix. ■

Lemma 1 captures that, with sufficient equity exposure, the executive will exert effort and will make the optimal project choice. As there is no debt in this benchmark example, the executive’s incentives are not distorted by the tax shield or too-big-to-fail subsidy. The equity-linked bonus in this case perfectly aligns the executive’s payoff with that of the equity holders, and that is consistent with the social optimum.

At \( t = 0 \), the executive will anticipate that he will make an efficient project choice and so expects his bonus award to be \( bS \). The executive’s participation constraint is determined by noting that the executive will accept the contract if the expected pay exceeds the outside option of \( u \):

\[
f + bS \geq u
\]  

(4)

We now turn to the optimal compensation scheme for the firm. Lemma 1 delivers the result that the executive will take the efficient decision of implementing the risky project if and only if \( Z > r \). The \( t = 0 \), expected payoff of the equity owners who finance the initial investment will depend upon the payments which must be made to the executive, and these will depend upon the project choice. The expected value for the equity holders at \( t = 0 \) is therefore:

\[
E(\Pi_0) = \text{[Expected payoff]} - \text{[Expected executive pay]} - \text{[Cost of Investment]}
\]

\[
= (1 - b)S - f - 1
\]  

(5)

**Proposition 1** The optimal remuneration scheme incentivises effort if the cost of effort is not too great: \( B < S - Z \). In this case the contract with lowest variable component for an all equity firm is characterised as follows:

1. The optimal wage contract satisfies:

\[
b = \frac{B}{S - Z}
\]  

(6)

\[
f = u - B - bZ
\]  

(7)
2. The expected return to the firm’s equity owners is given by:

\[ E(\Pi_0) = S - u - 1 \]  

(8)

3. The executive makes efficient investment decisions and so selects the risky project if and only if it has the higher npv \((r < Z)\).

Thus, in this benchmark case, the first best efficient project choice is delivered by a simple, and standard, remuneration contract consisting of base pay and an equity stake. The equity stake serves two purposes. The first is to motivate effort by allowing the executive to profit from the effort spent in studying the possible projects and selecting the better one. The size of the equity stake required \((6)\) grows the larger the incentive problem is \((\text{higher } B)\), or the smaller the expected benefit in equity values from screening and choosing projects optimally \((\text{lower value of } S - Z)\).

The second purpose of the equity stake is to align the executive’s incentives with that of the owners \((\text{Lemma 1})\). An increase of $1 in the expected return from a project is worth $b to the executive. Hence, the executive’s interests are perfectly aligned as he will gain most from choosing the project which increases the expected value of the equity holders’ stake the most.

The executive is assumed to be risk neutral, hence many contracts are possible as the executive is indifferent to extra risk. However, if the executive is risk averse, the firm would strictly prefer to lower the rate of variable pay whilst maintaining incentives to exert effort. Thus, the proposition focuses on the optimal contract with the lowest variable component.

We conclude this section by noting that the remuneration schedule generated via the contract \((f, b)\) in Proposition 1 is first best optimal for the shareholders. The contract of Proposition 1 generates the first best project choice \((\text{Lemma 1})\). The incentive compatibility constraint is binding, thus if the payoff from selecting the high value project when it is available declines any further then the executive will not exert effort. Finally, the total expected cost of employing the executive to the shareholders is \(u\) \((\text{equation 8})\). This is the outside option of the executive and so cannot be reduced further. Thus, the contract generated by Proposition 1 cannot be improved on and so is fully optimal. This contract is also socially optimal as it generates the first best project choice at the lowest possible cost of the executive’s outside option. We now turn to explore how debt, acting through such a contract structure, can distort project selection and risk taking.
5 Debt Financing and Leverage: the effect of tax shields

In the previous section we considered an all equity firm. Now we consider the effect of firm leverage on the executive’s decision making. Suppose that the owners decide to reduce their required equity stake by issuing debt $D$ at time $t = 1$ at contractual interest rate $i$, with the debt to be repaid after the project is complete, at $t = 2$. The equity owners supply sufficient equity to cover the costs of the investment and staff pay. The project choice is observed by the market and so the interest rate the firm pays on the debt will be endogenous and depend upon the risks of the project as they are observed by outside investors. The risk-free interest rate is normalised to one, and none of the following results depend upon this normalisation. We further allow for the reality that interest payments over and above the returning of the principal qualify for a tax shield against a corporate tax rate, denoted as $\tau$.\(^{10}\) This is an important addition to previous analyses of executive compensation.

Suppose that at $t = 1$ the executive selects the safe project. Denote the value of the firm at $t = 1$ as $X_{1}^{\text{safe}}$. The executive will therefore receive pay of $f + bX_{1}^{\text{safe}}$. As the investment costs a unit of capital, the total equity which is required of the owners given the chosen level of debt issuance is:

\[
E = 1 + [f + bX_{1}^{\text{safe}}] - D
\]  

(9)

As the project is safe, there is no risk for the debt holders in this case, and so the risk free interest rate of one applies. The safe project will deliver a payoff of $r > 1$. Hence, the $t = 1$ valuation is given by

\[
X_{1}^{\text{safe}} = \frac{E + D}{1 - [f + bX_{1}^{\text{safe}}]} + \frac{r - D}{r - D}
\]

\[
\Rightarrow X_{1}^{\text{safe}} = r - D \text{ using (9)}
\]  

(10)

Hence, the executive will receive a $t = 1$ payment, if he selects the safe project, of

\[
f + bX_{1}^{\text{safe}} = f + b(r - D)
\]  

(11)

Suppose instead that the executive selects the risky project. In this case the firm will have $t = 1$ value denoted $X_{1}^{\text{risk}}(\tau)$ where $\tau$ is the corporate tax rate at which the

debt tax shield is calculated. The executive will receive pay of \( f + bX_1^{\text{risk}}(\tau). \) As the investment costs a unit of capital, the equity required given the debt issuance is \( E = 1 + \left[ f + bX_1^{\text{risk}}(\tau) \right] - D. \) The project is, however, risky and debt holders will not be repaid in the event the risky project fails. Assuming the executive has received an incentive compatible contract which is generous enough to incentivise effort, the cost of debt finance for the risky project is given by interest rate \( i \) such that debt holders – who are assumed to be risk-neutral – are made whole in expectation. Hence, the equilibrium interest rate on debt is given by:

\[
\chi i D = D \iff i = 1/\chi
\]

Thus, in our analysis, the executive cannot avoid the discipline of an informed debt market after he makes his project choice. This contrasts with the large literature that followed Jensen and Meckling (1976) and argued that equity-linked bonuses alone create distortions in project choice as managers can increase risk at the expense of uninformed debt holders.

At \( t = 2 \), the firm must repay \( iD \) if it is able. We assume that the firm profits from a tax shield against the tax rate \( \tau \) on all interest payments over and above the repayment of the principal. The cost of the interest here is \( (i - 1)D \), and so the tax shield is equivalent to the government reimbursing the firm an amount \( \tau(i - 1)D \). The \( t = 1 \) firm valuation is therefore given by

\[
X_1^{\text{risk}}(\tau) = \frac{E + D}{1 - \left[ f + bX_1^{\text{risk}}(\tau) \right] + \chi \left[ \rho - iD + \tau(i - 1)D \right]}
\]

\[
\Rightarrow X_1^{\text{risk}}(\tau) = Z - D + \tau \chi (i - 1)D
\]

The value of the firm, \( X_1^{\text{risk}}(\tau) \) is pushed above the fundamental value of \( Z - D \) by the debt tax shield. This increase in firm value from the tax shield is well known from the trade-off theory of capital structure. What is new here is that the tax shield will have implications for project choice. The executive will receive a \( t = 1 \) payment, if he selects the risky project, of

\[
f + bX_1^{\text{risk}}(\tau) = f + b(Z - D + \tau \chi (i - 1)D)
\]

**Lemma 2** If there is any equity-linked bonus \( (b > 0) \) then an executive who exerts effort makes a socially inefficient project choice. The safe project is selected if and only if \( r > Z(\tau) > Z \) where

\[
Z(\tau) = Z + \tau \chi (i - 1)D
\]

Hence, the risky project is chosen too frequently.
Proof. Comparing (11) to (14) yields the result. ■

Lemma 2 demonstrates that the tax deductibility of debt interest payments introduces a distortion in the executive’s project choice. The executive wishes to maximise the size of his equity stake by maximising the value of equity. The tax shield allows debt interest payments to be paid out of pre-tax earnings, so that the value of the tax shield accures to the equity holders. The tax shield can be made greater by selecting riskier projects. Increasing project risk increases the probability of default and this increases debt interest payments. However, with a positive tax shield, the repayment to debt holders is subsidised by government. This effect incentivises the executive to select overly risky projects.

As debt interest tax deductibility is ubiquitous, this distortion in project selection is potentially significant. We therefore pause to emphasize the assumptions upon which the result depends. In Finance textbooks the value of the debt tax shield is often studied in the context of a constant dollar debt level, with constant tax and the debt a perpetuity whose principal is only paid off at infinity. In this setting the value of the debt tax shield is independent of the interest rate the company borrows at and is given by τD. Riskier projects have their income stream discounted at a higher rate which in this setting exactly offsets the dollar increase in the per period tax shield. Hence, if the value of the tax shield is independent of the interest rate then project choice cannot be distorted. However the value of the debt tax shield here is noted within (13) and does depend upon the interest rate charged, and so leads to executive project distortion. We believe our result that the tax shield is distortionary is widely applicable for at least three reasons:

1. If debt interest is repaid, and not a perpetuity, then the value of the debt tax shield depends upon the interest rate charged. Thus, the distortionary effect of the debt tax shield in project choice is greatest when the debt used to fund the project is intended to be repaid, and not to be permanently rolled over. An example would be debt used to fund a merger or acquisition, a leveraged buyout, or for project finance. Further, such merger decisions can be make-or-break for the bank or corporation and so can also result in default with non trivial probability.

2. Even if the debt is intended to be rolled over, if the dollar value of the debt level is not to be held constant throughout time then the value of the debt tax shield depends upon the prevailing interest and the distortionary effect we document applies. The debt levels would not remain at a constant dollar level if the borrowing bank or corporation was growing and intended to maintain a constant leverage ratio.

\[ \tau D \left[ 1 - \frac{1}{1+rT} \right] \]

is increasing in the cost of borrowing, \( r \).

\[ \tau D / (r_E - g) \]

where \( g \) is the company growth rate and \( r_E \) is the required return on unlevered equity. See Cooper and Nyborg (2006, equation 10). By inspection this grows in the cost of borrowing, \( r \).

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11See, for example, Brealey, Myers and Allen (2011).
12Suppose a risk averse borrower secures debt tax shield each period of \( \tau rD \) for \( T \) periods, and discounts this payment at an interest rate \( r \). The value of the tax shield is \( \tau D \left[ 1 - \left( \frac{1}{1+rT} \right)^T \right] \) which is increasing in \( r \).
13In this case the value of the debt tax shield is \( \tau rD / (r_E - g) \) where \( g \) is the company growth rate and \( r_E \) is the required return on unlevered equity. See Cooper and Nyborg (2006, equation 10). By inspection this grows in the cost of borrowing, \( r \).
case of non-constant dollar debt levels seems to us more relevant empirically. For example, in the run-up to the financial crisis, banks’ leverage rose significantly in both dollar and proportional terms.\textsuperscript{14} Indeed, this has given rise to the Basel III leverage ratio which internationally active banks are expected to start disclosing from 2015.

3. Theoretically competing valuation methodologies have been proposed for the value of the debt tax shield and many of these, including those used most by practitioners, depend upon the interest rate.\textsuperscript{15} Empirically the ratio of the value of the debt tax shield to debt is not constant in leading case studies of prominent mergers (See Section 8 and Graham (2000)).

Our analysis has further normalised the risk free return to one and assumed risk neutral creditors. These are not essential assumptions and their relaxation would not alter the result. In the next section we allow the bank to optimise the incentive contract and so study the tax shield distortion we identify more fully.

5.1 Optimal Contract

Given Lemma 2, the executive at the start of $t = 0$ anticipates that the risky project will be chosen if $Z(\tau) > r$. Thus, the expected payoff of the executive when exerting effort is $W = f + bS(\tau)$ where $S(\tau)$ is the expectation at $t = 0$ of the total value of the firm at $t = 1$, conditional on the executive exerting effort, and with potential tax shield provided by a corporate tax rate of $\tau$:

$$S(\tau) \equiv \frac{Z(\tau) - 1}{\bar{r} - 1} \cdot X^\text{risk}_1(\tau) + \int_{r=Z(\tau)}^{\bar{r}} X^\text{safe}_1 \cdot \frac{1}{r - 1} dr = \frac{(\bar{r} - Z(\tau))^2}{2(\bar{r} - 1)} + Z(\tau) - D$$

where the final equality follows as $X^\text{risk}_1(\tau) = Z(\tau) - D$. The participation constraint for the executive is that his expected pay exceeds his outside option of $u$, given that he expects to exert effort:

$$f + bS(\tau) \geq u$$

We now consider how generous the bonus must be to ensure that the executive exerts effort. If the executive shirks and just selects the risky project, he receives $f + bX^\text{risk}_1(\tau) +$  

\textsuperscript{14}See for example FSA 2009, The Turner Review: A Regulatory Response to the Global Banking Crisis, Exhibit 1.11.

\textsuperscript{15}Fernandez (2004) documents at least 5 competing methodologies, the majority of which have the value of the debt tax shield being a function of the interest rate, including the one he argues is commonly used by practitioners.
B. The executive therefore exerts effort if

\[ f + bS(\tau) \geq f + bX^\text{risk}_1(\tau) + B \]

which simplifies to yield:

\[ b \geq \frac{B}{S(\tau) - Z(\tau) + D} \quad (18) \]

The equity holders’ expected payoff at \( t = 0 \) is \( S(\tau) - E \). The equity required is endogenous and is set to cover the costs of investment and executive pay, net of the debt issuance. Hence:

\[ E(\Pi_0) = (1 - b)S(\tau) - f - 1 + D \quad (19) \]

**Proposition 2** The optimal remuneration scheme incentivises effort if the cost of effort is not too great: \( B < S(\tau) + D - Z(\tau) \). In this case the contract with lowest variable component for a leveraged firm is characterised by:

1. The optimal wage contract satisfies:

   \[ b = \frac{B}{S(\tau) - Z(\tau) + D} \quad \text{and} \quad f = u - B - b[Z(\tau) - D] \]

2. The expected return to the firm’s shareholder is given by:

   \[ E(\Pi_0) = (S(\tau) + D) - u - 1 \quad (20) \]

3. The executive over-invests in the risky project selecting the safe project if and only if \( r > Z(\tau) > Z \).

Proposition 2 demonstrates the relationship between the tax shield, the optimal equity-based remuneration contract, and the project choice. First, note that if there were no tax shield, \( \tau = 0 \), then the value of the project to the owners would be unaffected by the extent of leverage, \( D \), chosen. This follows as the expected equity profit (20) collapses to the equivalent for an all equity financed firm (8) as \( \tau \to 0 \) (substitute (16) into (20)). In this case, part 3 of Proposition 2 demonstrates that the executive would make the efficient project decision, as in the benchmark case analysed in Section 4.

In the presence of a tax shield, however, there is value to be extracted from leverage. In this case, a standard remuneration contract of base pay and an equity stake over-incentivises the executive to pursue the risky project. The tax shield delivers value to the equity holders, and the equity owners would like the executive to maximise it. The tax shield can be increased by taking on more leverage or by investing in riskier projects which creditors are willing to fund only at higher interest rates. The tax shield ensures that the government in part subsidises the increase in the interest rate caused by riskier
project choice. Consequently, the equity holders, and the executive, internalise less of the true cost of risk-taking, and the executive selects the risky project too often.

In this model, the interest rate payable on debt is endogenous and reflects risk. This model allows outside investors (e.g. bond market participants) to research the firm after a business direction or project is selected. Outside investors are not obliged to invest in the firm in advance of project choice (Edmans and Liu (2011)) or in ignorance of the project choice (Bolton et al. (2014)). As noted above, we believe our formulation is natural, particularly for projects which are material enough to affect the solvency of the institution.

5.2 The History Of Interest Tax Deductibility

We have demonstrated, through Lemma 2 and Proposition 2, that the tax deductibility of interest payments encourages equity-incentivised executives to undertake risky projects too readily. In Section 7, we will explore how regulation of the executive’s remuneration can mitigate this effect. First, however, one might wonder whether it would not be possible to simply remove the source of the distortion by eliminating the tax deductibility of debt interest itself. Indeed, Admati, DeMarzo, Hellwig, and Pfleiderer (2013) is a recent prominent contribution arguing that tax policy as concerns debt interest should be restructured so as not to encourage leverage.\textsuperscript{16}

Warren (1974) and Bank (forthcoming) document the origin of corporate debt interest tax deductibility in the US. The first attempt to impose a tax on corporations came in 1894. The initial proposal did not allow for interest tax deductibility. However, after lobbying by the heavily indebted railroad companies, interest payments became exempt through amendments in the Senate. This did not affect many firms at the time as “the great body of the corporations of our country [the US] make dividends covering practically [all] their earnings each year [rather than paying debt interest].”\textsuperscript{17} Nevertheless, the inequity of the treatment of bonds and stocks was felt over time, and so in 1909 the tax law limited the interest tax deductibility to only debt equal to the value of the corporation’s capital stock. In 1917, the United States entered the First World War and the tax law was changed once more so as to limit firms to only make an ‘acceptable’ rate of return on invested equity capital. As extra returns generated from leverage were taxed in their entirety at this time, it was felt fairer that the costs of debt needed to generate those extra returns should not fall on the equity holders. Thus, interest payments first acquired their fully tax deductible status. When the excess profits tax was repealed in 1921, the deductibility of interest as a cost of business persisted. The then status quo was not politically expedient to change.

\textsuperscript{16}See the discussion at the top of p18.
\textsuperscript{17}Republican Senator William Boyd Allison of Iowa, 26 Cong. Rec. 6869 (1894).
It has remained politically difficult to change the tax deductibility of interest since that time. Warren (1974) notes that the case for the equivalent treatment of interest and dividend payments becomes a case for the repeal of the tax deductibility of interest. If instead the tax law was changed to exempt both interest and dividend payments, then corporation tax would only apply to retained earnings which would, according to Warren, (a) discourage the retention of earnings; and (b) lead to the collapse of the corporate tax base. Indeed, President Roosevelt attempted to charge a differential tax rate on retained earnings in 1936. However, as Warren (1974, p 1609) notes, “Corporate managers experienced intense shareholder pressure to distribute earnings [...] in order to reduce corporate tax payments, and this development was said to threaten economic growth.” The differential tax treatment was repealed shortly after its introduction.19

However, the arguments for the repealing of interest tax deductibility have foundered on at least three counts. First, countries are unwilling to risk raising corporation tax by moving to tax interest due to the anticipated hit on competitiveness. For example, the UK government expressly sees interest tax relief as providing a competitive advantage to UK businesses.20 Second, if one were to tax debt interest, then this might encourage firms to identify substitutes for debt which remained tax deductible. For example, firms could make increased use of leasing and short term borrowing, such as trade credit. To capture debt interest payments it is possible that tax law would need to impute interest from rental charges, and in addition would need to determine when commercial deals of all kinds stopped being a legitimate business expense and instead become a proxy for interest. Finally, though in principle the government could tax interest and redistribute the tax so as to make firms indifferent, in practice it is feared that during the transition period highly indebted companies might be fatally damaged.

As the tax deductibility of interest appears likely to continue, it becomes increasingly important to study alternative ways any distortions in risk taking can be corrected. We will conduct such a study in Section 7.

18See section III.B, p1609.
19The UK did have a system of corporation tax which created an offsetting bias towards dividend payments and so penalised retained earnings between 1973 and 1999. The system was known as the Advanced Corporation Tax which allowed companies to pre-pay individuals’ dividend tax liability and set this cost against their corporation tax. The system was scrapped by the UK government in 1999 which argued, as above, that the system biased against good business investment decisions (See http://webarchive.nationalarchives.gov.uk/+/http://www.hmrc.gov.uk/feedback/ctfeed.htm).
6 “Too-big-to-fail” banks: the effect of implicit government guarantees

We have established that, in the presence of a debt tax shield, equity compensation distorts the executive’s project decision even when debt markets can efficiently price project risks. In the case of the banking sector, there is an additional distortion caused by the so-called ‘too big to fail’ effect: that is, the perceived unwillingness of the government to allow large or very connected banks to fail for fear of triggering a system-wide financial crisis. Indeed, bondholders of a number of large banks that failed during the recent financial crisis – for example, Bear Stearns, Northern Rock, RBS and Lloyds to name a few – did not suffer any losses thanks to government support. The presence of the ‘too big to fail’ effect implies that systemic banks and other financial institutions benefit from an ambiguous implicit guarantee on their debt, which lowers their interest costs for any given level of asset risk.

To capture the interaction of an efficient debt market with an ambiguous government guarantee, we suppose that creditors are bailed out with a publicly known probability $\mu$ if the risky project were to fail, such that the bank is unable to repay them.

We now proceed to analyse the executive’s project choice decision and call the firm a bank as the too-big-to-fail distortion is most applicable to banks. We maintain the assumption that the bank faces a corporate tax rate of $\tau$ and benefits from the tax deductibility of interest payments. If the executive opts for the safe project, then the debt will be repaid with certainty. The bank with debt $D$ will have $t = 1$ valuation of $X_1^{\text{safe}}$ as given by (10), and the executive’s pay will be (11).

Suppose instead that the executive selects the risky project. In this case, the executive receives $f + bX_1^{\text{risk}}(\tau, \mu)$. The $t = 1$ value of the bank is now a function of both the tax rate $\tau$, and the bailout probability $\mu$. The cost of debt finance is, once again, given by the interest rate which ensures that debt holders are made whole in expectation. The equilibrium interest rate is now $i(\mu)$ given by

$$\chi i(\mu) D + (1 - \chi) \mu i(\mu) D = D \Leftrightarrow i(\mu) = \frac{1}{\chi + (1 - \chi) \mu}$$

(21)

Note that an increase in the bailout probability, $\mu$, has two effects. First, it lowers the interest rate on debt for any given level of risk, given by $1 - \chi$. As this is effectively a subsidy for risk-taking, we would expect this to introduce distortions in the executive’s project choice. Second, the resulting reduction in the interest rate will also lower the benefit of the debt tax shield. We will demonstrate below that the second effect only partially offsets the first effect, such that, overall, an increase in $\mu$ will increase risk-taking.

To cover the costs of investment and staff costs, given the debt issuance $D$, the equity...
holders provide \( E = 1 + [f + bX_1^{\text{risk}}(\tau, \mu)] - D \). Given the interest rate payable on debt, the \( t = 1 \) valuation for the bank which is pursuing the risky project is:

\[
X_1^{\text{risk}}(\tau, \mu) = \frac{E + D}{1 - [f + bX_1^{\text{risk}}(\tau, \mu)] + \chi [\rho - i(\mu)D + \tau (i(\mu) - 1)D]}
\]

\[
\Rightarrow X_1^{\text{risk}}(\tau, \mu) = Z - \frac{\chi}{\chi + (1 - \chi)\mu}D + \tau \chi (i(\mu) - 1)D
\]

(22)

Hence, the executive will receive a \( t = 1 \) payment, if he selects the risky project, of

\[
f + bX_1^{\text{risk}}(\tau, \mu) = f + b \left( Z - \frac{\chi}{\chi + (1 - \chi)\mu}D + \tau \chi (i(\mu) - 1)D \right)
\]

(23)

Lemma 3 If there is equity-linked bonus \((b > 0)\), then the executive makes an inefficient project choice. The safe project is selected if and only if \( r > Z(\tau, \mu) > Z \) where

\[
Z(\tau, \mu) = Z + (1 - \chi) \mu i(\mu) D + \tau \chi (i(\mu) - 1)D
\]

(24)

Hence, the risky project is chosen too frequently.

Proof. Comparing (11) to (23) demonstrates that the executive is indifferent between the two projects if

\[
f + b \left( Z - \frac{\chi}{\chi + (1 - \chi)\mu}D + \tau \chi (i(\mu) - 1)D \right) = f + b (r - D)
\]

Simplifying yields (24). If the safe project delivers a return above this level then the executive will select it. ■

Lemma 3 demonstrates the nature of the distortion in executive project choice introduced by a too-big-to-fail government guarantee interacting with the debt tax shield. The executive’s project choice is influenced by two distortions. The first distortion, denoted by (†) in equation (24), is the value of the implicit government guarantee secured by the too-big-to-fail bank. This guarantee pays out if the bank should fail (with probability \(1 - \chi\)) in which case an amount \( i(\mu)D \) is paid out if the government does in fact step in to prevent default (with probability \( \mu \)). The second distortion, denoted by (‡), is the debt tax shield discussed in Section 5. The debt tax shield can only be secured if the interest payment is in fact made (with probability \( \chi \)), in which case a proportion equal to the corporate tax rate, \( \tau \), of the interest payment \((i(\mu) - 1)\) is subsidised by the government. Both distortions cause the equity-remunerated executive to make an excessively risky project choice. But (24) demonstrates that, as the probability of bailout \( \mu \) rises, the market interest rate declines, which increases the value of the implicit government
guarantee (†) but lowers the value of the tax shield (‡). We can now explore which effect
dominates:

**Lemma 4** The distortion in project selection grows as the bailout probability increases:
\[
\frac{\partial Z(\tau, \mu)}{\partial \mu} > 0.
\]

It also grows in the corporate tax rate saved via the debt shield, \( \tau \).

**Proof.** Equation (24) can be written as
\[
Z(\tau, \mu) = Z + D(1 - \chi) \frac{\mu + \tau \chi (1 - \mu)}{\chi + (1 - \chi) \mu}.
\]
Partial differentiation with respect to \( \mu \) then implies \( \frac{\partial Z(\tau, \mu)}{\partial \mu} = \text{sign} \chi (1 - \tau) > 0 \).

The second part is immediate. 

As the bailout probability rises, the interest rate payable is reduced for any given level of project risk. In addition, the increase in the bailout probability also reduces the value of the tax shield, but only on the proportion \( \tau < 1 \) of the interest payments. Hence, the incentive for equity-remunerated executive to select excessively risky project grows as the probability of bailout rises.

The expression (25) also shows that a capital adequacy requirement, which requires banks to keep \( D \) below a pre-determined level, will reduce the two distortions, but cannot eliminate them as long as banks are partially funded by debt. This implies that appropriately designed remuneration regulation can potentially complement capital adequacy requirements. We consider this issue in Section 7.

### 6.1 Optimal Contract

Given Lemma 3 the executive at the start of \( t = 0 \) anticipates that the risky project will be chosen if \( Z(\tau, \mu) > r \). Thus, at the point the contract is offered, the expected payoff of the executive when exerting effort is \( W = f + b S(\tau, \mu) \) where \( S(\tau, \mu) \) is the expectation at \( t = 0 \) of the total value of the bank at \( t = 1 \), conditional on the executive exerting effort:

\[
S(\tau, \mu) \equiv \frac{Z(\tau, \mu) - 1}{\bar{r} - 1} \cdot X_{1}^{\text{risk}}(\tau, \mu) + \int_{r=Z(\tau, \mu)}^{\bar{r}} X_{1}^{\text{safe}} \frac{1}{\bar{r} - 1} dr = \frac{(\bar{r} - Z(\tau, \mu))^{2}}{2(\bar{r} - 1)} + Z(\tau, \mu) - D
\]

where the final equality follows as \( X_{1}^{\text{risk}}(\tau, \mu) = Z(\tau, \mu) - D \). Replicating the working which led to Proposition 2 we have:

**Proposition 3** The optimal remuneration scheme incentivises effort if the cost of effort is not too great: \( B < S(\tau, \mu) + D - Z(\tau, \mu) \). In this case the contract with lowest variable component for a leveraged bank which may be too-big-to-fail (probability \( \mu \)) is characterised as follows:
1. The optimal wage contract satisfies:

\[ b = \frac{B}{S(\tau, \mu) - Z(\tau, \mu) + D} \quad \text{and} \quad f = u - B - b[Z(\tau, \mu) - D] \] (27)

2. The expected return to the bank’s shareholders is given by:

\[ E(\Pi_0) = (S(\tau, \mu) + D) - u - 1 \] (28)

3. The executive over-invests in the risky project by selecting the safe project if and only if \( r > Z(\tau, \mu) > Z \).

Proof. Analogous to Proposition 2.

Proposition 3 demonstrates how equity holders will optimally adjust the equity-based remuneration of their executive when the bank’s investments are distorted by both the tax shield and the presence of an implicit government guarantee on debt. Since equity holders benefit from maximising the values from the tax shield and the implicit government guarantee, they will structure the executive remuneration in such a way to incentivise him to select the safe project only if \( r > Z(\tau, \mu) > Z \). This, however, leads to excessively risky project choice from a social point of view. We also observe that, as either the tax distortion \( \tau \) or the bailout probability \( \mu \) grows, the executive’s pay is increasingly concentrated in bonus and less in fixed pay. This follows from part 1 of Proposition 3 noting that

\[ S(\tau, \mu) - Z(\tau, \mu) = \frac{(\bar{r} - Z(\tau, \mu))^2}{2(\bar{r} - 1)} - D \] (29)

and using that fact that \( Z(\tau, \mu) \) is increasing in both \( \tau \) and \( \mu \) (Lemma 4). As the tax shield becomes more generous, or the bailout probability rises, the executive becomes more likely to select the risky project after exerting the project search effort. The diminished benefit from project search makes him less likely to exert effort in the first place. To incentivise the executive to still exert effort, more of the executive’s rewards need to be in the form of variable pay linked to the share value. It is optimal for the bank’s equity holders to incentivise this effort as long as the cost of effort felt by the executive \( (B) \) is smaller than the expected gain in profits from having the executive make an informed decision.

7 Socially Optimal Executives’ Pay

We have established that the executive’s project decision is distorted towards excessive risk-taking by both the presence of the debt tax shield and an implicit guarantee stemming from the institution being too-big-to-fail. In this section, we ask what restrictions a
regulator might wish to impose on the structure of executives’ pay to improve project selection and minimise the negative side-effects of these distortions. We will explore four interventions: (i) using debt as part of the executive’s compensation; (ii) adjusting the value of equity base for bonus calculations; (iii) the use of bonus deferral with clawback clauses; and (iv) exogenous caps on the bonus which can be paid in relation to the fixed salary. We continue to use the most general model of the distortion comprising both the tax shield and any too-big-to-fail implicit subsidy.

7.1 Payment in Debt: An Irrelevance Result

It has been proposed that the distortion introduced by mispriced debt can be corrected by remunerating the executive in part through debt. Thus, we explore this proposition by allowing the firm to remunerate the executive through a proportion \( c \) of the debt \( D \), in addition to the proportion \( b \) of shares and fixed pay \( f \).

Given the debt issuance \( D \), the equity required will adjust to cover the costs of remuneration and investment. The value of the firm at \( t = 1 \) is again given by \( X_{\text{safe}}^{1} \) and \( X_{\text{risk}}^{1}(\tau, \mu) \), depending on the project chosen. If the executive selects the safe project then the firm’s debt is riskless and so valued at \( D \). Hence, the executive’s payment at \( t = 1 \) would be

\[
\text{payment} = f + bX_{\text{safe}}^{1} + cD \tag{30}
\]

If instead the executive selects the risky project, then the market value of the debt \( D \) at \( t = 1 \) is \( \chi i(\mu)D + (1 - \chi)\mu i(\mu)D \), where \( i(\mu) \) is given by (21). The competitive debt market ensures that the risk-neutral debt holders cannot make money in expectation, and so (21) delivers that the value of the debt is again \( D \). Hence, the executive receives a \( t = 1 \) payment of

\[
\text{payment} = f + bX_{\text{risk}}^{1}(\tau, \mu) + c\left[\chi i(\mu)D + (1 - \chi)\mu i(\mu)D\right] = f + bX_{\text{risk}}^{1}(\tau, \mu) + cD \tag{31}
\]

Proposition 4 (Pay In Debt Irrelevance) The optimal executive remuneration scheme when debt repayments are allowed satisfies the following:

1. The availability of debt pay leaves the optimal share bonus unchanged at (27). The fixed salary is reduced by the amount \( cD \).

2. The expected return to the firm’s shareholder is unchanged at (28).

3. The executive behaviour is unchanged by the availability of debt pay. The executive over-invests in the risky project by selecting the safe project if and only if \( r > Z(\tau, \mu) > Z \).
Proof. The executive’s payments when he is in part paid in debt ((30), (31)) differ from the payments in the absence of payment in debt ((11), (23)) only by the constant \( cD \). Interpreting \( f + cD \) as the fixed fee delivers the result.

Proposition 4 demonstrates that the equity owners cannot improve their payoff by using payments in debt. Crucially, in our analysis with an efficient debt market, the expected return to debt holders is independent of project choice. Hence, the presence of debt in the executive’s remuneration does not alter the project selection incentives. This is true even if the debt is held to maturity as the executive’s debt is potentially bailed out, as with other creditors.\(^{21}\) Thus, with efficient and informed, debt markets, the distortions arising from the debt tax shield and too-big-to-fail guarantee are not corrected by payment in debt.

This result stands in contrast to both Edmans and Liu (2011) and Bolton, Mehran and Shapiro (2014), who advocate that debt payments to executives are required to bring the project choice closer to the first best. The difference in our result from theirs stems from the difference in the assumptions about the ability of the debt market to price project risk. With inefficient or uninformed debt markets, as assumed in their analyses, the managers are able to risk-shift – i.e. they can take excessive risks at the expense of the debt holders. As the expected return to debt holders in that case does depend upon the project choice, payment in debt which must be held to maturity exposes the executive to some of the costs of risk-taking, and so can help correct for distorted project choice.

7.2 Measuring Executive Performance Against A Re-based Value Of Equity

The practice of using Return on Equity to reward senior executives has been criticised by senior banking regulators (e.g. Haldane (2011)) on the grounds that it encourages bank executives to strive to increase their gearing and keep equity low. We have noted that equity pay also encourages too much risk in project selection due to the rents an executive can earn from the debt tax shield and the implicit government guarantee arising from the too-big-to-fail considerations. This section examines a regulation that mandates that performance-related pay must not be based on the change in the value of equity alone (or equivalently here the Return on Equity). Instead, we consider a regulation which requires executive pay to be based on the equity valuation corrected for the debt tax shield and the value of any implicit government guarantee. In Section 8, we will review the literature on the extent to which the value of the debt tax shield, and the value of any implicit government guarantee, can be estimated by investors. Here, we first explore how rebasing the equity metric away from raw RoE can alter the executive’s incentives.

\(^{21}\)To treat the executive’s debt differently to other debt is to introduce deferred payment penalties. We analyse such an intervention in Section 7.3.
Using Section 6 and explicitly equation (24) the value of the debt tax shield, $V^\text{tax shield}$ is
\[
V^\text{tax shield} = \begin{cases} 
0 & \text{safe project selected} \\
\tau \chi (i (\mu) - 1) D & \text{risky project selected}
\end{cases}
\] (32)
while the value of the implicit government guarantee, $V^\text{gov g'tee}$ is
\[
V^\text{gov g'tee} = \begin{cases} 
0 & \text{safe project selected} \\
(1 - \chi) \mu i (\mu) D & \text{risky project selected}
\end{cases}
\] (33)

The intervention considered here is therefore that the executive can only be rewarded in proportion to the equity value of the firm net of the value of the tax shield ($V^\text{tax shield}$) and net of the value of the implicit government guarantee ($V^\text{gov g'tee}$).

**Proposition 5 (Rebasing RoE)** When the executive is rewarded based on equity value net of the value of the tax shield and net of the value of the implicit guarantee, the executive who exerts effort will make an efficient project choice: select risky project if and only if $r < Z$.

**Proof of Proposition 5.** If the executive selects the safe project then the firm value is $X_1^\text{safe}$ given by (10). Rebasing the equity value as required in compensation, the executive in this case receives
\[
f + b \left( X_1^\text{safe} - V^\text{tax shield} = 0 - V^\text{gov g'tee} = 0 \right) = f + b \left( r - D \right) \] (34)

If instead the executive selects the risky project then the firm value is $X_1^\text{risk} (\tau, \mu)$ given by (22). Rebasing the equity value as required in compensation leaves the executive with
\[
f + b \left( X_1^\text{risk} - V^\text{tax shield} - V^\text{gov g'tee} \right) = f + b \left( \frac{Z}{\chi + (1 - \chi) \mu} D + \tau \chi (i (\mu) - 1) D - \tau \chi (i (\mu) - 1) D - (1 - \chi) \mu i (\mu) D \right) = f + b \left( Z - D \right) \] (35)

Comparing (34) to (35) yields the efficient project choice result. \QED

Proposition 5 shows that requiring the firm to measure executive performance against the return on equity net of the value of debt tax shield and the implicit government guarantee will ensure that the equity-remunerated executive will make the socially optimal project choice. Before discussing this result we first turn to the optimal compensation contract within this class that the firm will choose under this value of equity rebasing requirement. This will allow us to assess how firms would respond to the introduction of such a regulation.

Given Proposition 5, the executive at the start of $t = 0$ anticipates that the risky project will be chosen if it is efficient to do so: $Z > r$. Thus if $Z > r$, the executive
chooses the risky project and expects to be paid \(35\); otherwise, he will choose the safe project and expects to be paid \(34\). Thus, prior to the project selection, the executive expects to be paid

\[ f + b (S - D) \geq u \]  

Prior to the executive observing the realisations of payoffs available, the expected value of the firm is \(S_{\text{effic}}(\tau, \mu)\) and is given by:

\[ S_{\text{effic}}(\tau, \mu) \equiv \frac{Z - 1}{\bar{r} - 1} \cdot X_{1}^{\text{risk}}(\tau, \mu) + \int_{r=Z}^{\bar{r}} X_{1}^{\text{safe}} \frac{1}{\bar{r} - 1} dr \]

This captures that if the risky project is selected the market value of the firm will be given, as in section 6 by \(X_{1}^{\text{risk}}(\tau, \mu) = Z(\tau, \mu) - D\). Yet, \(S_{\text{effic}}(\tau, \mu)\) captures that the executive will make the project choice according to the efficient criterion of selecting the risky project if and only if \(Z > r\). This expression can be simplified to yield

\[ S_{\text{effic}}(\tau, \mu) = \frac{1}{2 (\bar{r} - 1)} \left\{ (\bar{r} - Z) - 2 \bar{D} (1 - \chi) \frac{\mu + \tau \chi (1 - \mu)}{\chi + (1 - \chi) \mu} \right\} - D \]  

The equity holders’ expected payoff at \(t = 0\) is therefore \(S_{\text{effic}}(\tau) - \mathbb{E}\). Sufficient equity must be supplied to pay the executive and investment costs after the leverage of \(D\). Hence, the equity holders’ expected profit is

\[ E(\Pi_0) = S_{\text{effic}}(\tau, \mu) - [f + b (S - D)] - 1 + \mathbb{D} \]  

We can therefore derive the optimal contract:

**Proposition 6** The optimal remuneration scheme incentivises effort if the cost of effort is not too great:

\[ B < \frac{(\bar{r} - Z)}{2 (\bar{r} - 1)} \left\{ (\bar{r} - Z) - 2 \bar{D} (1 - \chi) \frac{\mu + \tau \chi (1 - \mu)}{\chi + (1 - \chi) \mu} \right\} \]  

In this case the contract with lowest variable component for a leveraged firm is characterised by:

1. The optimal wage contract satisfies:

\[ b = \frac{B}{S - Z} \text{ and } f = u - B - b [Z - \mathbb{D}] \]

2. The expected return to the firm’s equity owners is reduced from the level without regulatory intervention (equation (28)) and is given here by:

\[ E(\Pi_0) = (S_{\text{effic}}(\tau, \mu) + \mathbb{D}) - u - 1 \]
3. The executive makes efficient decisions: he selects the risky project if and only if $r > Z$.

Assuming that the firm remains willing to incentivise effort, the executive will make an efficient project choice. Rebasings the executive’s pay so that the return on equity is reduced by the value of the debt tax shield and by the value of any implicit government guarantee returns project selection to the first best. The reason is that though taking on the risky project grows the equity holders’ payoff thanks to these distortions, the executive is prevented from internalising these marginal gains.

Equity bonus proportions in this case of rebasing, the factor $b$, fall as compared to the bonus without intervention (part 1 of Proposition 3 versus part 1 of Proposition 6, and using (29)). This is because, without rebasing, the executive had a strong incentive to select the risky project without searching for a safe project, and so bonuses had to be high to incentivise effort to confirm that a safe project wouldn’t be better. With the rebased performance target, the risky project is not privileged and so the benefits to the executive of identifying the right project are more substantial. Hence, it is possible to incentivise effort with lower bonus incentives.

The firm is now less valuable to equity holders (part 2 of Proposition 6), as the executive is no longer incentivised to select projects by taking advantage of the tax shield and the implicit government guarantee. Moreover, the benefit from executive effort is now reduced for shareholders, as by exerting effort the executive will now choose projects disregarding the subsidies arising from the tax shield and the implicit government guarantees. Thus, when these subsidies are large – and this happens when the debt is large – the shareholders will decide not to incentivise effort after all (condition (39) would be violated) and encourage the executive to forego informed project choice in favour of uninformed investment in risky projects which capture at least some subsidy.

We conclude this section by noting that the distortions in project choice are not corrected by using Return on Assets (RoA) instead of Return on Equity (RoE). This is because the distortions arising from the debt tax shield and the implicit guarantee increase both RoA and RoE. Consequently, the CEO will still choose overly risky project if his bonus is linked to RoA.

7.3 Deferred Payments with a Clawback Clause

It is known that deferral of pay can help prevent executives taking short-term decisions which push risk into the future (Thanassoulis (2013) and references therein). Here we explore whether pay deferral has a further benefit in correcting for the distortion in project choice which arises from equity holders being cushioned from the true cost of debt via implicit government subsidies. To consider this, suppose that the firm holds back a proportion $P$ of the bonus which is placed in an escrow account at $t = 1$. This deferred
bonus is only released to the executive at $t = 2$ if the firm does not default on its debt and is not bailed out by the government. For simplicity, we assume that the deferred payment in the case of bankruptcy does not accrue to the debt holders.\footnote{We make this assumption for three reasons. Firstly, it could be confiscated by the government to fund creditor bailouts, or to fund the cost of resolution in the case of no bailouts. Secondly, even if an executive’s penalty did accrue to creditors it is likely to be several orders of magnitude smaller than the outstanding debt of a firm and so be \emph{de minimis}. Finally the assumption simplifies the analysis by simplifying the payoffs to creditors in the bankruptcy state. However it is not an essential assumption as the intuitions do not hinge upon it.}

At $t = 1$, the firm raises debt $D$ and adds in sufficient equity to cover the costs of investment and staff pay. If the executive selects the safe project then the firm will have a $t = 1$ valuation of $X_{1}^{\text{safe}}$ as given by (10). This valuation is unchanged as the firm pays out the full bonus due to the executive at $t = 1$. As the project is safe, the executive will receive the deferred bonus at $t = 2$. We assume that the executive discounts his $t = 2$ pay by a factor of $\delta \leq 1$. The longer the time scale for projects to realise, the lower $\delta$ can be expected to be. By contrast, the firm discounts future payouts according to the prevailing financial interest rate. We normalise the associated firm discount factor to 1. Hence, if the executive chooses the safe project his pay will be:

$$f + b [ (1 - P) + \delta P ] X_{1}^{\text{safe}} \quad (41)$$

Suppose instead that the executive selects the risky project. The $t = 1$ value of the firm will again be altered by the value of the debt tax shield and the value of the implicit government debt guarantee. Since the escrowed payment in the case of bankruptcy is assumed not to accrue to the firms’ creditors, the interest payable on debt remains at $i(\mu)$ given in (21). As the deferred payment to the executive is accounted for by the firm at $t = 1$, the $t = 1$ valuation for the firm which is pursuing the risky project remains $X_{1}^{\text{risk}}(\tau, \mu)$ given by (22). If he selects the risky project, the executive will lose the portion of his pay in escrow with probability $1 - \chi$. The executive’s $t = 1$ expected pay is therefore

$$f + b X_{1}^{\text{risk}}(\tau, \mu) [ (1 - P) + \delta P \chi ] \quad (42)$$

**Proposition 7 (Pay Deferral)** Some deferral of bonus pay brings the executive’s project selection closer to the first best. However, too much deferral of pay will lead to excessively risk averse project choice if

$$V_{\text{tax shield}} + V_{\text{gov g'tee}} < [ Z - D ] \left( \frac{1 - \chi}{\chi} \right) \quad (43)$$

Where well defined, the optimal deferral proportion $P^*$ is given by

$$P^* = 1 / \left( \left[ \frac{Z - D}{V_{\text{tax shield}} + V_{\text{gov g'tee}}} \right] \delta (1 - \chi) + (1 - \delta \chi) \right) \quad (44)$$
This implies that the deferral proportion should increase if:

1. The probability of bailout $\mu$ is higher;
2. The bank's leverage $D$ is higher.

Proposition 7 demonstrates that forced deferral of bonuses can encourage the executive to make more efficient project selection decisions. However, excessive deferral can have negative effects and lead to excessive risk aversion. Section 6 demonstrated that the executive is over incentivised to take on risky projects as the costs of debt, which rise with the project’s riskiness, are subsidised via the debt tax shield and via any too-big-to-fail implicit guarantee. The executive can be encouraged to make more efficient decisions by stripping the value of these distortions, as much as possible, out of the executive’s own remuneration. Section 7.2 did this directly by reducing the value of equity used for remuneration calculations. Pay deferral works along similar lines. The deferred pay is conditional on the firm being able to repay its debt and not being bailed out. Thus, as the executive loses his deferred pay if the project were to fail, he internalises the risk associated with his project choice. The incentives of the executive are optimally realigned when the size of the deferral is exactly calibrated to offset the distortions arising from the value of the debt shield and too-big-to-fail subsidy, as in (44). As the size of the distortions due to the value of the debt tax shield or the value of the too-big-to-fail guarantee grow, the optimal deferral proportion also grows.

Note that the optimal deferral proportion depends upon the impatience of the executive, given by $\delta$. Under parameter values in which deferral can be excessive ((43) holds), more impatient executives, or ones overseeing projects with a very long life cycle, must have a larger proportion of their pay deferred to deliver optimal risk choices. As an executive’s impatience grows ($\delta$ falls), the value of all deferred pay will be discounted implying that the executive places little value on avoiding projects which might result in reduced pay a long time in the future. To counter this more remuneration must be pushed into the future to maintain the executive’s incentives. It follows therefore that the level of pay must also rise in the optimal contract to maintain the executive’s participation, as deferred pay is discounted.

Even if it is not possible to calculate the optimal deferral proportion, some deferral brings the executive’s decisions closer to the efficient project choice. This is because the value of pay is reduced most in states in which the subsidies to firm value are highest: when the risky project is chosen (high tax shield) and when it fails (implicit subsidy from too-big-to-fail). Thus, the executive is at the margin encouraged to discount the extra value provided by these distortions.
7.4 Bonus Caps As A Multiple Of Salary

The European Union is the first major jurisdiction to introducing a bonus cap on all material risk takers of banks and investment firms as part of financial regulation, with the stated aim of curbing excessive risk-taking incentives. Material risk takers can only receive variable pay up to a limit of 100% of their fixed salary. If preceded by an authorising vote at an AGM, this cap can be raised to 200% of the fixed pay. It has been noted that such bonus caps can have the unintended consequence of raising banks’ fixed costs and so reducing the banks’ robustness to bad investment realisations (Thanassoulis (2012)). Here we consider the implications of the bonus cap on executive project choice.

Suppose that if the executive has a fixed wage of \( f \), then the maximum dollar variable bonus the executive can receive is \( \kappa \cdot f \). For example, the EU bonus cap implies \( \kappa = 1 \), or 2 with shareholder approval. The firm can respond to such a cap by adjusting the fixed wage, \( f \), and the equity stake \( b \). We restrict attention to parameters such that both project choices are possible in the absence of the cap, allowing for the too big to fail and debt tax shield distortions.\(^{23}\) Studying the bonus cap formally we can show:

**Proposition 8 (Bonus Cap Damage)** A bonus cap cannot improve the project selection decision: either the cap does not alter the project selection decision from Proposition 3, part 3; or it results in the executive not exerting project selection effort and always selecting the risky project.

Proposition 8 implies that, contrary to its stated objective, the bonus cap has either no impact on project choice or potentially encourages more risky project choice. The intuition behind this result is as follows. The executive is paid after he selects a project but before the project results are realised. This timing captures that many investment projects take a long time to come to fruition, and in particular longer than the typical executive tenure. This is particularly the case for the financial sector (see the discussion towards the end of Section 3). The executive’s remuneration depends upon the firms’ equity value, which depends on the market’s assessment of the expected return on the project selected. Thus, if the executive encounters a risky project with a sufficiently good expected return, the firm’s equity price when investing in that project will be high enough such that the bonus cap becomes binding. In such a case, he has no incentive to exert costly effort to search for alternative projects that might yield higher returns for similar or lower risk, as he will not reap any reward from finding such a project given the binding bonus cap. Thus, if the cap is set at a sufficiently low level, then the executive will shirk and invest in an ill-researched and easily found project (which, in our model, is the risky project) which allows him to secure the maximum bonus allowed. This analysis therefore highlights a hitherto not noted danger of simple bonus caps: once a project is

\(^{23}\)Explicitly we restrict to parameters such that \( Z(\tau, \mu) < \bar{r} \). This can be guaranteed if \( Z+(1-\chi)D < \bar{r} \).
identified which creates enough upside to generate the maximum allowable bonus, there is no incentive to search for better, lower risk projects. Thus, a bonus cap could potentially diminish the incentive for risk management.

8 Evidence On The Value Of Tax Shields And The Implicit Too-big-to-fail Government Guarantee

This study has demonstrated that the debt tax shield and the *too-big-to-fail* government guarantee interact to distort the project choice of equity-remunerated executives towards excessive risk taking. We have proposed that these distortions can be tackled through pay deferral or by linking bonus to equity values that are rebased to correct for these distortions. The optimal deferral (Proposition 7) and the rebasing required (Proposition 5) are both functions of the value of the debt tax shield and the value of the *too-big-to-fail* government guarantee. In this section, we survey the literature on the value of the debt tax shield and the implicit *too-big-to-fail* subsidies to allow us to judge the likely magnitude of these distortions to project selection decisions.

Measuring the exact value of the debt tax shield has proved contentious. That debt offers firms a tax benefit has been evidenced by, for example, Masulis (1980) who finds that debt for equity swaps increase stock prices. However, estimating the tax benefits of debt is not entirely straightforward for at least two reasons. First, cash flows generated in the future through the tax shield will depend upon the presence of profits to save tax on, and these profits themselves may depend upon the tax shield. Second, and as noted earlier, the net present value of the tax shield also depends upon whether the debt is to be repaid, and how the leverage levels are to be adjusted through time. Graham (2000) reports that allowing for variable tax rates and for mandating a constant leverage ratio when profits allow, the value of the tax shield can be estimated as 9.7% of firm market value. This figure of approximately 10% of firm market value for the tax shield is corroborated by Kemsley and Nissim (2002). However, neither study is able to definitively determine the sensitivity of the value of the debt tax shield to interest rate changes due to data limitations. Graham (2000) conducts case studies of leading LBOs such as RJR Nabisco and Safeway. He shows that the ratio of the value of the tax shield to total debt jump up at the time of the LBO.\textsuperscript{24} Thus, these LBOs benefited from substantial tax benefits even controlling for the increase in the debt levels.

Using event studies some authors have begun the process of quantifying the impact of *too-big-to-fail* on bank value. In important early work O’Hara and Shaw (1990) conduct an event study on the day the Comptroller of the Currency in the US announced that eleven of the largest US banks were *too-big-to-fail*. O’Hara and Shaw show that this

\textsuperscript{24}Divide row 3 by row 4 in Table IV of Graham (2000).
announcement did indeed have a material effect on the banks’ values. The equity values of the too-big-to-fail banks increased by an estimated 1.3% of their overall total equity market value. This is less than a tenth of the value of the debt tax shield estimated by the works cited above which expressed results relative to total firm value rather than just the equity value. There exist a handful of studies which express the too-big-to-fail subsidy as an average reduction in the cost of borrowing. To give one a measure of what a significant too-big-to-fail reduction in borrowing costs would be as compared to the tax shield, at an example corporate tax rate of 30%, each percent of interest would be reduced by the tax shield by 0.3% or 30 basis points. Thus, if a firm was able to borrow at a 5% interest rate, the debt shield would be equivalent to a reduction in the cost of borrowing of 150 basis points. Acharya, Anginer and Warburton (2013) estimate that the too-big-to-fail advantage of US banks averaged only 24 basis points over the 20 years 1990-2010. Li, Qu, and Zhang (2011) place the too-big-to-fail subsidy at 23 basis points before the crisis, and 56 basis points after the crisis. IMF (2014) provides an overview of the methodologies for measuring the implicit subsidy for banks arising from implicit government guarantees, and finds that the funding cost advantage of systemically important banks peaked at around 250 bps at the beginning of 2009.

These figures taken together suggest, in normal times, that in a dollar sense the debt tax shield is the larger contributor to bank value, although the value of the implicit government guarantee tends to rise sharply in times of financial stress. However, it remains empirically unclear which effect is the most sensitive to changes in the interest rate payable and so which is liable to generate the most significant distortion in the executives’ project choice.

9 Conclusions

We have demonstrated that if debt markets are efficient, then executives incentivised by the return on equity favour excessively risky projects due to two types of government-induced distortions: the debt tax shield and the implicit too-big-to-fail government guarantee. These distortions have the effect of lowering the price equity holders pay for debt to fund riskier projects, and so encourage the equity-rewarded executive to select risky projects. Our analysis concerned debt being secured for a project which was subsequently repaid. Hence, the distortion in project choices we describe will apply in situations, such as M&A, in which debt is not intended to be permanent; or in situations, such as the run-up to the financial crisis, in which debt levels are not held at a constant dollar level.

We have evaluated various options for regulating executives’ pay, including: (i) payment in debt; (ii) rebasing the metric against which the executive is measured from RoE to equity value corrected for the value of the debt tax shield and the too-big-to-fail guarantee; (iii) deferred bonus with a clawback clause; and (iv) bonus caps. We show that payment
in debt does not correct for distortions in executives’ incentives. However, rebasing executive targets to be equity corrected for debt tax shields and for too-big-to-fail subsidies corrects for the distortions. Deferred bonus with payouts linked to future performance (known as malus) can also mitigate executive’s risk-taking incentives by linking part of his pay to the actual solvency risk. By contrast, bonus caps may reduce the incentives for executives to screen projects to identify low risk yet high value projects.

A Technical Proofs

Proof of Lemma 1. If the executive exerts effort then a comparison of the executive’s pay in the two cases yields that the executive will make the efficient project choice. At \( t = 0 \) the expected pay is therefore given by \( f + bS \) where \( S \) is the expected firm value under efficient project selection given in (2). If the executive shirks then she receives \( f + bZ + B \) if the risky project is selected, and \( f + bE(r) + B \) if the safe project is selected. Given (1) the risky project is preferred. The executive therefore exerts effort if \( f + bS \geq f + bZ + B \) which simplifies to yield (3).

Proof of Proposition 1. Suppose first that incentivising effort is optimal. In this case the objective function (5) is declining in \( f \) and \( b \). The optimal remuneration therefore lowers these variables until the participation constraint (4) is binding. Substituting back into the objective function, (5) is now independent of the bonus rate \( b \). The proposition seeks the contract with the lowest variable component, and this is achieved by reducing the bonus rate \( b \). This can be done to the point that the incentive compatibility constraint (3) is also binding which delivers (6). Substituting the resultant bonus \( b \) into the participation constraint (4) and reorganising, we obtain

\[
    f = u - bS = u - b(S - Z + Z) = u - B - bZ
\]

where the final equality follows from (3) and so delivers (7). Substituting (6) and (7) into (5) yields (8). Part 3 is given by Lemma 1. Finally we check that incentivising effort is optimal. If the contract does not incentivise effort then the risky project is chosen by the proof of Lemma 1. In this case the expected profit of the equity owners is \( Z - (f + bZ) - 1 \). To ensure the executive accepts the contract the fixed fee must satisfy \( f + bZ + B = u \). Hence the equity holders expected payoff is \( Z + B - u - 1 \). Comparing this to (8) we see that effort is desirable if \( B < S - Z \) as given in the proposition.

Proof of Proposition 2. The objective function \( E(\Pi_0) \) is declining in \( f \) and \( b \). The optimal remuneration therefore lowers these variables until the participation constraint (17) is binding. To keep to the lowest variable pay component we also require (18) to be binding. This yields part 1. For part 2 substituting the expressions for \( b \) and \( f \) into (19) yields the result. Part 3 is given by Lemma 2. Finally we check that incentivising effort
is optimal. If the contract does not incentivise effort then the executive’s payoffs follow from (11) and (14): by comparison the risky project would be chosen as \( Z > E(r) \) from (1). In this case the expected profit of the equity owners is \( Z(\tau) - (f + bX_{\text{risk}}^1(\tau)) - 1 \). To ensure the executive accepts the contract the fixed fee must satisfy \( f + bX_{\text{risk}}^1(\tau) + B = u \). Hence the expected equity holders payoff is \( Z(\tau) + B - u - 1 \). Comparing this to (20) delivers the result. ■

**Proof of Proposition 6.** The objective function (38) is declining in \( f \) and \( b \). The optimal remuneration therefore lowers these variables until the participation constraint (36) is binding. We must however maintain incentives for effort. If the executive at \( t = 0 \) without effort selects the risky project then he is paid according to (35). If however the executive without effort selects the safe project then his expected pay, derived from (34), is given by \( f + b(E(r) - D) \). Given (1) the risky project is preferred. The executive therefore exerts effort if his \( t = 0 \) expected pay makes it worthwhile

\[
f + b(S - D) \geq f + b(Z - D) + B
\]

which simplifies to yield \( b \geq \frac{B}{S - Z} \). This yields part 1. For part 2 substituting the expressions for \( b \) and \( f \) into (38) yields the result. To demonstrate that the equity value is reduced we note that, comparing (26) to (37):

\[
2(\bar{r} - 1) \left[ (S(\tau, \mu) + D) - (S_{\text{effic}}(\tau, \mu) + D) \right] = (Z(\tau, \mu) - Z)^2 > 0
\]

Which implies that \( S(\tau, \mu) > S_{\text{effic}}(\tau, \mu) \) delivering that the intervention has lowered the value of the firm to equity holders as required. Part 3 is given by Proposition 5. Finally we check that incentivising effort is optimal. If the contract does not incentivise effort then the risky project is chosen as noted above. In this case the expected profit of the equity owners is \( X_{\text{risk}}(\tau, \mu) - (f + b(Z - D)) - 1 + D \). To ensure the executive accepts the contract the fixed fee must satisfy \( f + b(Z - D) + B = u \). Hence the expected equity holders payoff is \( X_{\text{risk}}(\tau, \mu) + D + B - u - 1 \). Comparing this to (40) using (37) we have that effort is worthwhile if:

\[
B < S_{\text{effic}}(\tau) - X_{\text{risk}}
\]

\[
= \frac{Z - 1}{\bar{r} - 1} X_{\text{risk}}^1(\tau, \mu) + \int_{r=Z}^{\bar{r}} X_{\text{safe}}^1 - X_{\text{risk}}^1(\tau, \mu)
\]

\[
= \int_{r=Z}^{\bar{r}} \left[ X_{\text{safe}}^1 - X_{\text{risk}}^1(\tau, \mu) \right] \frac{1}{\bar{r} - 1} dr = \int_{r=Z}^{\bar{r}} [r - Z(\tau, \mu)] \frac{1}{\bar{r} - 1} dr
\]

Now note that, using (25) the condition becomes

\[
B < \frac{1}{\bar{r} - 1} \int_{r=Z}^{\bar{r}} \left[ r - Z - D(1 - \chi) \frac{\mu + \tau \chi (1 - \mu)}{\chi (1 - \chi) \mu} \right] dr
\]
which yields the result. ■

**Proof of Proposition 7.** Given the deferred proportion \( P \) of the bonus, the executive will choose the risky project over the safe project if and only if (42) is greater than (41). Thus the executive will select the safe project if

\[
[r - D] \left[ (1 - P) + \delta P \right] > [Z + V^{\text{tax shield}} + V^{\text{gov g'tee}} - D] \left[ (1 - P) + \delta P \chi \right]
\]

The first best would have the executive selecting the risky project if \( r > Z \).

Increasing \( P \) from zero makes the right hand bracket shrink, so yielding that some deferral improves project selection as required. Substituting \( P = 1 \) into (46), yields that the executive selects the safe project even if it is npv negative \((r < Z)\) if condition (43) holds. The optimal deferral quantity is found by substituting \( r = Z \) in condition (46) and setting to equality. This yields (44). Using (21), (32) and (33) we can write this out as:

\[
P^* = \frac{1}{\left[ \frac{Z - D}{\tau \chi \left( \frac{1}{\chi + (1-\chi)\mu} - 1 \right) D + (1 - \chi) \mu \frac{1}{\chi + (1-\chi)\mu} D} \right] \delta \left( 1 - \chi \right) + (1 - \delta \chi)}
\]

Differentiation then yields that \( \partial P^*/\partial \mu > 0 \) for part 1. Similarly \( \partial P^*/\partial D > 0 \). ■

**Proof of Proposition 8.** Suppose that the pay cap is binding and so the bank re-optimises pay and sets \( \{f^o, b^o\} \). First we show that there must exist \( r^o < \bar{r} \) such that

\[
\kappa f^o = b^o (r^o - D)
\]

Suppose for a contradiction that \( \kappa f^o \geq b^o (\bar{r} - D) \). Following the analysis of Section 6 let us calculate the executive’s remuneration. If the executive chooses the safe project and the cap did not bind then he would receive variable pay of \( b^o (r - D) \). The cap is not binding as \( r \leq \bar{r} \). If the executive selected the risky project then he would receive variable pay of \( b^o (Z (\tau, \mu) - D) < b^o (\bar{r} - D) \) where the inequality follows as we consider a setting where the safe project might be selected absent the cap. Hence the cap is again not binding. But we therefore have a contradiction as we are concerned with a binding cap.

Therefore given the optimised pay parameters \( \{f^o, b^o\} \) (47) holds. Suppose first that \( r^o > Z (\tau, \mu) \). If the executive selects the safe project then the equity stake required is \( E = 1 + [f^o + \min \left( b^o X_1^{\text{safe}}, \kappa f^o \right)] - D \). The executive’s payment will therefore be

\[
\begin{cases} 
    f^o + b^o (r - D) & \text{if } r \leq r^o \\
    f^o + \kappa f^o & \text{if } r > r^o 
\end{cases}
\]

If instead the executive selects the risky project then his remuneration is uncapped and
given by \( f^o + b^o (Z (\tau, \mu) - D) \). Comparing this to (48) the risky project is selected if \( r < Z (\tau, \mu) \) as in Proposition 3, part 3, as required.

Suppose instead that \( r^o \leq Z (\tau, \mu) \). If the safe project is selected then remuneration will be given by (48). If instead the executive selects the risky project then his remuneration is now capped and given by \( f^o + \kappa f^o \). The risky project weakly dominates the safe project for all realisations of the safe project’s return. Hence the executive will always select the risky project, and would not exert project selection effort in this case, yielding the result. ■

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