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The Owner-Manager Conflict in Insured Banks: Predetermined Salary vs. Bonus Payments

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“The Owner-Manager Conflict in Insured Banks:
Predetermined Salary vs. Bonus Payments” [1]

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Abstract: This paper examines the incentive of a bank's owners and manager to increase the level of assets risk if bank deposits are insured. The model consists of three players: a public insurer (e.g., the FDIC), the bank's owners (owners), and its manager (manager). Empirical evidence has shown that the management of risk (e.g., credit and interest risk) and a low level of audit and control can be instrumental in causing banks to fail or get into financial difficulties. In the model presented here, the form of compensation to the manager plays a crucial role in determining the level of asset risk. We show under which conditions and form of compensation bank's owners and manager have an incentive to raise the risk level. The model is run first under the assumption that the information between the bank and the insurer is symmetrical, and then under the assumption that it is asymmetrical for two forms of pay: a predetermined salary, and bonus payments whose value is not known at the time the contract between the owners and the manager is signed. We also examine whether there is a pareto-optimal contract between the owners and the manager as regards the risk level, given the two forms of pay. This question is important because the absence of such a contract could indicate the existence of a source of instability in the banking system.

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1. Introduction

The crisis in the US Savings and Loans sector in the 1980s impelled many researchers and policy-makers to replace the flat insurance premium policy with one that is risk-based.[1] In contrast to the general view that it was the flat premium system that encouraged the banks and the Savings and Loans to increase the risk level of bank assets,[2] John et al. (1991) argue that the biggest incentive to increase risk derives essentially from the fact that the owners' liability is limited to the amount of their investment in the bank (similar to holders of call option written on bank assets), compared with the theoretical possibility of unlimited profit. On the basis of that contents, Goldberg and Harikumar (1991) demonstrate that the ex post collection of a 'fair actuarial insurance premium' does not reduce the bank owners' motivation to increase the risk level. As defined in the literature, a 'fair actuarial insurance premium' should on average compensate the insurer for the risk transferred to it from safe banks,[3] and hence this premium differs in accordance with a bank's risk. Collecting a premium of this kind should leave the federal insurance funds (e.g., BIF for banks and SAIF for S/LS), on average, with neither a profit nor a loss.

Empirical findings support the hypothesis that the greater a banks financial difficulties, the greater its tendency to increase risk (if there is asymmetrical information between the insurer and the insured bank).[4]

Merton (1977) compared the insurer with a writer of a European put option written on bank assets. While Merton and others[5] assume symmetrical information between the insured banks and the insurer, there are those (e.g., Flannery, 1991) who argue that this assumption is unrealistic in the modem financial and business environment. Consequently.

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[1] According to the FDICIA legislation of 1991, by January 1994 the federal insurer (FDIC) forced to shift to a risk-based insurance policy. As of January 1993 the FDIC adopted such a policy, the risk categories being decided on the basis of a subjective CAMEL rating and the insured bank's risk-weighted capital ratios. The prevailing trend among US regulators in the last few years has been to stress the quality of management and the level of risk-management in insured banks. Consequently, the model presented here fits in with that trend.

[2] See Berlin et al. (1991), Flannery (1991), Kane (1986), and Ronn and Verma (1986).

[3] See, for example, Fissel (1994), Acharya and Dreyfus (1989). The model presented here ignores such externalities as bank runs, etc., which should be taken into account when determining a premium, because they are almost impossible to estimate.

4 Kane (1986) describes a situation in which a bank operates in a volatile business environment and is in danger of failing (and when information is asymmetrical) as being on the edge of disaster. In a situation of this kind the tendency is to increase risk as far as possible, because if profits are generated they will be transferred to the shareholders pockets, whereas losses will be rolled over to the public insurer.

[5] See Marcus and Shaked (1984), Ronn and Verma (1986), Pennacchi (1987), and Kendall and Levonian (199 1). In these and other studies the premium is generally calculated on the basis of Option Pricing Models, using market data. For a review of the various models of options for calculating the deposit insurance premium, see Flood (1990).

the insurer should take this possibility, known as moral hazard, into account when pricing a‘ fair actuarial deposit insurance premium’.[6]

In addition to the bank-insurer conflict, there is also a conflict between the bank’s manager and its owners. The agency theory posits that the firm’s manager aspires to maximize his own rather than the owners’ utility function. This conflict between the owners and the manager has led many researchers[7] to plan forms of compensation that will minimize this conflict. Shavell (1979) argues that if the manager is risk-neutral, a fixed payment (predetermined salary, regardless of business results) is pareto-optimal contract between the owners and the manager. If the manager is risk-averse, however, a pareto-optimal contract should depend to some extent on output, but the owners should never leave the manager exposed to risk alone. A similar conflict exists for portfolio managers. Kritzman (1987) compares a portfolio manager who receives a bonus (in comparison with a benchmark portfolio) but is never punished for poor performance, with someone who holds a European call option. Like all option-holders, this kind of portfolio manager will prefer to raise the risk level of the portfolio he manages, regardless of his and the portfolio-owners’ attitude to risk.

Empirical evidence supports the view that banks that are controlled by managers tend to be more diversified, to maximize sales rather than profits, to smooth income, and to invest in more liquid assets than banks that are controlled by owners.[8] In the following model the difference between the two conflicts - between the bank and its insurer, and between the manager and the owners - is connected to the symmetry of information. It is assumed that information is symmetrical between the manager and the owners, and not necessarily so when it comes to the banks and the insurer. We present the stakeholders of insured bank: the insurer, the manager, and the owners as holding options written on bank assets. The rest of the paper is organized as follows. Section 2 describes the model. In section 3 an evaluation of insurance premium (using option pricing models) when the manager’s salary is predetermined is presented. Section 4 posits the same for bonus payment. In section 5 we examine the possibility of signing a pareto-optimal contract between the manager and the owners for the above two forms of compensation. Section 6 concludes the paper.

[6] Landskroner and Paroush (1994) and Greenwald and Stiglitz (1986) argue that the damage to the entire economy should also be taken into account in calculating a fair premium, i.e., externalities such as bank runs and the domino effect should also be taken into consideration.

[7] See, for example, Kritzman (1987), Starks (1987), Shavell (1979).

[8] A bank is controlled by its managers if the latter are dominant in it, and a bank is controlled by its owners if they are considered to dominate the decision-making process (see Lloyd et al., 1987, Saunders et al., 1990, Crawford et al., 1995).

2. **The model**

We present the insurer, the manager, and the owners as holding contingent claims on bank assets, and assume that at the first stage there is full and symmetrical information (regarding the distribution of the future value of assets and their risk) between the bank and the insurer. Assume a commercial bank with the following 'economic balance sheet'[9] that signs an insurance contract with the insurer for the next period (assuming that all deposits are insured):

The 'Economic Balance Sheet' (the profit equation)

Liabilities	**Assets**
D	V
S	-
E	-
$E + S + D - IP$	$V - IP$

Where V is the present value of the bank assets, $D = D^*e^{-rdt}$ is the present value of the insured deposits (D is the end-of-period value of the deposits), dt is the time remaining until the insurance expires, r is the riskless interest rate, S is the present value of the manager's salary, E is the present value of the equity, and IP is the deposit insurance premium transferred to the insurer at the beginning of the period.[10] At the end of the insurance period the bank assets, V_T, which is the future uncertain value of V-IP, are divided up among the insurer (who pays the outstanding debt to depositors if the bank fails), the depositors, the manager, and the owners. The income of the bank's owners (subscripts, T, denoting end-of-period terms) and the priorities for allocating assets appear in Table 1, in accordance with the model's assumptions and the various scenarios.

[9] In constrast with an 'accounting balance-sheet', an 'economic balance-sheet', which represents the bank's profit equation, presents the value of assets and liabilities according to their economic (market) value. For example, end-of-period liabilities to depositors are presented in the balance-sheet according to their present value. The 'economic balance-sheet' also includes contingent assets and liabilities that do not appear in the accounting balance-sheet (i.e., off-balance-sheet items).

[10] In an 'economic balance-sheet' S cannot be given as the present value at a riskless interest rate of the sum promised to the manager at the end of the period, because if the bank collapses, the manager in the model is not certain to receive the full amount of his salary. On the other hand, the value of the insured deposits, D, is discounted at the riskless interest rate because depositors receive their money at all events. Consequently, compared with an 'accounting balance-sheet', the value of S is smaller (as a result of discounting at the interest rate of a risky asset).

Table 1

Scenario	Insurer	Shareholders	Manager	Depositors
$V_T > (D+S)_T$		$V_T - (D+S)_T$	S_T	D_T
$(D+S)_T \geq V_T > D_T$			$V_T - D_T$	D_T
$V_T \leq D_T$	$V_T - D_T$			D_T

The insurer 'buys' the negative part of the distribution of V_T within the range $V_T < D_T$ in return for the insurance premium, IP, which is paid by the bank at the beginning of the period,[11] and thus insures depositors' income for D_T. In a competitive deposit market, it is in effect equity-holders, not depositors, who pay the insurance premium. [12] In addition, the total of each row in the table is V_T, indicating that bank assets are divided among the various stakeholders. As will be shown below, this affects their attitude towards risk level of the bank assets. According to the structure of receipts in the table, we can present each one of the stakeholders: the equity-holders, the manager, the insurer, and the depositors, as having contingent claims on bank assets[13]. Equity-holders, in particular, hold a call option which is paid at the end of the period:

$$E_T = \max\left(V_T - (D+S)_T, 0\right)$$

The manager holds a call option with striking price D_L, and sells a call option with the striking price D_H. This constitutes a bull spread, whose value at the end of the period is:

$$\max\left(\min[V_T - D_T, S_T], 0\right) = \max\left(V_T - (D+S)_T, 0\right)$$

The insurer writes a put option whose value at the end of the period is:

$$IP_T = \min\left(V_T - D_T, 0\right)$$

After the insurer pays his share (D_T-V_T, if the bank fails), the depositors receive D_T, in any event. [14] Note that currently the insurer undertakes to cover only those losses of

[11] Although it is usually assumed in the literature dealing with deposit insurance that the premium is paid at the beginning of the period, little attention is paid to the question where this money comes from (the exception is Kendall, 1992). Below we assume that the premium is paid from bank assets, and hence the amount of the premium, which depends inter alias on the present value of the assets, is determined simultaneously.

[12] Crouhy and Galai (1991) show that in a competitive market deposit insurance inter alias protects stockholders rather than depositors. It is reasonable to assume that if the deposit market is monopolistic or oligopolistic at least part of the cost of insurance will be rolled over onto depositors. In that case, IP will represent the net cost to the bank (less the depositors' share in the insurance premium).

[13] Tax authorities are excluded from the model since their cash flow from\to the bank is similar to that of the deposit insurer.

[14] If there is no deposit insurance, the depositors hold an option that pays Min (D_T,V_T). In a risk-neutral world, and assuming that the price of the assets has a lognormal distribution, the value of these options can be calculated precisely (Smith, 1990; p. 349).

insured depositors that are the result of the bank's failure,[15] and this is in contrast to past policy.

The assumptions of the model are as follows:

a. The model covers one period only and ail deposits are insured. Throughout the period there are no random deposits or withdrawals. At the end of the period the depositors receive their deposits (including interest payments) and the residual of the bank's assets, minus the manager-s salary, is transferred to the equity holders. Order of priority in distributing the bank's assets is set out in Table 1.

b. In the first stage, the bank's owners hire a manager and the insurer sets the premium based on the risk level of bank assets (how this premium is determined will be explained later). Afterwards, the manager can, with the owners' knowledge, increase the risk of the assets, sometimes without the insurer's knowledge (when asymmetrical information prevails). [16]

c. The value of the bank assets is a product of the following:
- the value of unmanaged assets (which is log normally distributed).
- the equivalent value of the manager's contribution to the bank's assets (log normally distributed too). [17]

d. The bank assets can be traded instantaneously and no dividends are distributed. The rate of return on bank assets, on the value of the manager's contribution and the riskless interest rate, are fixed and known. There are no taxes or transaction costs. Short sales are allowed and the seller receives the full proceeds. There are no possibilities of arbitrage and all assets are perfectly divisible.

In this model both the owners and the manager can influence the bank's risk level, as follows:
1. The owners can select between a conservative manager and a manager who takes risks.

[15] In the past, the insurer's *de facto* policy was to cover all the liabilities of a failed bank, including the manager's salary, in the framework of a merger or purchase by a stronger, healthier bank. Consequently, depositors who had not paid deposit insurance were in fact covered (Ronn and Verma, 1989, footnote 2).

[16] The existence of asymmetrical information can be explained despite assumption d., that the information is free and available, as follows: Although the insurer has full knowledge about the bank's situation at the time of setting the premium, the bank may decide to change its level of risk at a later stage without the market's or the insurer's knowledge. The owners can choose between a conservative manager who does not take risks and a manager of opposite characteristics, and therefore the premium is revealed *ex-post* as mispriced.

[17] Assumption c. concerns the value of the bank assets as a multiplication of the unmanaged value with a value of manager's contribution. This assumption is acceptable in product functions concerning the log normal distribution of the underlying assets. As the product of any N log normal variables is log normal, the assumption is theoretically sound. However the sum of N log normal variables is not log normal (although this is sometimes ignored, such as the share options index. See also Hull 1989;p 139).

2. The manager himself, with the owners' knowledge, can change the level of risk at the second stage without the insurer's knowledge after filling his position and according to his preferences (if there is asymmetrical information between them). The risk level chosen by the manager remains fixed until the end of the period, that is there are no changes in the manager's preference.

We have ignored any factors that may influence the owners or the manager to reduce the risk level of bank assets. For example:(a) the charter value that gives a negative incentive to raise asset risk (Keeley 1990), (b) the manager's reputation that may be undermined in a case of bank failure (Lloyd et al 1987), and (c) control and strict supervision by the governing bodies and a strict checking system that does not permit banks to increase their assets' risk (Kane 1986). This is in order to demonstrate the latent risk potential in each of the payment systems; predetermined salary versus bonus payments.

We shall now present the bank's asset structure according to assumption c, that the present asset value after paying the premium (V-IP), is the product of the unmanaged assets (symbolized by P) and a value of the manager's contribution (A). On this assumption, the instantaneous changes dA and dP are random variables as described in the following standard Wiener processes:

(1)
$$\frac{dA}{A} = \mu_A dt + \sigma_A dZ_A$$

where A>0 represents the value of the manager's contribution, μ_A is the expected instantaneous growth rate of bank assets as a result of the manager's employ, σ_A is the standard deviation of the growth rate in A and Za is the Wiener process. [18]
Similarly, the standard Wiener process with respect to P will be shown as:

(2)
$$\frac{dP}{P} = \mu_P dt + \sigma_P dZ_P$$

where P is the value of unmanaged assets, μ_P is the expected continual rate of return on P, σ_P is the standard deviation of the return on P and Zp is the Wiener process.
As V=P*A-IP, it is shown that if we differentiate the changes of the total assets return according to A and P and assume for the sake of simplicity that the correlation between A and P is nil, we will find (for convenience IP is omitted in the following equations):

(3)
$$\frac{dV}{V} = \frac{dA}{A} + \frac{dP}{P} = (\mu_A + \mu_P)dt + \sigma_A dZ_A + \sigma_P dZ_P$$

where the behavioral equation of bank assets is:

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[18] This assumption brings up the problem of identity and estimating μ_A and σ_A especially as these parameters represent human capital. However, any reward plans need to cope with the same problem of isolating the manager's contribution to the firm. Additional discussion of this point can be found in Grinold and Rudd (1987) and Kritzman (1987).

(4) $$\frac{dV}{V} = \mu_v dt + \sigma_v dZ_v$$

and where μ_V is the expected rate of return on V, σ_V is the standard deviation of the rate of return and Zv is the standard Wiener process. That is, for the terms A and P:

(5) $$\mu_v = \mu_A + \mu_P, \qquad \sigma^2_v = \sigma^2_A + \sigma^2_P$$

Equation (5) states that the manager's influence on the assets return stems from his contribution to the expected growth rate (μ_A), but also from his propensity to take risks (σ_A).[19] Since equity E (calculated as a call option written on bank assets) is dependent on the variables A, P and t, it is possible to use Ito's Lemma:

(6) $$dE = E_A dA + E_p dP + E_t dt + \frac{1}{2}\left[E_{AA}(dA)^2 + E_{PP}(dP)^2\right]dt$$

where the subscripts represent partial derivatives (for example E_A= dE/dA) and the correlation between dA and dP is assumed to be zero. That is, there is no correlation between the manager's contribution and the behavior of the unmanaged assets.

If there are similar traded assets to A and P, the owners can build a riskless portfolio H[20] that contains Q_A*Q_P dollars from P*A and Q_E dollars (Q_E<0) from the option E as follows:

(7) $$H= Q_P P \text{ x } Q_A A + Q_E E = Q_V V + Q_E E$$

For very short time, it is possible to set equation (7) in the following way:

(8) $$dH= Q_P Q_A \text{ x } d(P^* A)+ Q_E dE$$

and if we express d(P*A) from equation (8) as a product of two stochastic processes A and P (whilst assuming zero correlation between them) we arrive at:

(9) $$dH = Q_A Q_P\left[A \times dP + P \times dA\right] + Q_E dE$$

replacing dE with the expression from equation (6) and expressing d_A,d_p in their explicit forms and rearranging terms will produce the following:

(1o) $$dH = \alpha dA + \beta dP + \gamma dt$$

where

$$\alpha \equiv Q_E E_A + Q_A Q_P$$
$$\beta \equiv Q_E E_P + Q_A Q_P A$$
$$\gamma \equiv E_t + 1/2\left(E_{AA}\sigma_A^{\ 2} A^2 + E_{PP}\sigma_P^{\ 2} P^2\right)$$

and where the subscripts represent the partial derivatives (for example, Et is the derivative of equity with respect to time).

[19] It is also possible to see from equation (5) that the manager's influence on the expected asset yield is not always positive. A successful manager increases on average the value of the assets (μ_A>0) whereas a poor manager may cause the opposite (μ_A<0).Here the manager's characteristics (μ_A,σ_A) are known to the owners and insurer at the time of setting the insurance premium (symmetrical information)

20 A major problem arises in evaluating the manager's contribution to the bank as human capital is not a traded asset (see (17)). Nevertheless if it were possible to quantify and categorize managers according to risk and growth profile and to find similar traded assets, then the owners could build a riskless portfolio. Note that as securitization is more developed and the markets are more complete (it is possible to replace each asset at the rate of other assets in the market) so it is easier to find such traded assets of equal value to the manager's contribution (A) and to the bank's unmanaged assets (P).

We would now like to calculate the value of the equity when the manager is paid in different ways. Four initial conditions are required in order to calculate this value E, namely:

(a) $H = Q_A Q_P (P * A) + Q_E E$

(b) $dH = \alpha dA + \beta dP + \gamma dt$

(c) $\alpha = 0 \Rightarrow (Q_E E_A + Q_A Q_P P) = 0$

(d) $\beta = 0 \Rightarrow (Q_E E_P + Q_A Q_P A) = 0$

Conditions (a) and (b) establish the hedge in the portfolio whereas conditions (c) and (d) are intended to protect against unexpected changes in A and P, respectively.

As the portfolio H is riskless (that is dependent only on dt) the rate of return must be equal to riskless interest rate - r in order to prevent arbitrage opportunities.

In the following section we find the value of equity (after premium payment) and examine the tendency of the bank's manager to set risk. Particularly we will check the situation of the bank's owners and manager in the following four situations:

1. The manager's salary is predetermined assuming symmetrical information between the bank and insurer.
2. The manager's salary is predetermined assuming asymmetrical information.
3. The manager collects bonus payments (a positive function of bank assets) with symmetrical information.
4. The manager collects bonus payments with asymmetrical information.

2.1 Calculation of Insurance Premium

The insurer evaluates the insurance premium immediately after the manager takes up his position, based on his characteristics (μ_A and σ_A). The premium reduces the value of the net assets to P*A-IP but does not change the features of the process; namely μ_V and σ_V. Hence, it is necessary to evaluate in the first stage the 'actuarially fair deposit insurance premium' and based on it to calculate equity and manager's salary as follows.

First we assume that the following boundary conditions exist:

(e) $$P_t * A_t \geq IP(P, A, D, \sigma, r, dt) \geq 0$$

(f) $$IP_T = \min[0, P_T * A_T - D_T] = \min[0, V_T - D_T]$$

where subscript T represents values at the end of the insurance period, dt the remaining time to the expiration day, P_t*A_t the asset value at time t, D the present value of bank deposits, r and σ the riskless interest rate and standard deviation of the return on bank assets, respectively. Condition (e) ensures that the value of bank assets is greater than the premium value at any time whereas condition (f) states that the maximum loss of the insurer at the end of the period is limited to D_T. For convenience it is assumed that the premium is determined for a complete year (dt=l).

The premium according to the Merton's model (1977) is a put option written on bank assets. In addition we have assumed that the premium paid at the beginning of the period from bank assets is a function of the value of the assets (P*A-IP). Therefore the premium is:

(11) $$IP = D \times N(g_1) - (P * A - IP) \times N(g_2)$$

where

(12) $$g_1 = \frac{\ln\left(\frac{D}{P*A-IP}\right)+\frac{\sigma^2}{2}}{\sigma}$$

(13) $$g_2 = g_1 - \sigma$$

and

$$\sigma^2 = \sigma_A^2 + \sigma_P^2$$

As the insurance premium IP appears on both sides of equation (11), a numerical simultaneous solution is needed to solve for IP.[21]

As will be shown, both owners and the manager have conflicting interests to that of the insurer as any rise in the premium will reduce the assets (P*A-IP) and will necessarily cause a reduction of the present value of the equity and the manager's compensation. On the other hand, when the information between the bank and insurer is symmetrical, a rise in the premium by the insurer would result from a rise in the risk level (for example, if the manager takes additional risks) - which has a known positive effect on the equity value. These two opposing influences can be read as, on the one hand, the reduction of the asset value as a result of the payment 1P and the consequent reduction of the present equity value, and on the other hand, the increase in the equity value as a result of increasing the risk level.

In the following we distinguish accordingly between the alternative payment methods and symmetry/asymmetry of information between the insurer and insured banks.

3. Predetermined Salary

In this section we will assume that the manager is entitled to receive a predetermined salary and that he will receive it at the end of the insured period (assuming the bank has not failed by then). Remember that D is the present value of the insured deposits that will not change throughout the period as a result of random deposits or withdrawals[22].

The owners hold an option (E) dependent on the unmanaged assets of the bank (P), the value of the manager's contribution (A), the present value of deposits (D), the present value of the manager's salary discounted at risk-free rate (S*),[23] the changes in the total assets return, and the time remaining until the insurance expires.

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21 Kendall (1992) demonstrated that if the present value of the assets is greater than that of the insured deposits, then such IP exists and is unique.

22 This actually means that the manager's pay is a function of the bank's actuarially stock price.

23 S* represents the present value of the salary promised to the manager at the end of the period (ST) discounted at a risk-free rate. In contrast, S is discounted at a rate higher than that rate since there is a positive chance that the salary will not be paid in full in the case that the bank fails and therefore S‹S*. From the owners point of view, the payment to the manager has similar priority of distributing bank assets as the depositors and therefore the value of the option in their authority is dependent on S*. From the managers point of view, however, the salary at the end of period is uncertain therefore S_T is discounted as a risky cash flow.

In addition to the four conditions outlined above (a)-(d), two further boundary conditions are required (g),(h) to solve the partial differential equation (10) for the equity value E. These conditions are:

(g) $$P_t * A_t \geq E\left(P, A, D, S^*, \sigma, r, dt\right) \geq 0$$

(h) $$E_T = \max\left[0, P_T * A_T - \left(D+S\right)_T\right] = \max\left[0, V_T - \left(D+S\right)_T\right]$$

where E is the present value of the equity, S_T represents the actual salary that the manager receives at the end of the period, subscript T denotes values at the end of the insurance period and the remaining parameters are identical to those that appear in conditions (e),(f).

Condition (g) ensures that the value of bank assets will be greater than the equity value throughout the period whereas (h) states that the maximal loss of equity holders at the end of the period is zero whilst their profits are unlimited.

Now after imposing these boundary and initial conditions we can express the value of the equity during the insured period as:

(14) $$E = \left(P*A - IP\right) \times N\left(d_1\right) - \left(D+S^*\right) \times N\left(d_2\right)$$

where

(15) $$d_1 = \frac{\ln\left(\frac{P*A-IP}{D+S^*}\right) + \frac{\sigma^2}{2}}{\sigma}$$

(16) $$d_2 = d_1 - \sigma$$

and

$$\sigma^2 = \sigma_A^{\ 2} + \sigma_P^{\ 2}$$

It is clear from equation (14) that in addition to the direct effect of the manager through his contribution A and his cost to the owners S*, he also affect bank assets risk which therefore influences his being chosen for the job and the motivation in raising the risk level of the bank's assets, as we shall now see.

The manager's salary at the end of the period (expiration date of the insurance contract) is dependent on the bank assets value at the time. According to table 1 if the assets' value is lower than the insured deposits [$V_T < D_T$] the manager does not receive anything. Otherwise, the manager receives the difference in value between the assets and the insured deposits up to the size of his salary.

That is to say, if the asset value is insufficient to cover all his salary the manager receives only the difference [V_T-D_T] whereas in the common case [$V_T > D_T$] he receives a full pay.

It is possible to present the manager's salary as the buying of a call option with a low striking price (D) and selling a call option with the higher price (D+S*), simultaneously. These two options are written on bank assets (minus the insurance premium) and have the same remaining time until the insurance period ends.

The manager's salary (uncertain) at any time in the period is equal to:

(17) $$S = C_L - C_H = \left(P*A - IP\right) \times N\left(s_1\right) - D \times N\left(s_2\right) - \left[\left(P*A - IP\right) \times N\left(d_1\right) - \left(D+S^*\right) \times N\left(d_2\right)\right]$$

where

$$s_1 = \frac{\ln\left(\frac{P*A-IP}{D}\right)+\frac{\sigma^2}{2}}{\sigma} \tag{18}$$

$$S_2 = S_1 - \sigma \tag{19}$$

where C_H, C_L are the call options with high and low striking price, respectively and dl, d2 are the same for equations (15) and (16), respectively.

If the information between the insurer and the bank is symmetrical then the manager's attitude towards risk, is set according to the relation between the depositors and the assets. Figure 1 presents the manager's salary as a function of this relationship and the risk level of bank assets.

[insert figure 1 here]

It can be seen from figure 1 that if the present value of bank assets is less than the deposits (the lowest line has a financial leverage of 0.93), any rise in the risk level increases the probability that the asset value at the end of the period will be greater than the deposits at this time - which hereby allows payment of the manager's salary. This means that the manager's situation is the same as a call-option holder interested in increasing risk. Conversely, where the present value (affected by the manager's contribution A) is large compared to the present value of deposits, the manager's situation is comparable to a seller of a call option, interested in reducing risk. (the top line has a financial leverage of 1.17). If the present value of bank asset is approximately equal to that of deposits (middle line on the figure) the manager's situation is similar to buying and selling two call options with different striking prices, simultaneously.

Note that if the information between the bank and the insurer is symmetrical and if the bank has positive equity at the beginning of the period (asset value is greater than liabilities), increasing risk worsens the manager's situation in all cases.

To finish this section, we will confirm that an 'economic balance sheet' (given earlier) consisting of various stakeholders with differing interests in the bank, does indeed balance. That is we will see that the present value of the assets less the insurance premium is equal to the present value of: the deposits plus the manager's salary and the equity less the insurance premium.

First we express the insurance premium from equations (1 1)-(13) by using these identities: log(X/Y) = -log(Y/X) and N(X) = 1-N(-X) where N(..) is the standard cumulative normal function, as follows: IP = D-(P*A-IP)+C_L. If we take IP from both sides of the equation, we get C_L = P*A-D. The equity E is equal to C_H that is a call option with the high striking price (D+S*). If we therefore substitute E into equation (17) the manager's salary is equal to S = P* A-D-E. If we pass E to the other side and subtract IP from both sides, we obtain D+S+E-IP=P*A-IP, and the 'economic balance sheet' does indeed balance.

3.1 Symmetric Information

We assume here that the insurer sets the risk adjusted insurance premium at the start of the period when the information between it and the bank is symmetrical. That is the insurer knows at this point the 'true' risk level of the bank. According to our assumption, after the manager takes up his position, he is able to change the risk level with the owners' knowledge. However, with symmetric information the insurer is also aware and adjusts the insurance premium accordingly. To allow this, we will assume that at the start of the period the bank assets are greater than its liabilities. We will now demonstrate the effect of the risk level of bank assets on equity and the manager's salary when the latter is predetermined.

Definition:
The 'pie' is the present value of both; equity and the manager's salary after the payment of an 'actuarially fair insurance premium. In the context of the discussion framework, the pie is the net asset worth (less depositors' liabilities and insurance premium payment) and is divided between the owners and manager.

Proposition 1
If the manager's salary is predetermined, the insurer collects an 'actuarial fair insurance premium' and the information between it and the bank is symmetrical, then the bank's asset risk level has no effect on the size of the 'pie'. If so, then the risk level positively affects the equity and negatively affects the manager's salary.

Proof:
First we will see that the risk level has no effect on the size of the 'pie'. We saw from the 'economic balance sheet' earlier that D+S+E-IP=P*A-IP from which we isolate the 'pie': S+E. As S+E=P*A-D, the risk level σ_V does not appear on the right hand side of this equation it does not affect the size of the 'pie'. That means, after the insurer has collected a 'fair actuarial premium' the 'pie' that remains to be distributed between the bank's owners and manager, is fixed as a sum of asset value less deposits, with no connection to risk. This is because although a rise in the risk level increases the value of the equity , it similarly increases the 'fair actuarial premium' by exactly the same amount .[24]

We will note that the 'pie' (P*A-D) is to be shared between the manager and owners. Therefore any increase in risk will improve the situation for one at the expense of the other. In appendix 1 it can be seen that the attitude of the equity holders is positive towards risk, and that of the manager, negative.

This proposition influences the choice of manager, as the owners of a 'healthy' bank with a positive 'pie', will have an incentive in choosing a manager that 'takes risks' (high σ_V) thereby raising the equity value. Conversely, a manager has opposite interests since a rise in the risk level *(ceteris paribus)* increases the chances of failure and reducing the present value of his salary. In this way Proposition 1 is consistent with the conflict between the manager and it's owners in the 'agency theory'. This conflict, supported by

[24] If the premium is not 'actuarially fair', as a result of asymmetry in information between the insurer and bank, for example, then the 'pie' will grow to the benefit of the owners and manager at the cost of the insurer. We will examine this situation later.

empirical evidence in banking (Saunders et al.; 1990, for example) demonstrates that the manager is inclined, and acts, to reduce risk whilst the owners wish the opposite.

3.2 Asymmetric Information

In this section, we will estimate the values of equity and the manager's salary when the information between the bank and the insurer is asymmetric, i.e. after the owners have chosen an manager and the premium is set according to his characteristics, the manager alters the risk level with the owners' knowledge but without the insurer's. Let the ratio between the 'true' asset volatility and that reported to the insurer be $\delta \equiv \sigma_V{}^*/\sigma_V > 1$.[25] Although the 'pie' grew as a result of the realization of the informed risk (vs. the 'true' one), it is still necessary to check whether the manager's attitude towards risk has changed.

The manager is interested in raising the low level of risk up to the point at which any additional rise will reduce the present value of his salary. As we have seen above, this phenomenon can be explained by representing the manager's salary as the simultaneous holding and selling of two call options with different striking prices.

With symmetric information, the manager 'rejects risk' as on the one hand, he may lose the salary promised to him, and on the other hand, the 'pie' did not grow as a result of increasing risk (the 'actuarially fair insurance premium' grew with risk). In comparison, with asymmetric information the 'pie' grows on the expense of the insurer hence, these two considerations work in opposite directions. Therefore, at low risk levels the 'pie' grows quickly and the manager prefers the first consideration whereas at high risk levels the opposite is true. In order to analyze this in our model, we will use again the 'economic balance sheet' shown earlier.

We saw that if the information between the bank and the insurer is symmetric, then the 'pie' remains fixed and does not grow with risk level. However, when the information is not symmetric, the manager and owners 'profit' from that moral hazard and the 'pie' grows.

Let us define the manager's and owners' profits from this moral hazard as $MH=IP-IP_{asym}$, where IP_{asym} is the insurance premium based on the reported risk which is lower than the 'true' risk, and IP is the 'actuarially fair insurance premium'. That is, if the information is not symmetric, then the 'pie' grows as a result of realizing the moral hazard of S+E+MH where S and E are based on IP.[26]

The manager's attitude towards risk is a function of his salary when information is symmetric and his share of MH. On the one hand, his attitude is negative when information is symmetric (Proposition 1) but on the other hand, he increases his salary as a result of a larger 'pie'. That is, given IP_{asym}, the manager's share of MH is a positive function of risk (IP is a positive function of risk). Therefore the function of his salary when information is asymmetric is not monotonic, if, as a result of a rise in risk level, his share

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[25] As δ increases, so the difference between the 'true' risk and the reported one increases, insurance premium from the insured bank decreases. We have ignored the question of why the owners don't raise δ to the maximum possible, as answering this would require a more general model which is beyond the scope of this paper.

[26] In the 'economic balance sheet' when information is asymmetric we obtain, therefore, the following: D+S+E=P*A+MH where E and S are based on IP.

in MH increases more than the reduction in his salary S with symmetric information, his attitude will be positive towards risk and vice versa. Figure 2 represents the manager's predetermined salary as a function of risk.

[insert figure *2* here]

We can see from figure *2* that increasing the risk level increases the manager's salary up to a certain point, beyond which the salary falls. That is, at the lower point of the scale (up to a standard deviation of 0.2) the manager's share of MH grows faster than the reduction of his salary in S with increasing risk, whereas where the curve falls, the opposite is true.

3.3 Attitude of the Owners to the extent of Asymmetry of Information

Inspection of the salary function of the manager and owners shows that both parties have an incentive to deepen the asymmetry between the bank and the insurer as both benefit from an increase in the 'pie' (the insurance premium being lower than 'fair'). It is also clear that the size of profit for the equity holders and the manager as a result of the asymmetry is equal to the loss of the insurer, a' sum zero game'.

The motivation to deepen this asymmetry in information is dependent on the manager's character. It is possible to see that the more the manager's contribution is to bank assets (A) and less to the risk level (σ_A), the less the owners benefit from asymmetric information. Conversely, the owners benefit more when the manager contributes less to the assets and more to the risk.

Figure 3 shows the indifference curve of the owners for symmetry/asymmetry with respect to the manager's characteristics (A and σ_A).

[insert figure 3 here]

Given the unmanaged asset values (μ_P) and their risk (σ_P), each point on the curve represents the same deposit insurance premium. The area under the curve characterizes the managers as 'steady' and 'cautious' where their contribution to asset value is great. In this area, the owners benefit less from asymmetry of information and the 'fair' premium is indeed low. Conversely, the area above the curve characterizes managers that follow policies of 'taking risks' with a small contribution to the asset value (low A). Since an increase in risk by this manager contributes to the equity holders, the latter benefit more from asymmetry in information and moral hazard; this is because the 'actuarially fair premium' is relatively high.

4. Bonus Payments

We assume here that the manager receives as payment, a bonus at the end of the insurance period, calculated as a percentage of bank assets at the time. The manager's position is similar to that of shareholders however, the former has priority on receiving the bonus payments.[27]

If λ represents the manager`s share of bank assets($0<\lambda<1$), then the physical payments to the manager at the end of the period will be $\lambda*V_T$ where V_T is the asset value at the end of the insurance period, obtained by investing P*A-IP at the start of the period.[28]

We saw earlier that in addition to the four initial conditions (a)-(d) above, we need two boundary conditions in order to solve the partial differential equation (equation 10). We will here add two boundary conditions to solve for equity as follows:

(i) $$P_t * A_t \geq E\left(P, A, D, S^{\bullet}, \sigma, r, dt\right) \geq 0$$

(j) $$E_T = \max\left[0; V_T - (D+S)_T\right]$$

where E is equity value, $S_T = \lambda*V_T$ represents the value of the manager's salary at the end of the period, subscript T represents values at the end of the insurance period and remaining parameters are the same as for (e),(f).

Condition (i) ensures that the bank's asset value is greater than equity throughout the period, whereas condition (j) sets the equityholders' losses to a minimum of zero, whereas profits are unlimited. As with predetermined salary, we can calculate now the equity value and manager's salary under two assumptions; symmetry versus asymmetry of information. Note that the size of the fair insurance premium (IP) calculated earlier does not change as the insurance premium is not calculated as an internal division of the 'pie' between the manager and owners.

4.1 Symmetric Information

Let us assume that the insurance premium is determined at the beginning of the period, and set according to the level of the 'true" risk and that the values of the equity and the manager's salary are according to these assumptions.

The manager's salary at the end of the period is a function of the asset value ($S_T=\lambda*V_T$) when, from the owners' point of view the manager's payment is a liability like that to the depositors. Therefore the striking price of the call option (held by the shareholders) is a sum of the insured deposits and the manager's salary $(D+S)_T$.

The function of the receipts of the equity holders at the end of the period is therefore similar to a call option that pays dividends:

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[27] If the manager is paid in actual shares and not salary, he becomes like a shareholder in every respect. In this trivial case we can expect him to behave like his owners. The bonus payments in our present model are a particular type of 'phantom shares', as if urging the manager to increase the market value of the assets as his salary will be set according to the value at the end of the period.

[28] The difference between paying the manager a bonus or predetermined salary is linked to the asset value. With a predetermined salary, there is no direct link to asset risk. However, with bonus payments, any change in the risk level upon which the manager makes decisions, may influence the present value of his salary. Therefore there arises a simultaneity in fixing asset value and manager salary. In addition we can see that as the manager and owners both benefit from an increase in risk there is no conflict between them regarding asset risk (assuming asymmetric information with the insurer) as with the predetermined salary. They will therefore prefer to increase risk for as long as it is at the insurer's expense.

$$\max\left[0, V_T - \left(D_T + \lambda V_T\right)\right] = \max\left[0, V_T^{\bullet}(1-\lambda) - D_T\right]$$

The equity value throughout the period is therefore:

(20) $$E = (P * A - IP) \times N(d_1) - \left(D + \lambda[P * A - IP]\right) \times N(d_2)$$

where

(21) $$d_1 = \frac{\ln\left(\dfrac{P * A - IP}{D + \lambda[P * A - IP]}\right) + \dfrac{\sigma^2}{2}}{\sigma}$$

(22) $$d_2 = d_1 - \sigma$$

and, as we saw earlier: $\sigma^2 = \sigma_A^2 + \sigma_P^2$

The manager is paid at the end of the period according to table 1 and the value of the assets as follows:

(23)
$$S_T = \begin{cases} \lambda V_T & \text{if } V_{T^*}(1-\lambda) > D_T \\ V_T - D_T & \text{if } V_T > D_T > V_{T^*}(1-\lambda) \\ 0 & \textit{if} \quad D_T > V_T \end{cases}$$

This equation is in effect, like the case of a bull spread where the striking price ($D_T+\lambda V_T$) of the call option sold at the end of the period, grows with a rise in the asset value, as follows:

$$\cdot S_T = \max\left(\min[V_T - D_T, \lambda V_T], 0\right) = \max(V_T - D_T, 0) - \max\left(V_T - [D_T + \lambda V_T], 0\right)$$

The manager's salary at any time throughout the period is equal to:

(24) $$S = C_L - C_H = (P * A - IP) \times N(s_1) - D \times N(s_2) - \left[(P * A - IP) \times N(d_1) - \left(D + \lambda * [P * A - IP]\right) \times N(d_2)\right]$$

where

(25) $$s_1 = \frac{\ln\left(\dfrac{P * A - IP}{\cdot D}\right) + \dfrac{\sigma^2}{2}}{\sigma}$$

(26) $$S_2 = S_1 - \sigma$$

and where d_1, d_2 are the same as in equations (21) and (22), respectively, and σ too.
Figure 4 shows the function of the manager's salary, dependent on the values of the assets and equity when the manager receives bonus payments.

[insert figure 4 here]

The difference between predetermined salary and bonus payments lies in the striking price which, with the predetermined salary does not change, but with bonus payments, the asset value at the end of the period dictates the striking price. When the present values of the assets is greater than the striking price (V > D+λV) the function of the manager's bonus payments is like that of the equity holders when the difference between them rests only on the size of λ that determines what share of the pie the manager and the owners receive. According to proposition 1 if the manager receives a predetermined salary, the insurance premium is 'actuarially fair' and the information between the bank and the insurer is symmetric, then the risk level of bank assets has no effect on the size of the 'pie'. Let us now examine the case with bonus payments.

Proposition 2:
If the manager receives bonus payments as his salary, the insurer sets an 'actuarially fair insurance premium' and the information between the insurer and the bank is symmetric, then the risk level of bank assets has no effect on the size of the 'pie'. In addition, the risk level positively affects the equity and negatively affects the bonus payments.

Proof:
As with proof for Proposition 1, the risk level has no effect on the size of the 'pie' (the equity plus bonus payments), as any rise in risk level increases the 'actuarially fair premium'. First let us express the insurance premium from equations (11)-(13) whilst using the identities: log(X/Y) = -log(Y/X) and N(X) = 1-N(-X), where N(.) is the standard cumulative normal distribution function; as follows IP = D-P*A-IP)+C_L, where C_L is a call option with a low striking price (D in equation 24). If we subtract IP from both sides of the equation, we obtain C_L = P*A-D. The equity E is equal to C_H, a call option with a high striking price (D+λV in equation 24). If we now substitute these into equation 24, the manager's salary will be equal to: S = C_L-C_H = P* A-D-E, or: S+E = P*A-D, that is, the 'pie' is independent of risk level.
The results obtained here are identical to those with the predetermined salary. In both cases where the information between the insurer and the bank is symmetric, the 'pie' remaining after payments of the insurance premium and liabilities to the depositors, is independent of risk level. Therefore, if the insurance premium is 'actuarially fair', any rise in the risk level that is intended to increase the size of the 'pie', will equally increase the premium, and the remaining 'pie' size remains unchanged.

For the second part of the proposition, as the 'pie' is fixed, any increase in the owners' income will lower the bonus payments. The owners are interested in increasing the risk level (appendix 2) as they consequently increase the present equity value. Therefore, the manager that receives bonus payments is interested in limiting risk.
We can conclude that, if the information between the bank and the insurer is symmetric (the 'pie' does not change with risk), the negative relationship between the manager and risk is independent of whether the manager receives a predetermined salary or bonus payments.[29]

[29] If the manager receives only shares at the beginning of the period as his payment, his attitude towards risk is the same as the equity holders. In the case where the 'pie' is fixed, we can see that the owners and the manager will both be indifferent to risk, as the relative shares of the manager λ*(V-D) and those of the owners (1-λ)*(V-D) in bank assets do not change.

4.2 **Asymmetric Information**

Let us assume here that the size of the premium (IP_{asym}) is set based on the bank's report to the insurer that the total risk of the assets is σ_V, when the 'true' risk is σ_V*. Giving IP_{asym} (smaller than the 'fair actuarial premium IP), a rise in the risk level of bank assets, increases the size of the 'pie'. Let the profit earned by the manager and owners as a result of this moral hazard be: MH = IP-IP_{asym}, where IP is the 'actuarially fair premium'. That is, the 'asymmetric pie' grows as a result of the moral hazard to S+E+MH when S and E are calculated according to IP, and MH is divided between the manager and owners according to λ.[30]

As we know that for given IP_{asym}, $\partial MH/\partial\sigma_V > 0$ (the derivative for IP with respect to risk is positive), then the present value of the equity grows. Conversely, for any risk growth, the 'pie' grows and with it , the bonus payments (see appendix 2 and Figure 2). This growth has two causes. The first stems from the manager's salary function which grows with risk level, and the second as a result of his share in MH that also grows with the gap between the reported and 'true' risk. Note that as λ grows, the manager benefits more from the asymmetry of information and therefore this may influence his attitude towards risk.

5. Contract without Conflict

In this section we will examine if the existence of a 'contract without conflict' between the owners and manager affects the assets' risk level. The absence of such a contract could lead to instability in the banking system., as we shall see later.

According to our assumption, after the manager takes up his position, he chooses the asset risk level according to his preferences and that does not change throughout the period. If this is done without the insurer's knowledge, the manager (with the owners knowledge) determines the assets risk level and the extent of information asymmetry.[31] For the owners, they affect risk only through their choice of manager - 'cautious' (with a low σ_A) or one that takes risks (high σ_A). The existence of a 'contract without conflict' between the manager and owners regarding the relevant variables is determined by the first derivatives of the profit functions of both sides. If these derivatives have the same sign (rising or falling) in the relevant area, we can call this a 'contract without conflict' with respect to the variable in question. In such a situation a 'contract without conflict' may cause instability as there are no conflicting interests between the parties and therefore no internal

[30] The insurance premium IP_{asym} is paid according to the assumption at the beginning of the period from the bank's assets. Therefore the assets available for investment grow at MH, and the manager receives a share of them according to his contract with the owners, that is, according to λ.

[31] We may describe a situation somewhat different from the case here. In an alternative circumstance, there exist in the labor market managers characterized by their expected contribution to assets (μ_A) and their stability (σ_A). The owners would prefer managers that meet their highest expectations, as they would increase the present value of the equity, whilst the managers' approach is dependent on: form of payment, bank situation and asymmetry of information. If the bank is 'healthy' and the manager's salary is predetermined, there would be a tendency to employ steady and conservative managers that do not endanger the bank. However if the bank is in difficulties, there is asymmetry of information and the manager receives bonus payments, they would prefer to employ managers that take risks. Therefore, with a predetermined salary, a 'contract without conflict' between managers holding a bull spread i.e. preferring to minimize risk level, and owners interested in increasing it, may exist according to the model. Conversely, a 'contract without conflict' concerning risk level, will exist with bonus payments as both the owners and manager have an incentive to increase the risk level.

point of compromise or agreement between them. That is, at least one of the two can improve his situation by increasing risk without harming the other party.[32]

We saw earlier that if the information between the bank and insurer is symmetric, then the 'pie' does not grow as a result of the risk level and a 'contract without conflict' with respect to risk does not exist; as the owners increase their share of the 'pie' only at the expense of the manager.

The two following propositions examine the existence of such a contract for two payment systems; predetermined salary and bonus payments, when the information between the bank and the insurer is not symmetrical.

Proposition 3

If the information between the bank and insurer is asymmetrical and the manager receives a predetermined salary, then a 'contract without conflict', with respect to risk, will not exist between the owners and manager all over the range.

Proof

Let us examine the sign of the derivatives of the manager's and owners' income function. If we find that, as supposed, the derivative of the equity function has the opposite sign to that of the manager, then we can state that no 'contract without conflict' exists between them. If however we find that the two derivatives are uniformly of the same sign, then such a contract is possible. Differentiating the equity function with respect to risk shows us (appendix 1):

Against this we saw earlier (Figure 2 and appendix 1), that after a certain point, the manager's salary falls with rising risk. Therefore, the approach of an manager whose salary is predetermined to a rise in risk level, is negative for certain levels of risk. Such is our proof.

Proposition 4

If the information between the bank and insurer is asymmetrical and the manager receives bonus payments, then a 'contract without conflict' between the owners and manager, with respect to risk level, is possible.

Proof

The fact that the manager receives a salary as a function of the asset value, exactly like the equity holders (only he has priority over them), changes the picture completely. Differentiating the function of the manager's salary (appendix 2) gives us: $\partial S/\partial \sigma_V > 0$. Differentiating the owners' income function (appendix 2) gives us: $\partial E/\partial \sigma_V > 0$. As these derivatives are of same sign, a rise in the asset risk level will improve the situation for both manager and owners, and, therefore a 'contract without conflict' is possible.

32 This is by definition a *Pareto-optimal* contract, with respect to the risk level of the bank assets, between the manager and his owners.

These results may affect both the relationship between the manager and his owners, and that between the insurer and the insured banks. Firstly, if the manager receives bonus payments, internal instability exists as a result of the 'contract without conflict' with respect to risk level. Saunders et al. (1990) and Lloyd et al.(1987) found that the manager in a banking firm acts to reduce the risk level of the bank's assets. However, according to the model where the manager receives bonus payments, he has an incentive to increase both risk and the asymmetry of information. An additional support for these results can be found in Agrawal and Mandelker (1987), who showed that the more a manager receives shares and share options in his salary package, so the more he takes up risky ventures.
DeFusco, Johnson and Zorn (1990) reported on positive reactions of the share market and a negative reactions of the bond market to the banks' announcement of adopting a bonus payment scheme for managers. They explained this phenomenon by the markets' assumption that the managers were going to raise the risk level for the benefit of the shareholders and at the bond holders expense.
Shaven (1979) argues that if the manager is risk-averse a good salary contract may be dependent on the firm performance but never leaves the manager carrying the risk alone. In the banking system and according to this model where information is asymmetrical, there are situations in which the manager 'enjoys' a rise in risk and there is certainly no need to compensate him for this. In these cases, where the manager's and owners' preferences are mutual, the results found are diametrically opposed to those found from the banking 'agency theory': which states that the manager acts to reduce risk against the owners will.

The owners have a motivation to increase risk level (John et al. 1991) whatever the form of manager's payment, whether there is symmetry of information with the insurer or not. Consequently and as they cannot influence the risk level directly, they must care to affect risk indirectly, either by choosing a 'risky' manager or by paying the manager bonus payments.

The insurer on his part must be aware of the form of payment and the possibility of asymmetrical information arising between it and the banks. Therefore if the aim of the insurer is to reduce the motivation of the banks' owners to increase the risk level of the bank assets, then it is recommended to restrict contracts that grant bonus payments to managers (as has been done in the United States for portfolio managers in the past).
These statements are especially crucial about banks in difficulties when the value of the 'pie' aims to zero, and in times of deregulation.[33]

6. Conclusion

We have examined the incentive to raise risk level in financial institutions that are insured by deposit insurance. In the framework of an options pricing model, we have regarded the equity holders as being in possession of a call option written on the bank's

[33] Empirical evidence (Keeley 1990; Crawford et al. 1995) shows that in times of deregulation when restrictions on taking risk are removed, banks' risk level grew, in USA.

assets; the insurer as writing a put option; and the manager as buying and selling two call options with differing striking prices.

The model presented here fits in well with the modem trend to see in a manager and 'quality management' parameters of great importance in controlling the risk level of bank assets; and this is in the light of empirical findings that the management of risk is one of the principal causes of bank failures.[34] We have examined in this framework two types of payments to the manager: predetermined salary and bonus payments whose value are a function of the assets. The insurance premium, equity value and manager's salary were calculated according to one of the payment methods and under two following assumptions; symmetrical information between the bank and the insurer compared to asymmetrical information.

We found that if the information between the bank and the insurer is symmetrical, and the insurer sets an 'actuarially fair insurance premium', then the risk level of bank assets does not change the 'pie' -equity value plus the manager's salary-whether the manager receives a predetermined salary or bonus payments. In comparison, when the information between the bank and the insurer is asymmetrical, the owners are interested in raising the risk level no matter what method of payment is chosen for the manager, but the manager's attitude towards risk is dependent on method of payment. If his salary is predetermined, then in most cases he will prefer to limit or even reduce the risk level whereas with bonus payments, his preferences match those of the owners.

We also examined the existence of a 'contract without conflict' with respect to risk level of the bank assets, between the manager and owners (assuming asymmetry of information between the insurer and the bank). It was established that such a contract does not exist if the manager's salary is predetermined. However if the manager receives bonus payments, a 'contract without conflict' is possible between manager and owners, as the conflict of interest between them disappears if the information between the bank and insurer is asymmetrical. In this case, the salary of the manager, like that of the owners, is a function of bank assets and his share in the moral hazard. This profit, is derived from paying an insurance premium lower than the 'actuarially fair premium' (as a result of asymmetrical information). Therefore, any increase in the risk would be worthwhile to the manager as well as the owners.

This result points to a potential source of instability in a banking system that insures its deposits. In the light of this, it is recommended that the insurer or other control authority should restrict contracts with bank managers to those that grant bonus payments.

[34] A study made by the OCC in 1992 of the factors contributing to bank failure in the US showed that in 63 percent of cases the level of audit and control was inadequate, in 57 percent decisions were made by one dominant element, and in 49 percent the management of assets and liabilities was defective.

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Appendix 1

Shareholders attitude to risk (Predetermined salary) with Symmetrical Information

Assume that the owners pay the bank's manager a predetermined salary (for the sake of generality, we need not assume dt=l in the proof). We saw that the equity value is equal:

(27) $$E = (P * A - IP) \times N(d_1) - (D + S^*) \times N(d_2)$$

where

(28) $$d_1 = \frac{\ln\left(\frac{P * A - IP}{D + S^*}\right) + \frac{\sigma^2 dt}{2}}{\sigma \sqrt{dt}}$$

(29) $$d_2 = d_1 - \sigma \sqrt{dt}$$

and

$$\sigma^2 = \sigma_A^2 + \sigma_P^2$$

As the pie does not change with risk (P*A-D) and IP is determined independent of the internal division between manager and owner, we will treat IP as fixed and differentiate E with respect to risk. According to the chain rule, the differential of equity with respect to risk is:

(30) $$\frac{\partial E}{\partial \sigma} = (P * A - IP)\frac{\partial N(d_1)}{\partial d_1} \times \frac{\partial d_1}{\partial \sigma} - (D + S^*)\frac{\partial N(d_2)}{\partial d_2} \times \frac{\partial d_2}{\partial \sigma}]$$

Differentiating the cumulative standard normal function with respect to d_1:

(31) $$\frac{\partial N(d_1)}{\partial d_1} = \frac{e^{-d_1^2/2}}{\sqrt{2\pi}} = N'(d_1)$$

d_2 relates to d_1 in this way:

(32) $$d_2 = d_1 - \sigma \sqrt{dt} \Rightarrow$$

$$d_2^2 = d_1^2 + \sigma^2 dt - 2 d_1 \sigma \sqrt{dt}$$

Putting both sides as power of e, after dividing by 2, gives:

(33) $$e^{-d_2^2/2} = e^{-d_1^2/2} \times e^{-\sigma^2 dt/2} \times e^{d_1 \sigma \sqrt{dt}}$$

Substituting these expressions in the differentials, and defining for d_1:

(34) $$\frac{\partial N(d_2)}{\partial d_2} = \frac{e^{-d_1^2/2}}{\sqrt{2\pi}} \times \left(\frac{P * A - IP}{D + S^*}\right) = N'(d_1) \times \left(\frac{P * A - IP}{D + S^*}\right)$$

Calculating the differentials $\partial d_1/\partial\sigma$ and $\partial d_2/\partial\sigma$ as follows:

(35) $$\frac{\partial d_1}{\partial \sigma} = \sqrt{dt} - \frac{d_1}{\sigma}, \qquad \frac{\partial d_2}{\partial \sigma} = \frac{d_1}{\sigma}$$

Now substituting all the above expressions in equation (29) and rearranging terms, we get:

$$\frac{\partial E}{\partial \sigma} = \left(\frac{P * A - IP}{D + S^*} \right) \times \left[N'(d_1) \times \sqrt{dt} \right] > 0 \qquad (36)$$

The equity holders attitude towards risk is positive as shown here: P*A-IP>0 (from boundary conditions e) and since the pie is positive: D=P*A-(E+S) and D+S*>0.

Equity holders' Attitude to Risk with Asymmetrical Information

If we separate the equity function into the symmetrical part and the profit resulting from the moral hazard, we obtain the equity holders attitude towards risk with asymmetrical information. We have already seen that the derivative of the equity function with respect to risk is positive when information is symmetrical. Similarly with the derivative of MH with respect to risk, IP_{asym} is the premium fixed according to the reported risk, that is lower than the 'actuarially fair premium' - IP. Hence the equity holders' attitude towards risk is positive in every case, with respect to risk and the derivative of the equity function is equal to:[35]

$$\frac{\partial E}{\partial \sigma^*} = \frac{\partial E}{\partial \sigma^*} + \frac{\partial MH}{\partial \sigma^*} =$$

$$\left(\frac{P * A - IP}{D + S^*} \right) \times \left[N'(d_1) \sqrt{dt} \right] + \frac{\partial \left(IP - IP_{asym} \right)}{\partial \sigma^*} > 0 \qquad (37)$$

where E is equity when information is asymmetrical and σ_V* represents the 'true' asset risk which is bigger than that reported $\sigma_V = \delta\sigma_V$* ($\delta > 1$).

Manager's Attitude to Risk with Asymmetrical Information

If we split the function of the manager's salary into the symmetrical part and the profit resulting from the moral hazard, we obtain his attitude to risk in a world of asymmetrical information. IP_{asym} is the premium set according to the reported risk, which is less than the 'actuarially fair premium'. Therefore, given IP_{asym} the derivative of MH $=$IP-IP_{asym} is positive with respect to risk as the 'actuarially fair premium' IP grows with a rise in risk level. Conversely, differentiating his salary function S when information is symmetrical

[35] The manager and owners are supposed to divide MH in a proportion that changes with risk. In the following derivatives, we have not referred to the internal division between the manager and owners, only in as much as they are always positive as they both 'profit' from MH. In order to obtain the internal split between them, the manager's and owners' income function must be differentiated an additional time.

(without profiting from moral hazard) is negative with respect to risk (proposition 1). Therefore, his attitude towards risk is uncertain:

$$\frac{\partial S^*}{\partial \sigma^*} = \frac{\partial S}{\partial \sigma^*} + \frac{\partial MH}{\partial \sigma^*} = \left(\frac{P * A - IP}{D}\right) \times N'(s_1)\sqrt{dt} -$$

$$\left(\frac{P * A - IP}{D + S^*}\right) \times N'(d_1)\sqrt{dt} + \frac{\partial\left(IP - IP_{asym}\right)}{\partial \sigma} \qquad (38)$$

The second expression on the right hand side is positive (equation 36); and so is the first expression (if we set S*=0 into equation 36). The third expression that is the derivative of MH with respect to risk is always positive, as we have seen. Therefore the manager's attitude towards risk depends on the 'profit' from asymmetric information - MH, size of salary promised to him and relationship of liabilities to assets; read as financial leverage (see Figure 2). If the sum of the first and third expressions is greater than the second on the right hand side of the equation, then the manager's attitude towards risk is positive. Otherwise his attitude is negative.

Appendix 2

Attitude of Shareholders, paying Bonus Payments, to Risk (Symmetrical Information)

We have seen already that the owners who pay bonus payments to the manager have a share of the equity equal to:

(39) $$E = (1-\lambda)(P * A - IP) \times N(d_1) - D \times N(d_2)$$

(40) $$d_1 = \frac{\ln\left(\frac{[1-\lambda][P * A - IP]}{D}\right) + \frac{\sigma^2 dt}{2}}{\sigma\sqrt{dt}}$$

(41) $$d_2 = d_1 - \sigma\sqrt{dt}$$

and

$$\sigma^2 = \sigma_A^2 + \sigma_P^2$$

We can differentiate the equity function with respect to risk in the same way as we calculated for the manager with predetermined salary, to obtain:

(42) $$\frac{\partial E}{\partial \sigma} = \frac{(1-\lambda)(P * A - IP)}{D} \times \left[N'(d_1)\sqrt{dt}\right] > 0$$

Both numerator and denominator are positive and therefore the equityholders' attitude towards risk is positive.

Attitude of Manager who receives Bonus Payments, to Risk (asymmetrical Information)

We assume here that the owners pay the bank's manager bonus payments. Let us split the manager's salary function into the symmetrical part and the profit resulting from moral hazard in order to obtain his attitude to risk in a world of asymmetrical information, as follows:

$$\frac{\partial S^*}{\partial \sigma} = \frac{\partial S}{\partial \sigma^*} + \frac{\partial MH}{\partial \sigma^*} = \left(\frac{P * A - IP}{D}\right) \times N'(s_1)\sqrt{dt} -$$

(43) $$\left[\frac{(1-\lambda)(P * A - IP)}{D}\right] \times N'(d_1)\sqrt{dt} + \frac{\partial\left(IP - IP_{asym}\right)}{\partial \sigma} > 0.$$

where d_1 and s_1 are identical to those in equations (40) and (25) respectively. If the first term on the right hand side is greater than the second, and if the third is positive, then in total the derivative is positive.

Figure 1

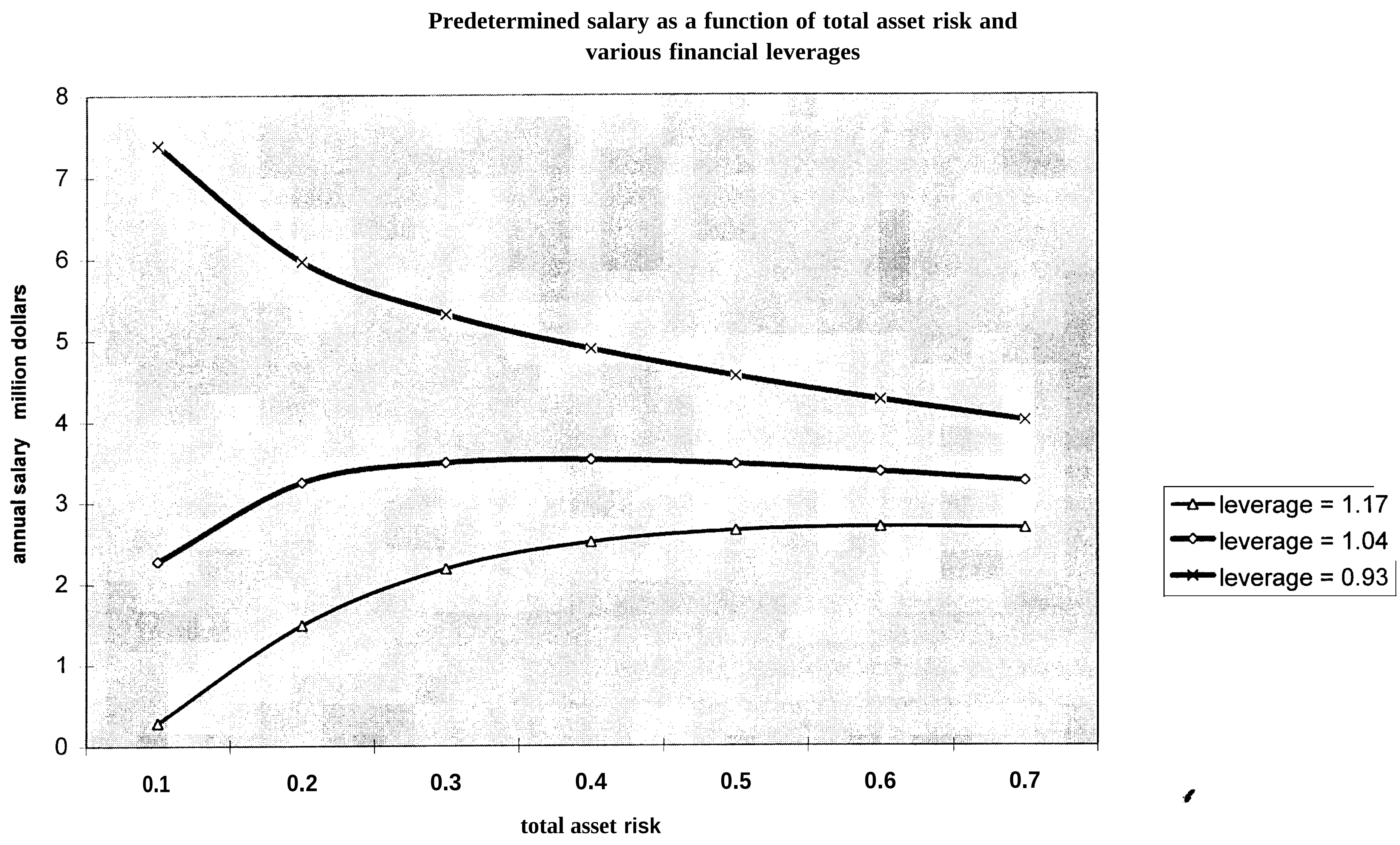

Predetermined salary as a function of total asset risk and various financial leverages
8
7
6
5
4
3
2
1
0
annual salary million dollars
0.1
0.2
0.3
0.4
0.5
0.6
0.7
total asset risk
leverage = 1.17
leverage = 1.04
leverage = 0.93

Figure 2

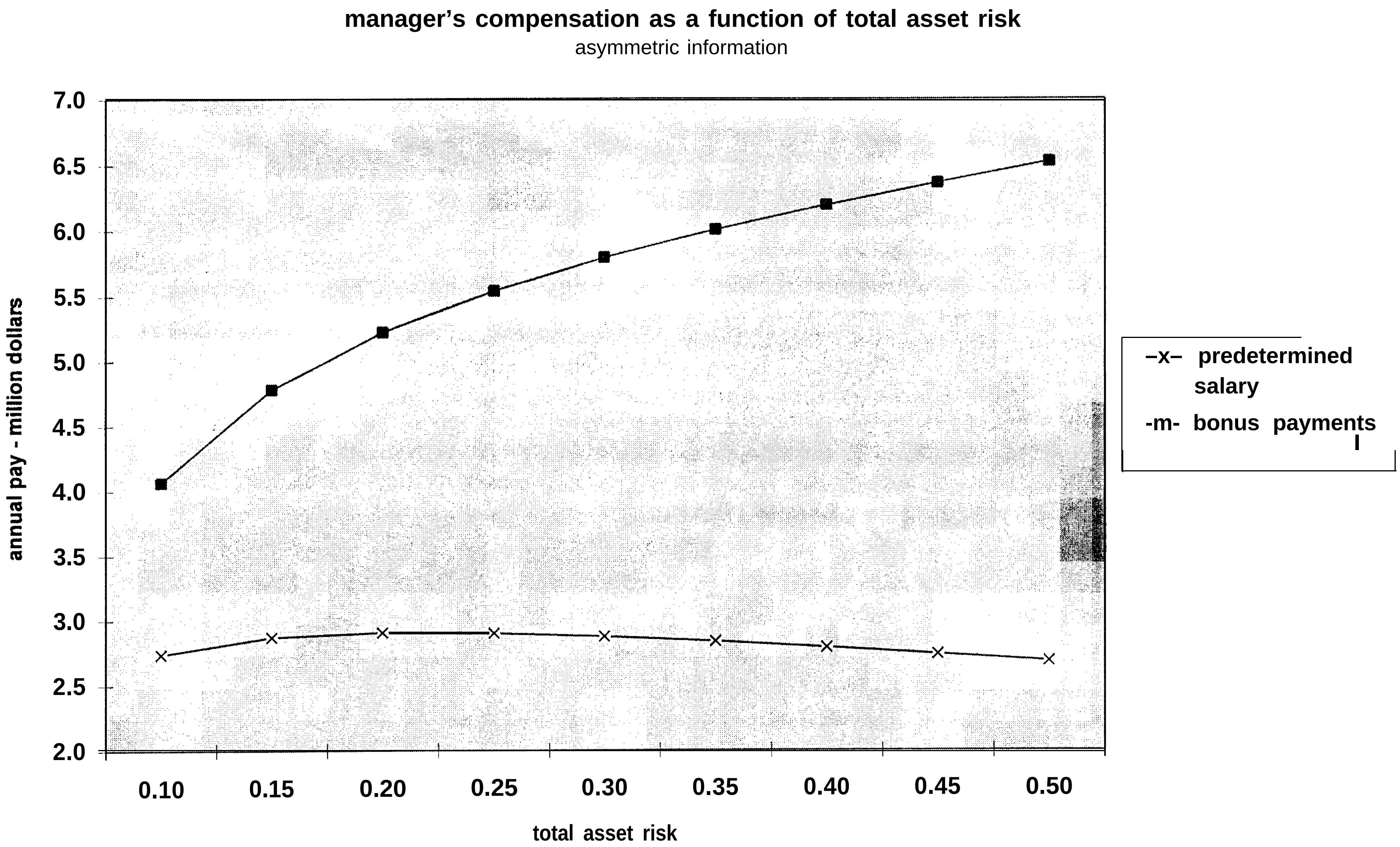

manager's compensation as a function of total asset risk
asymmetric information
annual pay - million dollars
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
total asset risk
–x– predetermined salary
-m- bonus payments

Figure 3

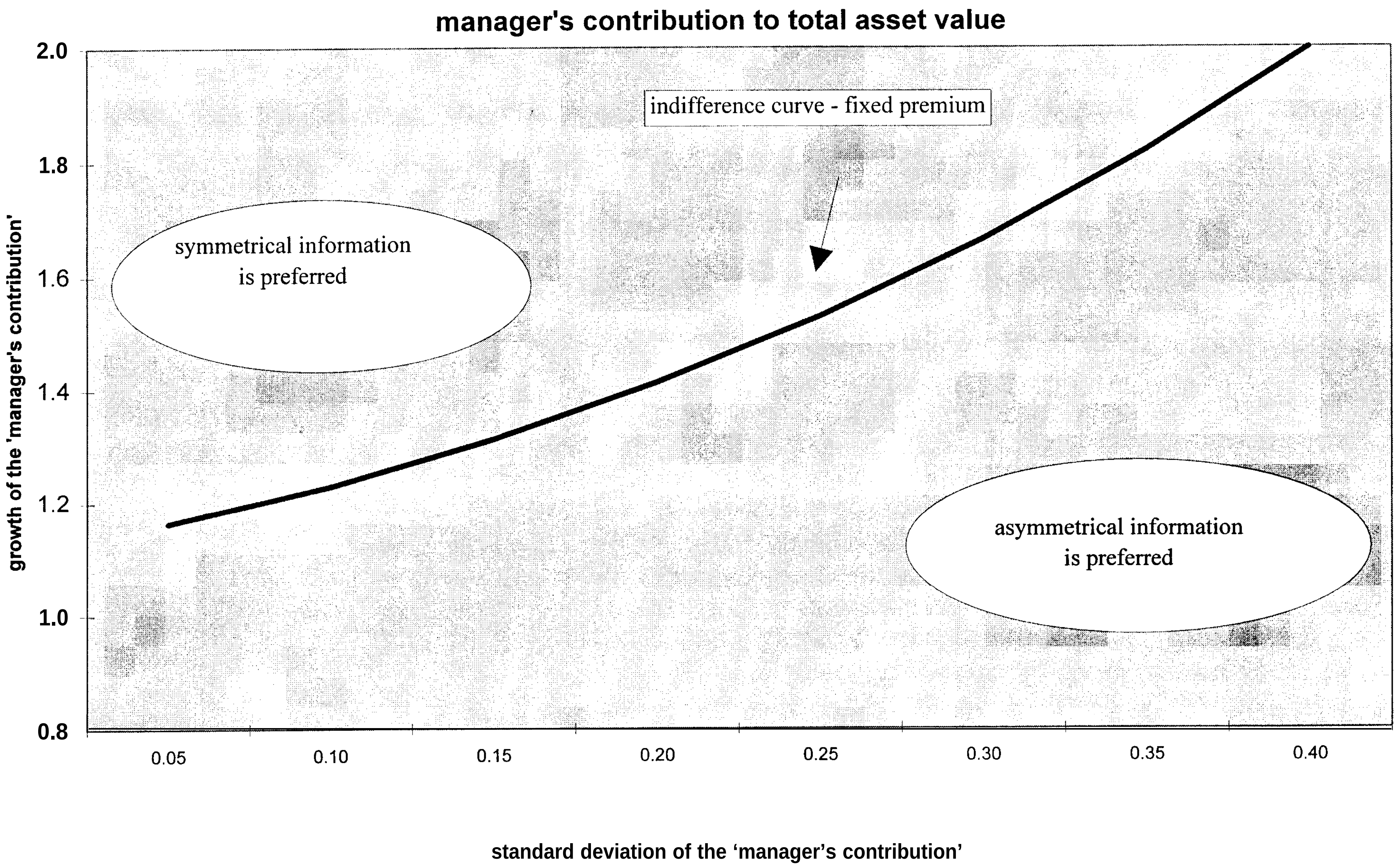
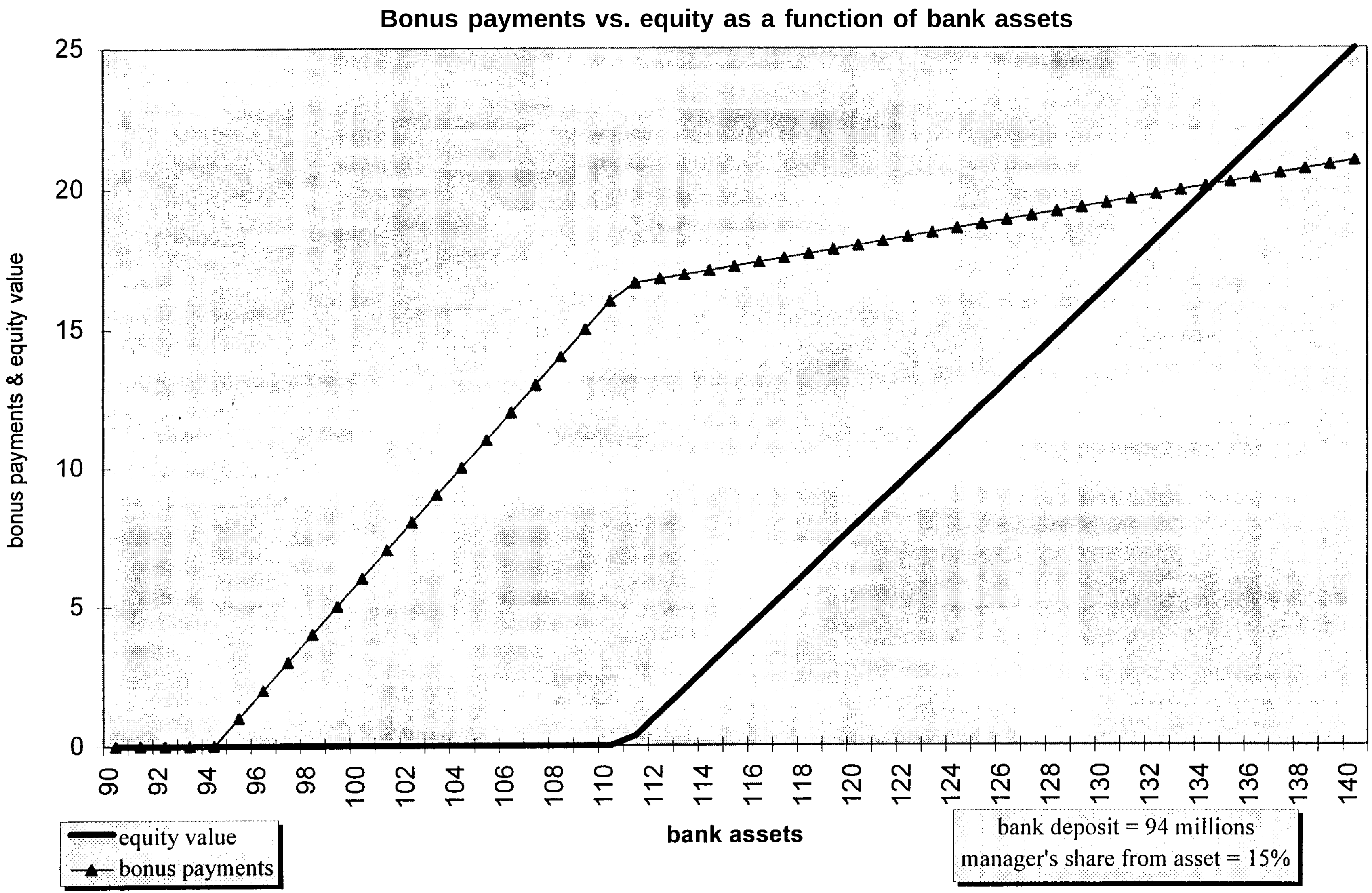

manager's contribution to total asset value
indifference curve - fixed premium
symmetrical information is preferred
asymmetrical information is preferred
growth of the 'manager's contribution'
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
standard deviation of the 'manager's contribution'

Figure 4



Bonus payments vs. equity as a function of bank assets
bonus payments & equity value
25
20
15
10
5
0
90
92
94
96
98
100
102
104
106
108
110
112
114
116
118
120
122
124
126
128
130
132
134
136
138
140
bank assets
equity value
bonus payments
bank deposit = 94 millions
manager's share from asset = 15%