Taxation and Regulation of Bonus Pay*

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Abstract

We explore the consequence for taxation and regulation of bonus pay when investors are protected by taxpayers from downside risk. The paper develops a model where workers in financial sector firms make decisions about effort and risk-taking which are influenced by the structure of bonus pay. Bailouts lead to too little effort, too much risk-taking and increase inequality. We show that the optimal structure of bonuses can be implemented by a combination of a regulation on the structure of bonuses and a tax on their level.

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"..a market economy and its disciplines offer the best way of raising living standards. But a market economy cannot survive on incentives alone. It must align those incentives to the common good. It must command support among the vast majority who do not receive the large rewards that accrue to the successful and the lucky. And it must show a sense of fairness if its efficiency is to yield fruit." Mervyn King, Governor of the Bank of England, Speech to Trades Union Congress, September 15th 2010.

1 Introduction

While it seems likely that the worst of the financial crisis of 2008 has passed, most of the structural issues that lay behind it remain unresolved. This paper focuses on one of these – the distortions in incentive pay due to government protection of investors from downside risk. One of the main legacies of the traumatic events of 2008 was a stark reminder that many risky investments are not subject to normal downside market discipline – when they fail, they receive publicly funded bailouts. This distorts the supply price of risk capital and the behavior of financial intermediaries.

In this paper, we focus on a key aspect of the distortion – the effect on the structure and level of incentive pay. We develop a model of bonus pay in a market equilibrium setting with two aspects of decision making by financial sector workers – risk-taking and effort. We use this to focus on two questions: (i) what is the incidence (in theory) of the substantial government subsidy that accrues to the financial sector and how does this affect compensation? (ii) what distortions do public subsidies induce in decision making *ex ante*? On the first of these, we argue that subsidies could be shifted to mobile financial sector works and on the second, we argue that there will be a tendency towards too much risk taking and too little productive effort. In short, bailouts reduce both efficiency and equity.

We develop a framework which incorporates the classic public economics approach where the policy maker's objective reflects a concern for both efficiency and equity when considering the value of a public intervention (see, for example, Atkinson and Stiglitz (1980)). In the same tradition, there is also a question about the ultimate incidence of a tax or subsidy. It is well-known that where a tax or subsidy is remitted/received may be a poor guide to where it falls which depends on the underlying competitive structure and scarcity of factors. In our core case, we assume that talent in the financial sector is the main scarce input and hence all taxes and subsidies are shifted to workers. But since it is their incentives that matter for the conduct of the financial sector, this has implications for economic efficiency.

In this paper, we home in on the consequences of bailouts to investors in risky assets on the structure of bonus pay. As a benchmark, we derive the socially optimal structure of incentives. This factors in the impact on risk taking and effort which determine the efficiency of financial intermediation. But policy makers may also care about the rewards that accrue to financial sector workers. We show that limited liability results in such workers optimally earning a rent but the size of that rent will depend on society's preferences about income distribution and policy makers may prefer to have a less efficient financial system in order to reduce inequality. However, there are limits to this as workers may be paid an "efficiency" utility.

We also derive the unregulated market equilibrium assuming that talented financial sector workers are scarce. This leads to all subsidies being shifted to such workers which reduces both equity and efficiency. We show how remuneration packages will be designed to induce excessive risk taking.

Finally, we study optimal policy and show that the socially optimal outcome can be implemented using a combination of a regulation on the structure of bonuses and a tax on their level. This division of labor between policies has the plausible feature that, in principle, regulators can make a purely technocratic judgement while tax designers focus on social preferences about equity and the efficiency of the financial sector. The latter is inevitably a social judgement which must be made by elected politicians.

One important feature of the analysis that we highlight throughout is a clear understanding of the distinction between two issues: the *structure* and *level* of bonus pay. The rise in the pay of bankers relative to others and the role of bonuses in this is well documented. For example, Bell and Van Reenen (2010) note that over the decade from 1998, the top 10% of workers by income in the UK economy had an increase in their wage share from 27% to 30%. The majority of this went to the top 1% and financial sector workers accounted for 75% of these gains. In 2008 this accounted for £12 billion and almost all of it resulted from bonus pay, rather than an increase in base salary. Also, these bonuses were mostly paid in cash on the basis of short-term returns unadjusted for risk and it is widely agreed that this increased incentives for risk-taking. In the analysis below, we show how the structure of bonus pay distorts risk-taking while the level of bonus pay affects inequality and the overall efficiency of the financial intermediation sector.

Protection of investors' downside risks using public money appears to be a ubiquitous feature of modern financial systems. As we discuss below, this could be due to some form of altruism where the government prefers to insulate individuals from the risks they face. However, it could also be due to successful lobbying on the part of investors. Either way, this prevents the government from committing not to bailout investors in future. Recognizing this puts us squarely in a second-best world akin to a Samaritan's dilemma (see Buchanan (1975)). And this distortion needs to be recognized when considering taxation and regulation of the financial sector.

While the massive bank bailouts in 2008 were headline grabbing, it is important to realize that modern states routinely protect investors from downside investment risk. Standard depositor protection in the retail banking sector is common place. However, the protective covenant of the state runs much deeper than this with a range of implicit or explicit guarantees on a variety of investment funds, such as private pensions or money market funds. More generally, it operates in other sectors of the economy as well, such as the bailout of the automobile industry, and can be seen to arise whenever there is a soft budget constraint. Since the current financial crisis began in earnest, there have been a range of explicit bailouts of the financial sector with banks and insurance companies receiving public injections of capital in a number of countries including the U.S., U.K., Ireland and Switzerland. All of these interventions subsidize the supply price of capital to the financial sector. Most private pension plans, which constitute a huge fraction of privately held assets at risk in a number of countries are implicitly or explicitly underpinned by some form of state guarantee. The U.S. government had little hesitation in seeking to guarantee investments in money market funds in the heat of the crisis. The potential costs of such interventions could have added up to many trillions of dollars. Thus, it is hard to quantify the impact of these many implicit guarantees. However, Haldane (2010) suggests that the cost of bailouts in the UK is around £20bn or around 1% of GDP and for the U.S., the figure is around $100bn which is also around 1% of GDP. While he acknowledges that these figures are imprecise, it is clear that the sums involved are significant. And this is without even recognizing that systems of social insurance and government transfer programs insulate citizens from the true consequences of their risky investment decisions.

The distributional goal at the heart of such policies may well make sense given that the losers are often not wealthy. For example, in the case of pensions, some kind of public guarantee is typically needed to encourage people to take on the risk of private pensions. There is nothing wrong *per se* with the social judgement that nobody should be left destitute in old age if they have saved for their retirement. But it has to be recognized that this has implications for how the financial system works and manages risk. The government may pursue a variety of means to minimize the likelihood that investors have to draw on public guarantees and some of the recent discussion about structural reform in the financial sector speak to this issue.[1] We believe that the issue is broader than "too big to fail". If the objective is to protect citizens who invest in risky assets, then even small financial institutions will have their incentives affected by public guarantees.

The remainder of the paper is organized as follows. In the next section, we discuss some related literature. In section three, we lay out the model. Section four derives socially optimal incentives. Section five characterizes the market equilibrium. Section six shows that the optimum can be implemented via a combination of a regulation on the structure of bonuses and a tax on their level. Section seven discusses some extensions of the model with concluding comments in section eight.

2 Related Literature

There is now a growing literature on arguments for regulating incentive pay in light of distortions in the financial sector. At the heart of all such arguments typically lies a failure of the market to price risk correctly with the two main culprits being the existence of bailouts (or any public policies which mitigate downside risks for investors) and/or behavioral issues in the management of risk. These issues are explored in general by Bebchuk and Spamann (2010).

Bolton, et al (2010) observe that bailouts in the form of deposit insurance (or naive debt holders) lead to excessive risk-taking. They observe that basing compensation on the price of debt (CDS spreads) can improve incentives. Radulescu (2010) looks at taxation of bonuses and Hakenes and Schabel (2010) argues that there should be ceiling on bonuses in the presence of bailouts. Thanassoulis (2011a, b) considers arguments in favour of regulating bonus pay when there are negative externalities from risk-taking decisions across banks. Garicano and Lastra (2010) argue that making bankruptcy credible, adjusting risk-premia in capital allocation, and claw-back of bonuses in the event of failure are likely to be more useful than taxes. Farhi

[1] See, for example, The Squam Lake Report (2010).

and Tirole (2011) show that bailouts to distressed institutions makes private leverage choices strategic complements, which leave little choice to authorities but to intervene.

Our paper is related to a large literature in incentive theory that explores the design of optimal contracts when the choice of riskiness by agents is unobservable, for example, Hirshleifer and Thakor (1992) and Biais and Casamatta (1999).[2] Ghatak and Pandey (2000) in the context of agricultural tenancy and Palomino and Prat (2003) in the context of finance analyze moral hazard in both effort and risk-taking, as we do in this paper. However, this literature does not explore the consequences of distortions other than those which create standard incentive problems. Myerson (2010) develops a model where the dynamic interplay between incentive pay of financial intermediaries of different generations can create equilibrium credit cycles, with repeated booms and recessions. Also related is the literature on bank regulation, including deposit insurance. It discusses the relationship between managerial incentive schemes, deposit insurance and bank regulation.[3]

Finally, the paper is related to the policy literature on the Samaritan's dilemma initiated in Buchanan (1975). This refers to situations where the government is unable to commit not to make a transfer to some group ex post which affects their ex ante risk taking incentives. The question is then how government policy anticipates this lack of commitment power. Coate (1995), for example, shows that such considerations can underpin the theoretical case for compulsory insurance.

3 The Model

We employ a very simple equilibrium model of financial intermediation to make the main points of interest. Intermediaries compete to employ workers who chose investment projects and raise funds for these projects from

[2]See Tirole (2006, Chapter 7) for a discussion of this literature.

[3]See, for example, John et al, (2000) for a theoretical analysis, Gorton, (1994) and Bhattacharya, Boot, and Thakor, (1998) for reviews of the literature, and Levine, (2004) for a review of evidence from various cross country studies.

investors in competitive capital markets.

There are three groups of citizens with, for simplicity, membership of each group being mutually exclusive. There are $M > 1$ consumers each of whom has an endowment 1 unit of capital. The economy comprises N financial intermediaries and n potential financial sector workers. Each financial intermediary can hire at most one financial sector worker. Each agent can manage one unit of capital. We assume that $M > N > n$ so that capital is not scarce but skilled agents are. This assumption will imply that any rents to financial intermediation accrue to financial sector workers. Neither intermediaries nor financial workers have any wealth that can be posted as a performance bond and their payoffs are subject to a limited liability constraint. We will return to this issue below.

Consumers are risk neutral and have access to a safe asset which yields a gross return of $\rho > 1$. This implies that there is a perfectly elastic supply of M units of capital as long as intermediaries pay an expected return of ρ.

Financial intermediaries invest in risky projects. There are three states of the world $s \in \{L, M, H\}$ with corresponding returns:

$$\Pi_H > \Pi_M > \rho > \Pi_L = 0.$$

The likelihood of the realization of these returns is affected by the actions of financial sector workers. These can be thought of concretely as decisions about which projects to invest in. There are two dimensions of choice: productive effort $e \in [\underline{e}, 1]$ and risk-taking effort $r \in [0, \overline{r}]$ where $\underline{e} > 0$ and $\overline{r} < 1$.

Effort increases investment returns in the sense of first order stochastic dominance while the choice of r transfers probability mass away from the middle return towards the high and low returns. We propose a technology which is additively separable between risk-taking and effort. Let $p_s(e, r)$ denote the probability that the return is s. Then, the probability distribution over investment returns is as follows:

$$\begin{aligned} p_H(e,r) &= \alpha e + \beta r \\ p_M(e,r) &= (1-\alpha)e - r \\ p_L(e,r) &= (1-e) + (1-\beta)r \end{aligned} \tag{1}$$

where $\alpha \in (0,1)$, and $\beta \in (0,1)$. We assume $\alpha + \beta < 1$ which is sufficient to ensure that $p_H(e,r) < 1$ for all $e \in [\underline{e}, 1]$ and $r \in [0, \overline{r}]$. We also assume that $(1-\alpha)\underline{e} - \overline{r} > 0$ which implies that $1 > (1-\underline{e}) + (1-\beta)\overline{r}$. Thus, for any choice of e and r, all three states occur with positive probability.

The cost to the intermediary of choosing (e,r) is assumed to be quadratic and additively separable: $C(e,r) = \frac{1}{2}e^2 + \frac{1}{2}r^2$. We will refer to the individual cost function for each action to be $c(x) \equiv \frac{1}{2}x^2$ (where $x = e, r$). This implies that the agent has to seek out risk-taking opportunities at a cost to himself and without any incentives, will not take any risks.[4]

To attract capital a financial intermediary pays a contractual return of R when its it makes a positive profit. We assume that investors cannot distinguish between the states H and M, while the financial intermediaries can. Since no cash returns are generated when the state is L, there is no option to offer a return in this case. However, the government can choose to bail the investor out and return $\pi \leq \rho$ in this case. In section 7.1, we discuss some possible micro-foundations for this. Given that all parties are risk neutral in the model, we could interpret π as the *expected* value of any bailout, i.e. the probability of receiving a bailout times the amount received.

Given the bailout, the investor receives R with probability $1 - p_L(e,r)$ and π with probability $p_L(e,r)$. Since investment funds are plentiful, the intermediary has to offer an expected return of ρ to the investor so that R solves:

$$[1 - p_L(e,r)]\, R + p_L(e,r)\pi = \rho. \tag{2}$$

[4]We focus the analysis on the case where a safe option is costless. It would be straightforward to extend the model to introduce a "normal" or "benchmark" level of risk taking $\hat{r} > 0$ and to suppose that it is costly to deviate from that level. In this case the cost of effort would be $\frac{1}{2}(r - \hat{r})^2$.

In general $R \geq \rho$ with a bigger bailout (π) implying a lower value of R.

We focus on the simplest form of public finance with bailouts being financed by lump-sum taxes levied on consumers. We will suppose that there is a resource cost involved in organizing these bailouts denoted by γ; making a transfer of a dollar to an investor who loses her money therefore costs $(1+\gamma)$ to the taxpayers. In this case, the per capita tax needed to finance expected losses is:

$$T = (1+\gamma)\left[1 - e + (1-\beta)\, r\right] \pi.$$

For future reference, it is convenient to define:

$$A\left(x\right) = \alpha \Pi_H + (1-\alpha)\Pi_M - x$$

and

$$B\left(x\right) = \beta \Pi_H + (1-\beta)x - \Pi_M.$$

These expressions are the private marginal return to a financial intermediary from a marginal increase in, respectively, effort, and risk in the presence of a bailout of size x. Without a bailout $(x = 0)$ these are also the social marginal return from a marginal increase in effort and risk. Observe that the bailout makes the private marginal return from effort lower and that from risk higher compared to the social marginal returns.[5]

For convenience, we make the following four-part assumption governing restrictions on the parameter ranges that we study:

Assumption:

(i) $\frac{A(\pi)^2+B(\pi)^2}{4} + \pi > \rho$ for all $\pi \leq \rho$.

(ii) $\Pi_M \geq \frac{\rho}{\underline{e}-(1-\beta)\bar{r}}$.

(iii) $B\left(0\right) = 0$.

(iv) $1 > A\left(0\right)$ and $\bar{r} > B\left(\rho\right)$

[5]Since $\pi \leq \rho < \Pi_M$, $A(\pi)$ and $B(\pi)$ are strictly positive.

The first of these gives a sufficient condition for investment in risky projects to be profitable *ex ante* even in the presence of a bailout and to ensure that trade takes place in all the cases that we study.[6] The second assumption ensures that, even without a bailout, the intermediary can credibly promise a sufficient return to the investor to compensate him for risk for any choice of e and r. The third says that greater risk-taking, in the absence of a bailout, generates a purely mean-preserving spread in returns. It also implies the following parameter restriction: $\beta\Pi_H = \Pi_M$. The fourth guarantees that solutions are interior for $\pi \in [0, \rho]$.

The workers in the firm receive a state-contingent wage (w_H, w_M, w_L) with the relationship between these wages determining the extent to which incentives are high powered. The fact that the intermediary has no cash when the state is L implies that $w_L = 0$. The payoff of the financial intermediary is therefore:

$$W = p_H(e, r)(\Pi_H - w_H - R) + p_M(e, r)(\Pi_M - w_M - R)$$

Using (2) and (1), this can be written conveniently as:

$$W(\pi) = e[A(\pi) - \alpha w_H - (1 - \alpha) w_M] + r[B(\pi) - \beta w_H + w_M] + \pi - \rho. \quad (3)$$

This is increasing in the size of the expected bailout, π, for fixed values of (e, r, w_H, w_M).

Even though the investors are bailed out, the bailout is fully shifted to the financial intermediary via a change in the supply price of capital. Investors continue to earn, in expected terms, the same they would earn without a bailout, namely ρ. This is a standard public finance argument about the incidence of a subsidy in such circumstances. And it would not matter, as a consequence, who the bailout cheque is paid to – to the investors directly or via intermediaries. In a competitive market for funds, our assumption that there is a limited number of intermediaries means that there no direct

[6] If e and r are contractible, then the maximized value of $W(\pi)$ is $\frac{A(\pi)^2 + B(\pi)^2}{2} + \pi - \rho$. Part (i) of the Assumption is stronger than the requirement that $W(\pi) > 0$ in this case. It is a sufficient condition for the expected *second-best* surplus to be always positive, i.e., when e and r are non-contractible.

ex ante benefit to investors from a bailout if it is anticipated at the time of making the investment. Having a bailout makes it cheaper for intermediaries to raise capital. However, there is still an issue – as we shall see below – about how the gains from the bailout are shared by residual claimants to profits of financial intermediaries and financial sector workers.

The *ex ante* utility of a financial sector worker is:

$$u(\pi) = e[\alpha w_H + (1-\alpha) w_M] + r[\beta w_H - w_M] - \frac{1}{2}e^2 - \frac{1}{2}r^2. \quad (4)$$

Dependence of the worker's utility on π here is indirect, working through changes in either wages, effort or risk-taking. We will assume that they have to receive a utility no less than an outside option denoted by $\underline{u}$.[7]

We now use this model to study two main cases: (i) the socially optimal bonus structure and (ii) the market equilibrium where intermediaries set pay structures and compete for workers.

4 Socially Optimal Bonus Pay

It is best to think of the social optimum as a situation where the financial sector is being run in the public interest and being controlled by the government. This will internalize in the objective any bailout costs which the government will give after investment returns are realized. But we are assuming that a commitment not to pay the bailout is infeasible. However, this is anticipated ex ante when determining incentives.

To study the optimal structure of pay, we use an ex ante measure of welfare where the weight on the welfare of the consumers is one and the weight on the welfare of workers in the financial sector is λ which could deviate from one to reflect the government's distributional preference.[8] We will assume

[7] To ensure that the outside option is not binding in any of the cases that we study, we assume that this does not exceed $\frac{A(\pi)^2+B(\pi)^2}{2} + \pi - \rho$.

[8] This is the simplest way to capture a distributional preference. For example, it is the way that distributional preferences between profits and consumer surplus are captured in the optimal regulation literature – see, for example, Baron and Myerson (1982). In general, we might posit a social welfare function based on individual utilities, applying a concave transformation to utility to represent a concern for equality. In the limit, this could be a Rawlsian maximin preference which could crudely be captured by $\lambda = 0$ in our weighting scheme.

that consumers are given shares in any surplus created in the financial sector and hence become residual claimants. This could also be implemented via a tax on pure profits in the financial sector which is distributed back to citizens. Thus per capita welfare is:

$$S(\pi) = W(\pi) + \lambda u(\pi) + [\rho - (1+\gamma)\pi\{1 - e + (1-\beta) r\}].$$

This is an intuitive expression: it sums up the expected payoffs of financial intermediaries, financial sector workers (who as a group get a welfare weight of λ), and investors (who are the same as the group of taxpayers). The bailouts are, in effect, redistribution between groups of taxpayers depending on whether they invest in a successful intermediary.

Substituting the values of $W(\pi)$ and $u(\pi)$ from (3) and (4) we obtain:

$$\begin{aligned} S(\pi) &= [e\{A(\pi) - \alpha w_H - (1-\alpha) w_M\} + r\{B(\pi) - \beta w_H + w_M\} + \pi] \\ &- (1+\gamma)\pi[1 - e + (1-\beta) r] \\ &+ \lambda\left[e\{\alpha w_H + (1-\alpha) w_M\} + r\{\beta w_H - w_M\} - \frac{1}{2}e^2 - \frac{1}{2}r^2\right] \end{aligned} \tag{5}$$

4.1 Benchmark: Contractible e and r

To fix ideas, let us briefly study the case where e and r are observable and verifiable. Then, the government could choose them directly to maximize (5) subject to the financial sector workers getting a payoff of $u \geq \underline{u}$. Observing that $A(\pi) + (1+\gamma)\pi = A(-\gamma\pi)$ and $B(\pi) - (1+\gamma)(1-\beta)\pi = B(-\gamma\pi)$, we can write (5) as:

$$S(\pi) = \left[eA(-\gamma\pi) + rB(-\gamma\pi) - (1-\lambda) u - \gamma\pi - \frac{1}{2}e^2 - \frac{1}{2}r^2\right].$$

The expression is intuitive. From society's point of view, the net cost of the bailout is $-\gamma\pi$. In the low profit state the payment of π is just a transfer and the real cost is just the resources used in bringing this about. Observe that $A(-\gamma\pi) > 0$ and $B(-\gamma\pi) < 0$ (because, by Assumption (iii), $B(0) = 0$). If $\lambda = 1$ then all that matters is the total expected social payoff less the disutility cost of the financial sector worker. However, if $\lambda < 1$ then social welfare is lower, the higher is the utility of financial sector workers.

Maximizing this with respect to e and r yields: $e = A(-\gamma\pi)$ and $r = 0$. Effort is now higher than in the absence of a bailout; this is because the planner wishes to minimize the expected social cost. Since we have assumed that r induces a mean-preserving spread in returns and is costly, risk-taking should be set to zero. In fact, $B(-\gamma\pi) < 0$ because risk-taking induces additional bailout costs.

The fact that $\lambda \leq 1$, implies that $u = \underline{u}$ so the workers get their reservation payoff. However, this distributional judgment has no bearing on efficiency in the case of full contractibility – there is complete separation between the pay of financial sector workers and the efficient operation of the financial sector. In addition, issues surrounding the optimal bonus structure for financial sector workers do not arise when e and r can be contracted over directly.

4.2 Moral Hazard in e and r

It is not very plausible to suppose that the behavior of financial sector workers can be monitored costlessly and perfectly. So we now suppose that e and r are private information and that financial contracts therefore have to be incentive-compatible. The incentive constraint (IC) for financial sector workers is obtained from:

$$\max_{\{e,r\}} (\alpha e + \beta r) w_H + \{(1-\alpha)e - r\} w_M - \frac{1}{2}e^2 - \frac{1}{2}r^2$$

which yields:

$$\begin{aligned} e &= \alpha w_H + (1-\alpha) w_M \\ r &= \beta w_H - w_M \end{aligned} \tag{6}$$

where we have assumed an interior solution. The two bonus levels can be manipulated to implement a level of effort and risk-taking. By solving (6) we obtain:

$$\begin{aligned} w_H &= \frac{e + (1-\alpha) r}{\alpha + \beta(1-\alpha)} \\ w_M &= \frac{\beta e - \alpha r}{\alpha + \beta(1-\alpha)}. \end{aligned} \tag{7}$$

An optimal second best financial contract is a pair $\{w_H, w_M\}$ that maximizes the principal's payoff subject to limited liability, incentive-compatibility and the agent's participation constraint. We find the solution in two stages: corresponding loosely to caring about efficiency and distribution.

Let us define

$$\hat{S}(-\gamma\pi, \bar{u}) \equiv \max_{\{e,r\}} \{e[A(-\gamma\pi) - e] + r[B(-\gamma\pi) - r] - \gamma\pi\}$$

subject to:

$$\frac{1}{2}e^2 + \frac{1}{2}r^2 \geq u.$$

Notice that $e[A(-\gamma\pi) - e]$ is simply $e[A(-\gamma\pi) - \alpha w_H - (1-\alpha) w_M]$ and $r[B(-\gamma\pi) - r]$ is equal to $r[B(-\gamma\pi) - \beta w_H + w_M]$ using the incentive constraints (6). This is therefore the maximized value of the expected social surplus (which takes into account the net cost of bailouts, $\gamma\pi$) subject to the participation constraint of financial sector workers, namely, they must have an expected utility of at least u. The solution to this problem would give us the efficient combination of effort and risk-taking for fixed u.

The distributional decision for the social planner then solves for the utility of financial sector workers, u, given the welfare weight λ which is given by:

$$\hat{u} = \arg\max_{u \geq \underline{u}} \left\{\hat{S}(-\gamma\pi, u) + \lambda u\right\}.$$

The solution to this two-stage problem is straightforward.[9] Used in conjunction with (7) it yields:

Proposition 1 *In the socially optimal second-best financial contract incentives are high powered to provide effort incentives, but is set to avoid risk-taking. Specifically:*

$$w_H(\pi) = \frac{1}{2-\lambda}\frac{A(-\gamma\pi)}{\alpha + \beta(1-\alpha)}$$

$$w_M(\pi) = \frac{1}{2-\lambda}\frac{\beta A(-\gamma\pi)}{\alpha + \beta(1-\alpha)}$$

with effort and risk-taking choices being: $e = \frac{A(-\gamma\pi)}{2-\lambda}$ *and* $r = 0$.

[9] The proof of this and subsequent results are in the appendix.

There are three main features of this solution worth noting.

First, incentives are set to avoid risk-taking. This is achieved by setting $\beta w_H(\pi) = w_M(\pi)$. The bonus pay does not depend on the marginal return from risk-taking, $B(-\gamma\pi)$ which is negative and depends only on the marginal return from effort, $A(-\gamma\pi)$. This is the key observation about the structure of bonus pay – the *ratio* of pay in state H and state M is set so as to make risk-taking unattractive. This limits the extent to which state H is rewarded, all else equal.

Second, incentives are high powered with $w_H(\pi) > w_M(\pi) > w_L(\pi)$. The optimal ratio of pay between state M and H is however not affected by the size of the bailout. This is because of the need to avoid risk-taking. However, the *level* of incentive pay is higher, the larger the expected bailout. This may seem surprising. However, since the policy maker is able to control any socially adverse risk-taking incentives, she can concentrate on setting the incentive to minimize the social cost associated with funding a bailout, i.e., to reduce the probability of state L. This underscores the problem in a lot of popular discussion about bonus pay and incentives: a certain degree of incentive pay is indeed socially productive.

Third, the result says something about the level of incentive pay and the fact that it depends on society's distributional preferences. However, since there is moral hazard and limited liability, there is an equity/efficiency trade-off and society has to pick a point on the second-best utility frontier. The level of incentive pay is increasing in λ, i.e. the greater the social value attached to rewards in the financial sector. Note that incentive pay is lowest when $\lambda = 0$ when the planner attaches no weight to the utility of financial sector workers. However, the latter continue to earn a rent (namely, the participation constraint does not bind and so they earn the utility equivalent of efficiency wages) on account of the need to motivate them. This would remain true even if financial sector workers were not intrinsically scarce and stems from the fact that unobserved effort is required from these workers. Thus, financial sector workers are optimally treated as a kind of aristocracy on account of the need to provide incentives when liability is limited. Such inequality is "tolerated" on the basis of the efficiency gains in the management of the sector.

Just how high the rewards to being a financial sector worker are cannot be determined *a priori* and depends on the structure of financial returns and the potential for effort to increase these rewards. Financial sector rewards will be higher still if $\lambda > 0$. If society is indifferent to distribution, caring only about social surplus regardless of distribution, i.e., $\lambda = 1$, then the reward structure increases effort further and generates more inequality.

In the way that we have framed this, the social planner could be a regulator who monitors the returns to investment projects and determines permissible pay structures as a function of these observables. At a practical level, implementing the socially optimal solution would require full disclosure of incentive pay by firms and a good knowledge of the underlying technology for producing those returns. More problematically, a regulator would have to make distributional judgements according to our model and represented by the parameter λ as there is no way of getting away from a fundamental equity-efficiency trade-off. This means that the choice of policy is not purely a matter of technocratic regulation but also has a distributional aspect. We will return to this point in section 5 below, when we discuss the kinds of policy instruments that are needed to implement the optimal outcome.

5 The Market Outcome

In a market, financial intermediaries compete by offering wage contracts to workers. These contracts respect the fact that effort and risk-taking are not directly contractible. However, intermediaries will ignore the effect of their behavior on expected bailout costs, thereby creating a divergence between the socially optimal bonus structure and the market determined outcome.

While we study a static model, we imagine a frictionless assignment problem where firms post wage contracts and then workers select firms (in this case intermediaries) on the basis of the utility that they obtain. Thus, the market is “cleared” by an adjustment in the utility level received by workers.

As above, the incentive constraints yield (6). Using this in (3), we can think of the principal in a financial firm picking effort and risk-taking directly. Their payoff is:

$$\hat{S}(\pi, u) - \rho = \max_{\{e,r\}} e\left[A(\pi) - e\right] + r\left[B(\pi) - r\right] + \pi - \rho$$

subject to:

$$\frac{1}{2}e^2 + \frac{1}{2}r^2 \geq u.$$

This is very similar to what we had in the case of the social planner with two differences: first, the principal in a financial firm does not take into account the net cost of bailouts, and takes π as a positive net transfer, and second, it views the cost of capital as a net cost ρ unlike the social planner who includes the payoff of the investors in his objective function.

As long as there are values of $w_H \in [0, \Pi_H]$ and $w_M \in [0, \Pi_M]$ which "implement" the preferred level of e and r, this will be a second-best optimal financial contract. The level of u then adjusts to clear the market for workers. Since we have assumed that financial sector workers are scarce then all of the surplus will go to them, i.e. $\hat{S}(\pi, u^*(\pi)) = 0$ where $u^*(\pi)$ is the market determined utility level of a financial sector worker when the bailout is π.

Before deriving the market determined solution, define

$$\phi(\pi) = \frac{1}{2}\left[1 + \sqrt{1 + \frac{4(\pi - \rho)}{A(\pi)^2 + B(\pi)^2}}\right].$$

This function is is well-defined, given Assumption (i), and satisfies $0 < \phi(\pi) \leq 1$ for $\pi \leq \rho$.

We now have:

Proposition 2 *In a market equilibrium, incentives are high powered and set to encourage risk-taking. Specifically,*

$$\begin{aligned} w_H(\pi) &= \frac{A(\pi) + B(\pi)(1-\alpha)}{\alpha + \beta(1-\alpha)}\phi(\pi) \\ w_M(\pi) &= \frac{\beta A(\pi) - \alpha B(\pi)}{\alpha + \beta(1-\alpha)}\phi(\pi) \end{aligned}$$

with effort and risk-taking choices being $e = A(\pi)\phi(\pi)$ *and* $r = B(\pi)\phi(\pi) > 0$.

The pernicious consequences of financial sector bailouts on the market equilibrium outcome are clear from this result.

First, the model delivers an insight which lies at the heart of the debate about the structure of bonus pay – namely that bonuses will encourage socially wasteful risk-taking. This is because with no account taken of the social costs of bailouts $B(\pi) > 0$. As a consequence, we have $w_H(\pi) > \beta w_M(\pi)$. So incentives are too high powered compared to the socially optimal solution. This is the fundamental distortion in the *structure* of bonus pay induced by bailouts.

Second, bailouts are also bad for effort incentives (they lower $A(\pi)$) leading to *lower* levels of effort which does contribute towards producing high returns.[10] This is because they increase the return to failure.

Third, given the outcome described in Proposition 2, the utility of a financial sector worker is:

$$u^*(\pi) = \frac{1}{2}\left(\frac{\sqrt{A(\pi)^2 + B(\pi)^2 + 4(\pi - \rho)} + \sqrt{A(\pi)^2 + B(\pi)^2}}{2}\right)^2. \quad (8)$$

Thus, the utility of financial sector workers is higher due to the bailout. Competition between financial firms leads to subsidies to investors being "shifted" to workers. This is a classic public finance argument about the incidence of a subsidy applied to our setting. It captures the intuition that the real beneficiaries of bailouts are scarce workers through competition in the labor market. Hence, in a market equilibrium where financial sector workers are scarce, bailouts increase inequality as well as reducing efficiency.[11]

It is interesting to ask what happens if π goes up? We can show that in a market equilibrium, an increase in the level of bailouts (π) increases

[10] In addition, due to the standard incentives vs. rent extraction trade-off, effort is less than $A(\pi)$ which would be the level achieved with full contractibility. This is because, as noted above, $\phi(\pi) \le 1$ as $\pi \le \rho$.

[11] If financial sector workers were not scarce, then some of the benefits of bailout subsidies would accrue to residual claimants in financial sector firms.

the equilibrium level of risk-taking. We know that $A(\pi)$ goes down and $B(\pi)$ goes up. In addition, we can show that $\phi(\pi)$ goes up.[12] As a result, risk-taking certainly goes up. Effort is subject to two opposing effects: the higher expected bailout dulls incentives by lowering $A(\pi)$ but financial sector workers get more rents and this is reflected in the increase in $\phi(\pi)$.

6 Optimal Policy

We now show that the second best optimum can be implemented by a combination of two policies: a regulation on the structure of bonuses, and a tax on their level. The latter mirrors the kind of policies that have seen in practice. For example, the UK Treasury introduced a one-time tax of 50% on bonuses over £25,000 for the fiscal year 2009-10.

We consider regulations which affect the structure of bonus pay by determining the relationship between w_H and w_M. Specifically, let ξ be such that:

$$\xi w_H = w_M.$$

Comparing, the market equilibrium and the planning optimum of the previous section makes clear why the prospect of bailouts will generate a market failure which can be used to motivate direct regulation of bonus pay. But the interplay of efficiency and equity considerations complicates this.

The bonus tax that we consider is levied on the intermediary so that, for every \$1 of bonuses that it pays out, the cost is $\$1 + t$ where t is the tax

[12] It is straightforward to check that the sign of $\phi'(\pi)$ is the same as that of $A(\pi)^2 + B(\pi)^2 - 2(\pi - \rho)(B(\pi)(1-\beta) - A(\pi))$. By Assumption (i), $A(\pi)^2 + B(\pi)^2 + 4(\pi - \rho) > 0$. Notice that $\pi - \rho < 0$ and so this would imply the above expression determining the sign of $\phi'(\pi)$ is positive so long as $A(\pi) - (1-\beta)B(\pi) < 2$ which is true as $A(\pi) \in (0,1)$ and $B(\pi) \geq 0$.

rate.[13] The per capita tax revenue raised is

$$R(\pi,\xi,t) = (e[\alpha + (1-\alpha)\xi] - (1-\beta) r [\beta - \xi]) w_H t$$

and the payoff of the intermediary is

$$\begin{aligned} W(\pi,\xi,t) &= e[A(\pi) - (1+t) w_H (\alpha + (1-\alpha)\xi)] \\ &\quad + r[B(\pi) - (1+t) w_H (\beta - \xi)] + \pi - \rho. \end{aligned}$$

The dependence on (π,ξ,t) here and below comes in part from the way in which these policies affect the choices of (w_H, w_L, e, r). The utility of a financial sector worker is:

$$u(\pi,\xi,t) = e[\alpha + (1-\alpha)\xi] w_H + r[\beta - \xi] w_H - \frac{1}{2}e^2 - \frac{1}{2}r^2.$$

The choices of effort and risk-taking are now given by:

$$\begin{aligned} e &= w_H [\alpha + (1-\alpha)\xi] \\ r &= \max\{w_H[\beta - \xi], 0\}. \end{aligned}$$

It is apparent from this that choosing ξ effectively allows the policy maker to influence r. Assuming an interior solution, this yields the following utility level for a financial sector worker:

$$u(\pi,\xi,t) = \frac{(w_H)^2}{2}\left[(\beta - \xi)^2 + (\alpha + (1-\alpha)\xi)^2\right].$$

Expected bailout costs are:

$$T(\pi,\xi,t) = (1+\gamma)[1 - w_H[\alpha + (1-\alpha)\xi] + (1-\beta) w_H [\beta - \xi]]\pi.$$

In a market equilibrium, we continue to suppose that all supernormal returns in the financial sector accrue to workers through competition. This

[13] Tax policy is clearly bound up with more general debates about the optimal taxation of income. But the argument that we are making here is somewhat different as we are talking about a specific way to influence the primary income distribution rather than redesigning the income tax. This is motivated by having a model where any excess returns in financial markets show up as rents to workers in that sector. Thus, the motivation is to tax those rents on the basis of the inequality that they generate. However, given that the level of these rents is affected by effort, there is a trade-off between efficiency and rent extraction.

implies that the bonus tax levied on firms is also shifted to workers. Hence, the maximand for the policy maker is:[14]

$$\lambda \bar{u}(\pi, \xi, t) + R(\pi, \xi, t) - T(\pi, \xi, t).$$

Our key result on optimal policy is as follows:

Proposition 3 *The optimal choice of regulation and taxation* (ξ^*, t^*) *has* $\xi^* = \beta$ *and*

$$t^* = \frac{\frac{A(-\gamma\pi)A(\pi)}{(2-\lambda)} + (\pi - \rho)}{\left[\frac{A(-\gamma\pi)}{2-\lambda}\right]^2} - 1$$

These policies implement the second best optimum that we described in Proposition 1.

The optimal regulation is easy to understand as this sets the bonus structure to achieve $r = 0$.

The optimal tax regulates the level of bonuses and guarantees that, in a world where all of the surplus is extracted by workers, the optimum of Proposition 1 is implemented.

To understand the structure of optimal taxation, it is worth considering a couple of special cases. First, suppose that $\pi = \rho$ so that there is a bailout which fully compensates investors when the project fails. The optimal tax now becomes:

$$t^* = \frac{(1-\lambda) A(\rho) - (1+\gamma)\rho}{A(-\gamma\rho)}.$$

The first term, $(1-\lambda) A(\rho)$, is positive and represents the desire to tax on redistributive grounds. This term goes to zero if $\lambda = 1$. The second term is equal to $A(\rho) - A(-\gamma\rho)$, is negative and represents the desire to increase effort to reduce the prospect of a bailout. It is more negative, the higher is the cost of the bailout. The optimal tax balances these forces. If $\pi < \rho$, there is an additional negative term due to the fact that the firm faces a loss which passes onto the workers which further reduces effort.

[14] Observe that we do not apply $1+\gamma$ to the tax revenue. However, if γ is interpreted as the marginal cost of public funds rather than an administrative cost of organizing the bailouts, we would do this.

In general, there is no guarantee that the tax on bonuses will be positive. Indeed as $\pi \to 0$, it is bound to be negative. This may seem surprising. But it follows from the fact that paying ρ as compensation to investors enters the social planner's payoff as a transfer which is therefore ignored in setting the optimal incentive scheme whereas the intermediary operates under the constraint of having to compensate investors for parting with their capital. But the planner in our framework can, in principle, make transfers to overcome this constraint.

Although obvious in the context of the discussion so far, it is worth underlining that neither a tax nor a regulation on the structure of bonuses alone can achieve the second best optimum. That said, a regulator could simply mandate that bonuses are as in Proposition 1. However, a nice feature of the way of looking at policy suggested in this section is that it corresponds to a reasonable division of policy responsibilities between institutions along the lines of that we see in practice.

The regulation is a purely technocratic decision based on knowledge of the production technology for risk-taking as represented in our simple model by β. It affects the structure but not directly the level of bonuses. Practically speaking, this could be a decision made by a financial regulator or a central bank.

By contrast, the optimal tax is clearly a political decision as signified here by its dependence on the distributional judgement embodied in λ. The social judgement on equity and efficiency is typically legitimized by some kind of electoral process and falls clearly outside the scope of technocratic policy making. Quite rightly this should remain the domain of finance ministries. What matters is that both kinds of policies are applied if the second-best optimum is to be realized.

It is important to note in closing this discussion of taxation and regulation that these instruments are an alternative to having the government directly choose the salary structures for financial sector workers. This could be achieved, for example, with nationalization of the financial sector. There is nothing in our model which justifies privately owned and operate financial intermediaries. To delve into these issues more deeply would require extending the model to consider the costs and benefits of public ownership.

7 Further Issues

The model that we have presented is extremely stylized. It is a vehicle for exploring the logic of the arguments but is far from an applicable model which could be used to design any kind of specific policy. In this section, we discuss a number of further issues and extensions to the basic framework.

7.1 Endogenous Bailouts

We have taken the bailout level as exogenous throughout. We now discuss how this could be given foundations and how this might have a bearing on the results.

One foundation for the bailout would be to consider the actions of a benevolent government which cannot commit not to insure its citizens against losses incurred in investing in risky assets. Suppose that the government had a "maximin" distributive preference then it would want to make a transfer towards those who lose their money in risky investments. Making them as well off as those who have invested in safe assets would imply setting the bailout at a level $\pi < \rho$. This corresponds roughly to how the U.K. government compensates those who lose their money in bankrupt private sector pensions schemes under the Pension Protection Fund. Our analysis can be read as saying that this *ex post* redistribution now requires an *ex ante* intervention so as to mitigate the adverse consequences for the behavior of intermediaries. And the logic follows the Samaritan's dilemma problem that we mentioned above. Given the increasing importance of private pensions in many countries, this bailout problem is likely to get greater to the extent that governments offer such protection. Our argument says that this necessitates some kind of bonus pay regulation to the extent that risk taking behavior cannot be monitored directly.

An alternative perspective on the bailout is to see it as the product of *ex post* lobbying depending on the scale of the losses that are faced by investors. To illustrate this argument, consider a world where there are two identical intermediaries labelled as $i \in \{1, 2\}$. We assume that each will lobby for a bailout if their project fails. However, we assume that they are successful in their lobbying efforts only when *both* projects fail, it requires a large enough political constituency. For simplicity, suppose that if a bailout is received then it as the level of ρ, the safe return.

Consider the perspective of firm i (firm j is symmetric). In the event that its project fails, the investors expected bailout is:

$$\pi_i = p_L\left(e_j, r_j\right)\rho,$$

i.e. it gets ρ only when firm j's project also fails.

The fact that the expected bailout depends on the behavior of intermediary 2 creates an externality between the intermediaries. It is natural to assume that each intermediary sets its optimal incentive scheme non-cooperatively with decisions forming a Nash equilibrium. In a symmetric equilibrium, the externality built in via the bailout will lead to each firm increasing risk taking and lowering effort compared to the case where the externality that is imposing on the other firm is taken into account. There is now a risk-taking complementarity between the intermediaries. And this generates a additional source of market failure.[15]

It is straightforward to show, without fully characterizing the symmetric equilibrium of this game, that the equilibrium level of risk-taking will increase. Recall from Proposition 2 that in a market equilibrium, $e = A(\pi)\phi\left(\pi\right)$ and $r = B(\pi)\phi\left(\pi\right)$. Consider firm i for whom $e_i = A(\pi_i)\phi\left(\pi_i\right)$ and $r = B(\pi_i)\phi\left(\pi_i\right)$. Suppose r_j goes up or e_j goes down, which makes $p_L\left(e_j, r_j\right)$ go up, and so π_i goes up. Then we know from Section 5 that risk-taking goes up.

[15]In future work, it would be interesting to explore these issues with correlated project returns. Moreover, firms may face incentives to offer worker's incentives to induce excess correlation in returns because they know that investors are insured when all firms face a bad shock together.

7.2 Multiple Jurisdictions

We have studied a single jurisdiction providing a bailout within its borders in a closed economy. But one feature of the current debate and of the financial crisis is multiple governments interacting via open markets for capital and talent.

Here, therefore, we consider the consequences of allowing mobile talent and capital in a world where there are two jurisdictions which determine policy on the bailout as well as taxation and regulation. If policies are welfare maximizing and coordinated across jurisdictions, then the model essentially collapses back to what we have studied so far. So the interesting case is where two countries are setting policy non-cooperatively within their own jurisdictional boundary.

To be concrete label these countries as A and B and suppose that the policy vector in country J is $\left\{t^J, \xi^J, \pi^J\right\}$. We follow focus on the case where the two countries are symmetric. Suppose that firms are fixed in locations but financial sector workers and capital can move costlessly to any location. We continue to assume that financial sector workers are scarce relative to the number of financial firms and the amount of capital in any jurisdiction. So, in principle, any country could become specialized in financial services. We will begin by studying the case $\pi^A = \pi^B = \rho$ and each bailout is financed in the country where the investment takes place. In the absence of taxation and regulation, then each jurisdiction is equally attractive as a home for financial services.

Now consider, however, what happens when the two jurisdictions set tax and regulation policy non-cooperatively. In this case, the tax will be $t^A = t^B = 0$. The latter follows the standard logic of tax competition applied to this setting. It reflects the fact that if the tax were positive then a government could undercut by a small amount and steal the tax base. Hence, we would not expect bonus taxes to survive with free mobility and policy competition. This is because, as we saw in the last section, the bonus tax is primarily a redistributive instrument.

In the case of the regulation, the finding is more optimistic and both jurisdictions will set $\xi^A = \xi^B = \beta$. This is because optimal regulation raises the utility of the financial sector workers as well as total surplus. Hence workers will migrate from a poorly regulated to a well-regulated jurisdiction. Thus, we do not expect any race to the bottom in regulating the structure of bonuses.

Suppose now that the generosity of bailouts differs across jurisdictions so that $\pi^A > \pi^B$. Then, even with optimal regulation, financial intermediation will migrate towards the high bailout jurisdiction.[16] Moreover, productive effort will be lower than is desirable in this jurisdiction. And from a world welfare point of view, financial intermediation will be carried out in the least efficient place. So efforts to curb bailouts would benefit from coordination to keep a level playing field. This is currently an issue where, with differing fiscal positions restricting the credibility of bailouts in some jurisdictions, we would expect a movement of financial intermediation to places where governments have deeper pockets. Coordinated tax policy on bonuses could be used to offset this but would require jurisdictions to cooperate to avoid the standard race to the bottom.

7.3 Implementation Issues

Even at a conceptual level, there is a question of how far it is reasonable to assume that a regulator is fully informed about the technology of production in the financial sector. This is embodied in our assumption that the parameter β is known by the regulator. If not, then additional complications would be introduced. Certainly extending the analysis to have β to be private information to the financial intermediary is an interesting extension. One could then study optimal regulatory mechanisms. In practice, the use of such mechanisms is likely to be severely circumscribed by the fact that financial regulators are not typically able to use transfers as means of

[16] Combining this with the discussion of optimal bailouts in the last section, this is a possible of source policy externalities across jurisdictions if one jurisdiction is more susceptable to lobbying for bailouts than another.

achieving self-selection. This may mean that a pooling solution is the only option where the average β is used to regulate the financial sector making it impossible to have such a finely tuned system of bonus regulation.

Perhaps an even bigger practical issue would arise from the possibility of financial regulation which means that β is constantly changing, even varying over the business cycle, and would make it difficult to have any kind of fixed rule that would achieve optimal bonuses to limit socially sub-optimal forms of risk-taking by financial firms. In practice, we would be likely to see only crude efforts to bring regulations on bonus structures. Once that dimension is imperfect, efforts to try to get better signals of r in our framework becomes pressing. It would generally be optimal for the regulator to use such information in assessing bonus structures.

But all of these practical concerns should not make us lose sight of one very simple and general implication of our model, namely, that greater transparency in the reporting of bonus structures at all levels of financial firms is warranted from a public interest point of view. Attempts by regulators to bring these into the daylight as a means of assessing their implications for risk-taking is perfectly justified once the social implications of risk-taking in the presence of bailouts is recognized.

7.4 Over-optimism bias

Finally, note that while we have focused here on bailouts as the source of sub-optimal incentives in the financial sector, the general structure that we have proposed could be applied to a wider variety of market imperfections affecting investment returns. It could, for example, be used to study the implications of psychological biases in risk perceptions that encourage excessive risk-taking. Such cases would also affect both efficiency and distribution.

To illustrate this, consider the case where $\pi = 0$. Suppose though that investors, workers and principals in the financial sector all over-estimate β. Let $\hat{\beta} > \beta$ be their belief with:

$$\hat{\beta}\Pi_H - \Pi_M > \beta\Pi_H - \Pi_M = 0.$$

Such over-optimism about the returns to risk taking will lead financial intermediaries to set incentives for workers so that $r > 0$ even though they would not do this if they had the "correct" belief. As in the bailout model, this could motivate the need to regulate bonus pay to reduce risk taking. However, the motivation for this would essentially be paternalistic. However, a combination of decision making biases and bailouts would further compound the cost of bailouts.

More generally, the analysis points towards wider debates about connecting finance with their broad economic purpose and focusing on the true social costs and benefits from financial market development.[17]

8 Concluding Comments

The debate about bonus pay has been thrown into sharp relief by the financial crisis. But, even before its onset, there were concerns about rewards earned in the financial sector and their implications for inequality and fairness. Once it was clear that it was tax payers rather than investors who are the true residual claimants, this put a whole new gloss on the issue of pay in the financial sector and the sources of the returns that generated such high rewards.

The case remains for implementing structural reforms in the banking sector which reduce the likelihood of bailouts. A variety of measures currently under debate include trying to get the optimal structure of banking and of macro-prudential regulation which reduce the payoffs of socially sub-optimal risk-taking. But the reality is likely to remain that governments will continue to finance schemes which fundamentally distort the supply price of capital to risky projects since no democratic government will ever want to sit idly by and watch even a moderately small group of investors lose their money in a way that can become politically sensitive. Nowhere was this more forcefully illustrated than in the case of Northern Rock, a mid-sized mortgage lender

[17] This is discussed further in Besley and Ghatak (2011) which discusses how organizational form can be used to connect finance with a social purpose.

and the first UK casualty of the crisis in 2007. The political heat on the UK government from this case was intense. It is clear that standard schemes for depositor protection and lender of the last resort facilities raise all the issues that we have covered in this paper.

This paper has explored the implications for both equity and efficiency for taxing and regulating bonus pay in the financial sector. We have used a framework in which the government protects investors from downside risk and argue that, if there is scarce talent for working in the financial sector, then the benefits of such protection is shifted to these workers. The paper explores the implications of this for both the structure and level of bonus pay. Protection of investors both increases inequality and reduces efficiency. The optimal intervention is a combination of a regulation on the structure of bonuses and a tax on their level. The argument that pay contracts are private arrangements between consenting adults and hence to be kept secret does not hold up once the implications of public funded protection against the downside risks from making risky investments is taken on board.

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Proof of Proposition 1: Use:

$$\frac{1}{2}\left[e^2+r^2\right]=u$$

to obtain:

$$e=\sqrt{2u-r^2}.$$

Plug this into the maximand to obtain that

$$\hat{S}\left(-\gamma\pi,u\right)=\max_r\left\{\sqrt{2u-r^2}\left[A\left(-\gamma\pi\right)-\sqrt{2u-r^2}\right]+r\left[B\left(-\gamma\pi\right)-r\right]-\gamma\pi-\rho\right\}.$$

Differentiate with respect to r to get:

$$-\frac{A\left(-\gamma\pi\right)}{\sqrt{2u-r^2}}r+B\left(-\gamma\pi\right)$$

Clearly this is negative at $r=0$ since $B\left(-\gamma\pi\right)<0$. Also, it is straightforward to check that the second-order condition is satisfied. Hence $r=0$ as claimed. Turning to:

$$\max_u\left\{\hat{S}\left(-\gamma\pi,u\right)+\lambda u\right\}$$

the first-order condition is

$$\frac{A\left(-\gamma\pi\right)}{\sqrt{2u-r^2}}-2+\lambda=0.$$

It is clear upon inspection that the second-order condition with respect to u is satisfied. Since at the optimum $r=0$, we get

$$u=\frac{1}{2}\left[\frac{A\left(-\gamma\pi\right)}{2-\lambda}\right]^2.$$

In that case:

$$e=\sqrt{2u}=\frac{A\left(-\gamma\pi\right)}{2-\lambda}$$

and we solve the optimum contract from (7) plugging in the values $r=0$ and $e=\frac{A(-\gamma\pi)}{2-\lambda}$ derived above.

We need to check that the participation constraint (PC) does in fact bind at the optimum, as have assumed above. Suppose not. Then,

$$\max_{e,r} e\left[A\left(-\gamma\pi\right)-e\right]+r\left[B\left(-\gamma\pi\right)-r\right]-\gamma\pi-\rho$$

yields $e=\frac{A(-\gamma\pi)}{2}$ and $r=0$ (as $B\left(-\gamma\pi\right)<0$). Given this, the financial sector worker's equilibrium expected payoff is $\frac{1}{2}e^2=\frac{1}{2}\left[\frac{A(-\gamma\pi)}{2}\right]^2$ and $\hat{S}\left(-\gamma\pi,u\right)=\left[\frac{A(-\gamma\pi)}{2}\right]^2-\gamma\pi-\rho$. Then, $\max_u\left\{\hat{S}\left(-\gamma\pi,u\right)+\lambda u\right\}$ is increasing in u and u

will therefore be raised to the point where the PC must be binding. ■

Proof of Proposition 2: Substituting e from the PC the objective function is

$$\max_r \sqrt{2u-r^2}\left[A(\pi)-\sqrt{2u-r^2}\right]+r\left[B(\pi)-r\right]+\pi-\rho.$$

The first-order condition with respect to r is:

$$-\frac{A(\pi)}{\sqrt{2u-r^2}}r+B(\pi)=0$$

which can be solved to obtain

$$r=\sqrt{\left[\frac{2u}{1+\left(\frac{A(\pi)}{B(\pi)}\right)^2}\right]}.$$

The case in Proposition 2 solves this, and zero profit condition of the financial intermediary:

$$\sqrt{2u-r^2}\left[A(\pi)-\sqrt{2u-r^2}\right]+r\left[B(\pi)-r\right]+\pi-\rho=0$$

for r and u. Observe that:

$$2u-r^2=\left(\frac{A}{B}\right)^2 r^2.$$

Using this:

$$\sqrt{2u-r^2}\left[A(\pi)-\sqrt{2u-r^2}\right]+r\left[B(\pi)-r\right]+\pi-\rho=\sqrt{A(\pi)^2+B(\pi)^2}\sqrt{2u}-2u+\pi-\rho.$$

Solving this quadratic equation yields:

$$u=\frac{1}{2}\left[\sqrt{A(\pi)^2+B(\pi)^2}+\sqrt{A(\pi)^2+B(\pi)^2+4(\pi-\rho)}\right]^2.$$

This can now be used to obtain values of r and e. From this w_H and w_M can be backed out using (7). Finally, note that the expected payoff of the intermediary is decreasing in u when the PC binds. Consider the case where the PC does not bind. In this case, the expected surplus is $e\left[A(\pi)-e\right]+r\left[B(\pi)-r\right]+\pi-\rho$ and maximizing it with respect to only the incentive constraints yields a value of $\frac{A(\pi)^2+B(\pi)^2}{4}+\pi-\rho$ which is positive by Assumption (i). This ensures that there exists a positive level of u that solves the competitive case where the PC binds. ■

Proof of Proposition 3: The fact that $\xi^*=\beta$ follows directly from Proposition 1. To solve for the optimal bonus tax, observe that w_H solves:

$$w_H \left[\alpha + (1 - \alpha) \beta\right] A(\pi) - (1 + t) \left(w_H \left[\alpha + (1 - \alpha) \beta\right]\right)^2 + \pi - \rho = 0.$$

Now we can use the formula for w_H in Proposition 1 in this expression to yield.

$$\frac{A(-\gamma\pi) A(\pi)}{2 - \lambda} - (1 + t) \left[\frac{A(-\gamma\pi)}{2 - \lambda}\right]^2 + \pi - \rho = 0.$$

Solving this yields the result. ■