Implicit Contracts, Managerial Incentives and Financial Structure

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Abstract

This paper examines how managers may be given incentives to exert e¤ort, and to implement e¢cient implicit contracts with workers. Under certain assumptions, this can be achieved by tying managerial compensation to shareholder value. However, if reputation e¤ects are weak, it is more e¢cient to adopt an incentive scheme in which the manager is punished by outside investor intervention when performance falls below a critical level, and otherwise retains control, receiving a …xed reward. The required form of outside intervention can be implemented through a …nancial structure combining "hard" debt with a relatively dispersed ownership structure.

JEL Classi…cation Numbers: G32, G33, J41.

Keywords: implicit contracts, managerial incentives, …nancial structure, debt, ownership concentration.

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1. Introduction

How do …rms induce their workers to provide e¤ort? And how do investors in a …rm induce managers to take value-maximising decisions? Both these questions have been studied extensively in the recent literature on labour economics, corporate …nance and contract implementation, but in most cases they are considered separately. Yet there is an important connection. In large …rms, workers' incentive schemes are typically implemented by managers, who have better information about workers' performance than is available to outside agents. At the same time, there is usually some separation between ownership and control, so that managerial interests are not automatically aligned with those of shareholders, and managers need to be given incentives to, for example, provide e¤ort, and undertake pro…table investment projects. Thus managers act mainly as agents in their relationship with shareholders, and as principals in their relationship with workers. The present paper explores the connection between these two roles, and shows that their interdependence has important implications for the way managerial incentives are provided (in particular, for the relative importance of compensation schemes and …nancial structure), and for the way worker incentives are provided.

Consider the relationship between a …rm and its workers. When individual workers' performance is observed by the …rm but is not veri…able, explicit, legally enforceable contracts cannot condition on it[1]. Worker incentives may then be provided most e¤ectively through implicit contracts, which can o¤er rewards contingent on individual performance (see, for example, Bull (1987), and MacLeod and Malcomson (1989,1993))[2]. How are these contracts enforced? The standard answer is reputation (see Carmichael (1989) for a discussion): the argument is that a …rm has an incentive to develop and retain a reputation for trustworthiness by honouring current implicit contracts, as long as it values the option of entering into similar implicit contracts in the future. The expectation of significant quasi-rents is required to make this option valuable. Moreover, accurate and reliable information ‡ows about breaches of implicit contracts are needed to sustain strong reputation e¤ects.

If these conditions are met, shareholders in the …rm cannot gain in the long-run from reneging on the promises made to workers. Managers may then be given incentives to provide e¤ort and to implement e¢cient contracts with workers by

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aligning their interests with those of shareholders as far as possible: for example, by tying managerial compensation closely to shareholder value ("high-powered incentives"). However, if reputation e¤ects are weak, shareholders can pro…t ex post by reneging on the promise made to workers. If managerial interests are aligned with those of shareholders, managers will breach implicit contracts whenever the immediate gain from breach exceeds the long-term loss in terms of reputation. This restricts signi…cantly the set of implicit contracts that are feasible ex ante.

Consider then the following alternative: suppose that managerial compensation is not tied to shareholder value, but the manager incurs a substantial penalty if performance is poor. Speci…cally, assume there is an informative signal about managerial e¤ort; moreover, although this signal is not contractible ex ante, the manager can provide credible information about its realised value ex post, for example to an investor or …nancial intermediary. When the signal takes a value below some critical threshold, the manager is penalised. This kind of scheme can be designed to induce the manager to provide e¤ort. It has the advantage that, as long as performance is satisfactory, the manager has no incentive to breach implicit contracts with workers, even if the resulting increase in short-run pro…ts would exceed the expected long-run cost in terms of reputation. This is because managerial compensation is not tied to shareholder value: the manager will only have an incentive to breach implicit contracts if she can avoid the penalty for poor performance by doing so.

The analysis presented below shows that this incentive scheme can, under reasonable conditions, implement the second-best outcome (the …rst-best outcome is not feasible because managerial e¤ort is unobservable), even when reputation e¤ects are weak. This is in contrast to a scheme that relies on high-powered incentives. Intervention by outside investors is required to penalise the manager when performance is poor; at the same time, the manager should be able to enjoy signi…cant discretion when performance is satisfactory, which allows her to reward the workers' e¤ort, as well as her own. Financial structure can be used as an incentive scheme to induce the e¢cient form of outside intervention. This can be achieved through a combination of debt and a relatively dispersed ownership structure. Debt makes it possible to induce outside intervention when performance is poor (through a default mechanism), as required by the managerial incentive mechanism, while a relatively dispersed ownership structure can ensure that shareholders do not intervene to breach implicit contracts when performance is satisfactory. This is because when ownership is dispersed the shareholder who decides to intervene incurs a considerable cost, but reaps only a small fraction of the bene…ts: the resulting free-rider e¤ects make shareholder intervention less likely.

The model has a number of interesting implications for managerial incentives, …nancial structure and labour contracts. Firstly, it shows that in some circumstances (when reputation e¤ects are strong and cash‡ow volatility low) managerial incentives may be provided e¤ectively by tying compensation to shareholder value, with capital structure playing no incentive role (although of course this does not preclude the use of debt for other reasons). This case corresponds to the one analysed in standard principal-agent theory, which examines the optimal design of compensation contracts but generally ignores the role of …nancial structure[3]. However, when the above conditions do not hold, managerial incentives are provided more e¤ectively through …nancial structure: this case is clearly related to those analysed in many recent contributions to the literature on corporate …nance, which examine the incentive role of …nancial structure under the assumption that compensation-based incentives are not su¢cient to discipline managers[4]. In the present paper, the optimal …nancial structure combines leverage with a relatively dispersed ownership structure. This makes it possible to motivate workers through implicit contracts even when reputation e¤ects alone would not be su¢cient to sustain such implicit contracts in equilibrium. The implicit contracts that obtain in this case o¤er workers state-contingent rewards, with the higher rewards being given in the more pro…table states.

The analysis generates a number of potentially testable predictions, including the following:

- more pro…table …rms, and especially those operating in markets with signi…cant barriers to entry, should be more likely to adopt high-powered monetary incentives for their managers, and less likely to use leverage for incentive purposes;
- managerial compensation is likely to be less sensitive to …rm performance in the presence of risky debt; moreover, the level of severance pay is likely to be lower in the presence of risky debt;
- workers' compensation is likely to be more sensitive to …rm performance in the presence of risky debt and low-powered managerial incentives than in the presence of high-powered managerial incentives and safe debt (or no debt).

The paper clearly draws on several ideas from the existing literature, and notably the following. Firstly, the role of debt as a managerial disciplining de-

[3] The principal-agent literature is surveyed in Hart and Holmstrom (1987) and Sappington (1991).

[4] For recent surveys and discussions, see Harris and Raviv (1991), Hart (1995) and Shleifer and Vishny (1997).

vice. Grossman and Hart (1982) and Hart and Moore (1995) have explored the role of "hard" (senior, nonpostponable) debt as a constraining in‡uence on managers. In Grossman and Hart, managerial incentives are provided by the threat of bankruptcy, which penalises management, while in Hart and Moore debt is used to prevent the manager from obtaining …nance to undertake unpro…table (empire-building) investment projects. In this paper debt is used to ensure that management will need to raise new …nance to repay debtholders in the least profitable states; this will only be feasible if the performance (e¤ort) signal does not fall below the critical threshold. Otherwise the …rm defaults, triggering debtholder intervention, which penalises management. Harris and Raviv (1990) have emphasized the informational advantages of using debt: …rstly, a …rm's ability to repay its debt obligations in itself conveys information to outside investors; secondly, if the …rm defaults, creditors can use the option to force the …rm into liquidation to obtain further information from the …rm's management. Similar e¤ects are at work in the present paper, since the performance (e¤ort) signal is not directly observable by outside agents: the …rm's ability to repay its debt obligations provides information about the value of the signal (which must be su¢ciently high); moreover, if the …rm defaults, debtholders can use the threat of breaching implicit contracts to obtain from the manager more precise information concerning the value of the signal.

The interpretation of …nancial structure as an incentive mechanism to induce the appropriate form of outside intervention comes from Dewatripont and Tirole (1994), and also Berkovitch and Israel (1996). In Dewatripont and Tirole, debtholders are called to take control in bad times to act as a "tough principal", while shareholders are in control in good times and act as a "soft principal". In the present paper it is also the case that debtholders act as a tough principal, intervening when performance is poor, while equityholders act as a soft principal, allowing management substantial discretion when perfor

the …rm's manager and its owner(s)[6]. In the present paper excessive shareholder intervention ex post can constrain the scope for e¢cient implicit contracts between the …rm and its workers[7]. The third, related, idea concerns the possible role of management as a commitment device to enforce implicit contracts with workers, put forward by Shleifer and Summers (1988). The present paper formalises the idea and investigates the circumstances in which it may apply.

While it draws together several ideas from the existing literature on managerial incentives and …nancial structure, this paper is one of relatively few that explicitly consider the interdependence between managerial compensation and …nancial structure. Holmstrom and Tirole (1993) show that a relatively dispersed ownership structure, by increasing market liquidity, encourages market monitoring[8]: as a result, the …rm's stock price becomes more informative. This makes it possible to design a more e¢cient managerial compensation contract than the best that could be achieved using only information on current and future (realised) pro…ts. In the current paper it is also the case that tying managerial compensation to …rm value (as re‡ected in the stock price) is more e¢cient than tying it to current and future pro…ts. However, in some circumstances, a combination of low-powered monetary incentives and an optimally chosen …nancial structure is more e¢cient still, as noted above. The main reason for this is that the e¢cient enforcement of (ex ante optimal) implicit contracts requires the manager's interests to di¤er from those of shareholders ex post.

John and John (1993) show that the optimal managerial compensation con-

tions reduce free cash ‡ow, limiting the extent to which the manager can demand higher compensation after taking actions that will increase cash ‡ow contingent on his being retained. Their paper and mine can be viewed as complementary, since theirs deals primarily with issues concerning the optimal compensation of managers who can add value to the …rm but also take that value away if they leave. The present paper deals instead with the optimal compensation of managers and workers who can add value to the …rm but cannot take that value away simply by leaving the …rm: one example is the creation of value through new ideas, which are incorporated into decisions about …rm strategy, investment, product design, and organisational change.

The remainder of the paper is organised as follows. Section 2 describes the model. Section 3 examines the contracting problem and characterises its solution. Section 4 investigates how this solution may be implemented through a combination of implicit contracts, …nancial structure and low-powered monetary incentives for the manager. The …nal part of the section examines what can be achieved instead through high-powered managerial incentives, and shows that high-powered incentives are less e¢cient in general. Section 5 discusses the implications of the results for labour contracts and …nancial structure, and concludes.

2. The model

The model has two periods and three dates, t=0,1,2. There is an initial contracting stage at t=0 when a manager and a group of workers are hired and their incentive schemes are set in place. The …rm's …nancial structure is determined at this stage. During the …rst period the manager and the workers choose their respective e¤ort levels, which jointly determine the probability distribution of returns at t=1,2. The …rm is sold at the end of the second period and all claims are settled.

2.1. The manager

In the …rst period, the manager provides an unobservable e¤ort level E, which may be high (E_H) or low (0); the high e¤ort level has utility cost K (where $1 > K > 0$), while the low level has zero cost. The high level is assumed to be e¢cient. The manager's e¤ort choice may also be thought of as an investment decision: in this case K represents the manager's private bene…t if she chooses the less pro…table project. Firm pro…tability at t=1 and t=2 depends on the state of nature μ_1; which is realised at t=1: higher values of μ_1 denote more pro…table states. The manager's e¤ort (investment) decision a¤ects …rm pro…tability through its e¤ect on the probability distribution of μ_1; speci…ed below. The manager has no initial wealth. Her preferences are described by the utility function $U(y) - k(E)$, where y

denotes income, $k(E_H) = K$, and $k(0) = 0$: $U(:)$ satis…es the following properties: $U(y) = ¡ 1$ for $y < 0$; $U(y) = y$ for $y \in [0;1]$ and $U(y) = 1$ for $y > 1$: The utility of income is thus piecewise linear, with a horizontal segment for $y ¸ 1$ and a vertical segment at $y = 0$: Attention can therefore be focused on $y \in [0;1]$; with risk neutrality inside this segment[9]. The disutility of e¤ort, K; is assumed to be su¢ciently smaller than one for this not to be restrictive. For simplicity, the value of the manager's reservation expected utility at t=0 is assumed to be equal to zero: the manager's participation constraint is therefore not binding. One further assumption will be made about the manager:

(A1) The manager will honour any implicit contract agreed with the workers as long as she does not incur a loss by doing so.

This seems a useful benchmark assumption to make, implying that, other things held equal, the manager prefers to honour implicit contracts; however, monetary incentives may induce her to renege.

2.2. The workers

At t=0, a group of N homogeneous workers are hired for two periods. Like the manager, they are required to provide e¤ort during the …rst period. Each worker can choose one of two e¤ort levels: the high level (e_H) has utility cost M (where $1 > M > 0$); while the low level (0) has zero cost. The high e¤ort level is assumed to be e¢cient. Each worker's preferences are described by the utility function $U(y) ¡ m(e)$; where $U(y)$ is the same as for the manager, $m(e_H) = M$ and $m(0) = 0$. As in the manager's case, therefore, attention can be focused on $y \in [0;1]$; with risk neutrality inside this segment[10]; the disutility of e¤ort, M; is

[9] This speci…cation follows Dewatripont and Tirole (1994). In standard principal-agent models the manager (agent) is assumed to be risk-averse, while the …rm (principal) is risk-neutral; the optimal sensitivity of managerial compensation to performance is thus determined by the tradeo¤ between incentives and insurance. A signi…cant degree of managerial risk aversion is then needed to account for the very low sensitivity of managerial pay to performance found in many empirical studies (see, for example, Jensen and Murphy (1990)). The present paper analyses a model in which the manager has to be given incentives not only to provide e¤ort but also to implement e¢cient contracts with workers. In some circumstances this may be achieved more e¤ectively through an appropriately chosen …nancial structure than through a close link between pay and performance. The empirical …ndings might then be explained without requiring managers to be very risk-averse. To explore this possibility, the speci…cation adopted by Dewatripont and Tirole seems appropriate as well as convenient.

[10] If we assumed instead that workers are everywhere risk-averse, the main implications of the schemes considered in section 4, summarised in Propositions 2, 3 and 4, would be una¤ected, except that for low values of the reputation cost $¸$ ($¸ < NM$) Scheme 1 would implement a "third-best" solution, with state-contingent rewards for workers, instead of the "second-best" solution, which in this case would entail …xed rewards of value M. The ranking of Schemes 1 and 2 would be the same, since Scheme 2 could not, in general, implement the third best (nor

assumed to be sufficiently smaller than one for this not to be restrictive; moreover, the value of each worker's reservation expected utility at t=0 is assumed to be equal to zero, so that participation constraints are not binding.

2.3. Stochastic structure

The state of nature μ_1 is realised at t=1. The likelihood of more profitable states (higher values of μ_1) depends on the manager's initial effort decision. This dependence is captured by specifying the conditional density of μ_1 at t=0 as $f_E(\mu_1)$ for $E = E_H$ and $f_0(\mu_1)$ for $E = 0$; where E is the manager's effort choice. The distribution of μ_1 is assumed to satisfy the monotone likelihood ratio property (MLRP): $f_E(\mu_1) / f_0(\mu_1)$ is increasing in μ_1: The firm's returns at t=1, denoted by R_1; depend on the state μ_1 and on the workers' effort choices: $R_1 = R_1(\mu_1; e_1; ::; e_N)$: For convenience, I shall denote by $B_1(\mu_1)$ the returns contingent on all workers providing the efficient level of effort during the first period; thus $B_1(\mu_1) \geq R_1(\mu_1; e_1; ::; e_N)$; with the equality holding if, and only if, $e_i = e_H$; $i = 1; ::; N$: $B_1(\mu_1)$ is assumed to be continuous and increasing in μ_1.

The firm's returns at t=2, denoted by R_2, also depend on the state μ_1 and on the workers' effort choices. This assumption is intended to capture the fact that some of the value-enhancing activities undertaken by management and workers (which require effort) have a lasting effect, beyond their immediate impact: for example, by generating new ideas, which lead to improvements in product design, service provision, or organisational efficiency. Returns at t=2 may differ from those obtained at t=1, on the other hand, because of random shocks occurring during the second period. I shall denote by B_2 the firm's returns at t=2 contingent on all workers having provided the efficient level of effort during the first period. At t=1, B_2 is a random variable, with distribution function $H(B_2|\mu_1)$; and density $h(B_2|\mu_1)$. The conditional density of B_2, given the realisation of μ_1, is assumed to satisfy the following assumption (MLRP):

(A2) $h(B_2|\mu_1) / h(B_2|\mu_1^{\circ})$ is increasing in B_2 for $\mu_1 > \mu_1^{\circ}$.

We can also define the density at t=0 of total returns, $B \equiv B_1 + B_2$; contingent on all workers providing the efficient level of effort during the first period. This too is assumed to satisfy the MLRP, and is denoted by $q_i(B)$; for $i = E; 0$, where $q_E(B) = q(B|E = E_H)$, and $q_0(B) = q(B|E = 0)$. The firm is sold at t=2. The going-concern value of the firm at this point (not including the returns R

2.4. Information

I make the following informational assumptions:

(A3) Each worker's e¤ort choice is observed by the manager, but not by outside agents.

Thus explicit, legally enforceable contracts between the …rm and each worker specifying a reward contingent on e¤ort are not feasible. On the other hand, implicit contracts of this form, enforced by the manager, may be feasible, as shown below.

(A4) The realisation of the state μ_1 at t=1 is observed by the manager and the workers (the …rm's "insiders") but not by outside agents. However, the manager can, if she wishes, provide credible information about μ_1 at t=1 (for example, to an investor, a bank or other …nancial intermediary); this information is not contractible ex ante, at t=0.

(A5) The manager can manipulate to some extent the timing of returns; speci…cally, she can increase (decrease) …rst-period returns and correspondingly decrease (increase) second-period returns[11]. However, she can, if she wishes, provide credible information about R_1 and R_2; this information is also not contractible at t=0.

The idea here is that the manager has access to information about …rm profitability which she can choose to withhold if it is in her interest to do so[12]. Contracts directly contingent on this information are therefore not feasible; incentives have to be provided indirectly.

(A6) Realised pro…ts in each period, $¼_t$, t=1,2, are veri…able. They are equal to the di¤erence between returns and any expenditure incurred to reward the workers for their …rst-period e¤ort. This expenditure is not, however, veri…able.

The reasons for assumption (A6) are as follows. Firstly, I assume that the manager cannot simply steal returns: thus realised pro…ts are veri…able. Secondly, it

[11] For a discussion of managerial discretion over the timing of returns see Fudenberg and Tirole (1995), who analyse the implications for income and dividend smoothing. As they note, "two methods can be used to smooth earnings reports. The …rst is the use of the ‡exibility allowed in the generally accepted accounting procedures to change reported earnings without changing the underlying cash ‡ows. Examples of this type of manipulation include adjusting reserves for losses (inventory obsolescence and bad debt), altering the point at which sales are recognized, and shifting costs between expense and capital accounts. The second method...is to change operations to smooth the underlying cash ‡ows themselves. Examples of this include altering shipment schedules, o¤ering end-of-period sales, and speeding up or deferring maintenance".

[12] This assumption is close in spirit to Harris and Raviv (1990): in their model managers have access to information about …rm quality which they are unwilling to provide to investors if this is likely to result in liquidation. In the present paper the manager may be unwilling to provide information about performance when performance is poor, to avoid being penalised. However, the manager's inability to provide convincing evidence of good performance in itself conveys information, which can be used to structure incentives.

seems likely that certain forms of reward (particularly non-pecuniary bene…ts) would be di¢cult to evaluate with su¢cient accuracy: for example, some investment expenditures may bene…t the …rm and the workers (through improvements in working conditions) in ways that are not easy to quantify separately. Moreover, even if we assume that only monetary rewards are used for this reason, the …rm may still be able to undertake non-veri…able actions which increase revenue but lead to a deterioration in working conditions; this would be equivalent to a reduction of the workers' rewards. Thus the cost of rewarding the workers is not veri…able.

2.5. Financial structure

The …rm's …nancial structure is determined at t=0, along with the manager's and the workers' incentive schemes. The …rm may be thought of as being owned by an entrepreneur, who puts the incentive schemes in place and issues securities to maximise the value of his wealth. The assumption of an entrepreneur who determines the …rm's …nancial structure at t=0 is simply a convenient way of investigating the role of …nancial structure in the provision of incentives. For simplicity, all investors are assumed to be risk-neutral, and the risk-free rate of return is assumed to be equal to zero. Securities are of two types, standard debt and equity; as will become clear below, this assumption is not restrictive.

Any debt issued at t=0 is assumed to be senior, nonpostponable ("hard") debt. If the …rm cannot repay any debt due at t=1, debtholders intervene: this penalises the manager. The motivation for this assumption is as follows. There are two possible outcomes in the event of default: bankruptcy and renegotiation. Bankruptcy is more likely when there are many debtholders, making renegotiation more di¢cult and costly. In the US, a …rm may …le for bankruptcy under chapter 7 (liquidation) or chapter 11 (reorganisation) of the US bankruptcy code[13]. The …rst option ob

ager will incur some penalty, as long as she does not have all the bargaining power in the renegotiation. The consequences of default can therefore act as a credible discipline mechanism for the manager.

Equityholders are the residual claimants. They can intervene at t=1 to replace the manager and/or breach implicit contracts. Intervention is costly however; an equityholder who takes the initiative to intervene incurs a cost c(Á) > 0: The variable Á represents the degree of ownership dispersion: the more dispersed is ownership, the greater are the coordination and bargaining costs among shareholders involved in organising a successful intervention. Thus c(Á) is increasing in Á. Notice that, with a dispersed ownership structure, intervention becomes less likely, not only because the equityholder who intervenes has to bear a higher cost, but also because he will only reap a small fraction of any resulting bene…ts. The entrepreneur at t=0 chooses how much debt to issue. He also chooses the degree of ownership dispersion, Á, and the highest share of the …rm's equity that will be held by any single investor, ¹: A low value of ¹ (high value of Á) implies that equityholders will be relatively "passive", while a high value of ¹ (low value of Á) implies a greater likelihood of equityholder intervention.

3. The entrepreneur's problem

At t=0, the entrepreneur sets in place the manager's and the workers' incentive schemes, and determines the …rm's …nancial structure, so as to maximise the value of his wealth. The essence of the entrepreneur's problem is to ensure that:

- ² the manager provides the e¢cient level of e¤ort, at the lowest possible cost to the …rm, and
- ² the workers provide the e¢cient level of e¤ort, at the lowest possible cost to the …rm.

As a reference point, it is useful to consider what the "…rst-best" solution would be; that is, if it were possible to write contracts directly contingent on e¤ort. In this case the entrepreneur would o¤er the manager a contract specifying a reward of value K contingent on e¤ort E_H. Similarly each worker would be o¤ered a contract specifying a reward of value M for e¤ort e_H. Once these contracts had been accepted, the entrepreneur could simply sell his equity in the …rm; the value of his wealth would then be given by the following expression:

$$!^F = \int^{\mathbf{Z}} Bq_E(B)dB + W ¡ K ¡ NM \qquad (3.1)$$

where the integral represents the expected value of …rst- and second-period returns; W is the expected going-concern value of the …rm at t=2, and the cost

of rewarding the manager and the workers is given by the last two terms. By assumption, this is the best the entrepreneur can do, since he is inducing the e¢cient choice of e¤ort by the manager and the workers, and capturing all the expected rents.

The …rst-best cannot be achieved because the manager's e¤ort is unobservable; managerial rewards must therefore be tied to the realisation of μ_1; implying that the manager will earn some rents. Consider then the "second-best" solution, in which the manager's reward is contingent on μ_1, while the workers' rewards are contingent on their e¤ort choices. The contract o¤ered to each worker is the same as in the …rst-best solution; the di¤erence lies with the manager's incentive scheme. Let the manager's reward, contingent on μ_1; be denoted by $y(\mu_1)$. The reward which minimises the manager's rents, while ensuring that she chooses the e¢cient level of e¤ort, is the solution to program 1 below.

Program 1

$$Min \int y(\mu_1) f_E(\mu_1) d\mu_1$$

$$s.t: \int y(\mu_1)[f_E(\mu_1) - f_0(\mu_1)]d\mu_1 \geq K$$

The following proposition describes the solution.

Proposition 1 The managerial reward $y^{\alpha}(\mu_1)$ which minimises managerial rent while inducing the manager to choose the e¢cient e¤ort level E_H is given by:

$$y^{\alpha}(\mu_1) = 0 \qquad 8\ \mu_1 < \mu^{\alpha}$$

$$y^{\alpha}(\mu_1) = 1 \qquad 8\ \mu_1 \geq \mu^{\alpha}$$

for some critical value μ^{α}:

Proof: see Appendix.

In words, the manager is rewarded with a payment of value one as long as performance, described by μ_1; does not fall short of a critical value μ^{α}; otherwise she receives no reward. The value of the entrepreneur's wealth in the second-best solution just described is equal to:

$$!^S = \int B q_E(B) dB + W - \int_{\mu^{\alpha}}^{1} f_E(\mu_1) d\mu_1 - NM \qquad (3.2)$$

The second-best solution cannot be implemented by writing contracts contingent on the state and on workers' e¤ort choices, because neither of these are contractible (from assumptions (A3) and (A4)). However, it may be possible to implement the second best by giving the manager appropriate incentives to provide e¤ort ex ante, and to enforce e¢cient implicit contracts with workers ex post. The next section investigates this possibility.

4. Implementation through implicit contracts and …nancial structure

This section examines how the second-best solution described in section 3 may be implemented through an appropriate choice of implicit contracts, …nancial structure, and low-powered monetary incentives for the manager. E¢cient implicit contracts between the …rm and the workers, discussed below, induce the workers to provide e¤ort at the lowest possible cost to the …rm. The manager has to be given incentives to enforce these implicit contracts, and also to provide e¤ort herself. A combination of low-powered monetary incentives, leverage, and a relatively dispersed ownership structure can, under reasonable conditions, achieve this, while minimising managerial rent (section 4.2) - thereby implementing the second best. The intuition for this is as follows. Capital structure can be used to induce debtholder intervention (through a default mechanism) when performance is poor. Ex ante, this provides the manager with the right incentives to exert e¤ort; ex post, it leaves the manager with substantial discretion when performance is satisfactory, which enables her to reward the workers according to the implicit contract agreed at $t=0$. Low-powered monetary incentives ensure that the manager is not tempted to renege, while a dispersed ownership structure deters shareholder intervention aimed at breaching implicit contracts. The …nal part of this section investigates what can be achieved through high-powered monetary incentives, and shows that in general these do not allow implementation of the second best.

4.1. Implicit contracts with workers

Since the manager observes individual workers' e¤ort choices, she can induce each worker to provide the e¢cient level of e¤ort by promising an appropriate reward, as long as the promise is credible. This may be thought of as an implicit contract between the …rm and the workers, enforced by the manager. The workers' reward can take a variety of forms, including monetary payments (e.g. informal bonuses, discretionary increases in wages and/or pensions), as well as non-pecuniary bene…ts (e.g. in-kind bene…ts, improvements in working conditions, perks). I shall

denote by $G(\mu_1)$ the total cost to the …rm of rewarding the workers in state μ_1 at t=1, assuming they have all provided e¤ort during the …rst period. For example, if the workers are rewarded with a bonus of value M, irrespective of the state μ_1; the total cost to the …rm is simply $G(\mu_1) = NM$. More generally, the reward may vary with the state[14].

E¢cient implicit contracts, from the entrepreneur's point of view, are those that induce the workers to provide e¤ort while leaving all expected rents to the …rm. They must therefore satisfy the following condition[15]:

$$\int G(\mu_1) f_E(\mu_1) d\mu_1 = NM \qquad (4.1)$$

The …rm can, of course, breach the implicit contract with the workers at t=1: once the workers have provided e¤ort, the …rm can simply deny them the promised reward. However, breach may have a reputational cost: the magnitude of this cost depends on the assumptions we make about the availability of information to different agents. Since part of the purpose of the present paper is to investigate how managerial incentive schemes should vary with the magnitude of reputation e¤ects, I shall proceed as follows. Firstly, I describe two possible informational structures of interest: one allows for the possibility of strong reputation e¤ects, while the other implies weak reputation e¤ects. Secondly, I propose a very simple, reduced-form way of modelling reputation e¤ects which will make it possible to compare the implications for managerial incentives of di¤erent informational structures.

Consider then the following setup. Assume that the …rm, as long as it stays in business, hires successive generations of workers, each generation (group of N workers) being employed for two periods. Thus we can think of the basic two-period model outlined in section 2 as being repeated over time, with each successive generation. Each generation …nds out whether the …rm has breached the implicit contract with the previous generation before accepting the …rm's o¤er of employment. Thus in terms of the model of section 2, there is a new generation of workers which decides whether to join the …rm at t=2: these workers know whether the …rm honoured or breached the implicit contract with the previous generation, at t=1. This follows from assumptions (A4) to (A6): since the manager can provide credible information about the realisation of μ_1; R_1 and R_2, prospective employees can require that information, and condition their decision upon it. Information about μ_1 and R_1 is su¢cient to establish whether the work-

[14] As will become clear below, it may be desirable to let rewards vary with the state in some circumstances.

[15] In principle, there may be ways of rewarding workers through non-pecuniary bene…ts which cost the …rm less than their expected value to the workers. Allowing for this would not alter the main qualitative implications of the analysis.

ers had provided e¤ort during the …rst period, while information about ¼1; ½2; R_1 and R_2 is su¢cient to establish whether the …rm has rewarded the workers (since $G(\mu_1) = R_1 + R_2 - ¼_1 - ½_2$).

If the …rm has breached the implicit contract with the previous generation, the current generation of workers is not willing to enter into a similar implicit contract. In this case the …rm has to resort to a di¤erent type of contract, which entails less e¢cient and more costly incentive schemes for workers[16]. Let Z represent the present discounted value, at t=2, of the …rm's expected pro…ts in this case. The reputation cost of breach, denoted by ¸; is simply equal to the di¤er

can therefore be very e¤ective in this respect), but its speed and accuracy may be limited, implying that reputation e¤ects will be weak. Such weak reputation e¤ects can be represented in a very simple and convenient way through low values of ¸; the reputation cost of breach. Thus the formulation in terms of ¸ makes it possible to compare circumstances which allow for strong reputation e¤ects (high values of ¸) with circumstances which allow only for weak reputation e¤ects, or no reputation e¤ects (low values of ¸, or ¸ equal to zero). This formulation will be used in the remainder of the paper.

4.2. Scheme 1: …nancial structure and low-powered incentives

As discussed earlier, implementing the second best requires minimising the manager's rents while giving her incentives to provide e¤ort, and to enforce e¢cient implicit contracts with workers. The managerial reward scheme which minimises managerial rent while inducing her to provide e¤ort, described by Proposition 1, entails giving the manager a …xed reward (of value one) if, and only if, performance is satisfactory ($\mu_1 \geq \mu^{\alpha}$). This scheme cannot be implemented through an explicit, legally enforceable contract, because μ_1 is not contractible; however, it can be implemented by giving outside investors an incentive to intervene if, and only if, $\mu_1 < \mu^{\alpha}$: The idea is that, as long as performance is satisfactory, the manager retains control and receives a (contractual) salary increase (of value one) during the second period. However, if performance is poor, outside investors intervene: they either replace the manager, or use the threat of dismissal (with no severance pay) to force her to accept a renegotiated contract with no salary increase.

Consider …rst how the scheme might be implemented with an all-equity …nancial structure. In this case equityholders should have an incentive to intervene if, and only if, $\mu_1 < \mu^{\alpha}$: However, since they do not observe the realisation of μ_1, equityholders will decide whether to intervene on the basis of the expected gains and costs, with the expectation taken over the possible values of μ_1; the resulting decision rule can be either "intervene" or "do not intervene", but it cannot be contingent on the realised value of μ_1. Speci…cally, equityholder intervention will take place if and only if the following condition holds:

$$\pi\{1 + E_{\mu_1}[\max(0; G(\mu_1) - \rho)]\} \geq c(\acute{A}) \qquad (4.2)$$

The expected gains from intervention consist of the saving in managerial compensation, equal to one, plus the expected savings from reneging on implicit contracts with workers. The expression on the left-hand side therefore represents the expected gain from intervention accruing to the investor holding the largest share of the …rm's equity, π. This should be at least equal to the cost of inter-

vention, c(Á). Clearly if this condition holds, it will hold for all values of μ_1:Thus implementation through equityholder intervention is not feasible.

Intuitively, having more than one type of investor should make it possible to ensure that intervention takes place in some states but not others. Consider then how the scheme might be implemented by inducing debtholders to intervene when $\mu_1 < \mu^{\alpha}$, while giving equityholders an incentive to remain "passive". The latter may be achieved through an appropriate choice of Á and ^{1}, implying a relatively dispersed ownership structure. The former may be achieved through an appropriate choice of capital structure, such that the …rm defaults when $\mu_1 < \mu^{\alpha}$: This kind of managerial incentive scheme has the following implications for implicit contracts with workers. Firstly, as long as the manager is able to retain control, and has su¢cient resources, she will reward the workers as promised (by assumption (A1)). Secondly, when debtholders intervene, they will allow the workers to be rewarded if, and only if, the cost of rewarding them does not exceed the reputation cost of reneging on the implicit contract. Thus if reputation costs are small, fer

the …rst period. If $\mu_1 = \mu^{\alpha}$, current returns are equal to $B_1(\mu^{\alpha})$. The manager can, moreover, raise new …nance by pledging future returns. New …nance is provided by a …nancial intermediary, call it "the bank"; the bank is assumed to be risk-neutral and to price loans competitively (i.e. so that its expected rate of return is equal to zero). Thus the maximum amount of new …nance that can be raised is equal to the expected value of future returns, taking into account limited liability, which is given by the integral in the expression for the value of F_1 above[18]. The manager can therefore repay the debt F_1 and retain control. Clearly she can also repay the debt and retain control if $\mu_1 > \mu^{\alpha}$; since in this case …rst-period returns, as well as expected future returns, are higher. If $\mu_1 < \mu^{\alpha}$; on the other hand, the manager cannot avoid default, leading to debtholder intervention.

Now consider what the manager can do if she honours the implicit contract with the workers. When $\mu_1 \geq \mu^{\alpha}$, the manager can repay the debt F_1; retain control and reward the workers as promised if, and only if, the following condition holds:

$$B_1(\mu_1) - G(\mu_1) + \int_{1-W}^{1} (B_2 + W - 1)h(B_2|\mu_1)dB_2 \geq F_1 \tag{4.4}$$

where the integral denotes the expected value of future returns, taking into account limited liability, given that the …rm's reputation is maintained. Expression (4.4) can be re-written as:

$$G(\mu_1) \leq B_1(\mu_1) - B_1(\mu^{\alpha}) + \tfrac{1}{2}X_1 + X_2 + \int_{1-Z}^{1} (B_2 + Z - 1)[h(B_2|\mu_1) - h(B_2|\mu^{\alpha})]dB_2 \tag{4.5}$$

where

$$X_1 = [1 - H(1 - W|\mu_1)]; \qquad X_2 = \int_{1-W}^{\frac{1}{2}+Z} (B_2 + Z - 1)h(B_2|\mu_1)dB_2 \tag{4.6}$$

Expression (4.5) gives an upper bound to the value of workers' rewards when $\mu_1 \geq \mu^{\alpha}$: When $\mu_1 < \mu^{\alpha}$; on the other hand, it should not be possible for the

[18] I assume that the manager, if she is able to retain control at t=1, has su¢cient discretion to obtain her reward during the second period, before the bank can demand repayment of the loan at t=2. For simplicity I also assume that there are always su¢cient resources to reward the manager.

manager to avoid debtholder intervention. This means that promised rewards should not decrease too rapidly with μ_1. Speci…cally, the following condition must hold:

$$B_1(\mu_1) - G(\mu_1) + \int_{1-W}^{1} (B_2 + W - 1)h(B_2|\mu_1)dB_2 < F_1 \tag{4.7}$$

implying that

$$G(\mu_1) > \{X_1 + X_2 - [B_1(\mu^{\alpha}) - B_1(\mu_1) + \int_{1-Z}^{1} (B_2 + Z - 1)[h(B_2|\mu^{\alpha}) - h(B_2|\mu_1)]dB_2\} \tag{4.8}$$

At the same time, once debtholders intervene, the implicit contract with the workers will be enforced if, and only if, the expected returns from honouring the contract are at least equal to the expected returns from breach:

$$\int_{-W}^{1} (B_2 + W)h(B_2|\mu_1)dB_2 - G(\mu_1) \geq \int_{-Z}^{1} (B_2 + Z)h(B_2|\mu_1)dB_2 \tag{4.9}$$

implying that

$$G(\mu_1) \leq \{[1 - H(-W|\mu_1)] + \int_{-W}^{Z} (B_2 + W)h(B_2|\mu_1)dB_2 \tag{4.10}$$

Expressions (4.9) and (4.10) take into account the fact that the manager is no longer able to obtain her reward once debtholders intervene. Using the above conditions, the following result can be obtained.

Proposition 2 (Scheme 1) The second best can be implemented through a combination of implicit contracts, …nancial structure and low-powered managerial incentives if, and only if, the following condition, (C1), holds:

$$\int_{\mu^{\alpha}}^{1} G^H(\mu_1) f_E(\mu_1)d\mu_1 + \int_{-1}^{\mu^{\alpha}} G^L(\mu_1) f_E(\mu_1)d\mu_1 \geq N M$$

where

$$G^H(\mu_1) = B_1(\mu_1) - B_1(\mu^{\alpha}) + \{X_1 + X_2 + \int_{1-Z}^{1} (B_2 + Z - 1)[h(B_2|\mu_1) - h(B_2|\mu^{\alpha})]dB_2$$

and

$$G^L(\mu_1) = \beta[1 - H(-W|\mu_1)] + \int_{-W}^{Z} (B_2 + W)h(B_2|\mu_1)dB_2$$

Proof: see Appendix.

Condition (C1) requires that the maximum rewards that can be credibly promised to the workers, given by the left-hand side of the inequality, be sufficient to compensate them for the disutility of effort, given by the right-hand side. The intuition for (C1) can be obtained most easily by considering the special case when $B_2 \geq 1 - Z$; that is, when second-period returns are never lower than a critical value given by $1 - Z$. In this case, the condition simplifies to:

$$\beta + \int_{\mu^*}^{1} \{B_1(\mu_1) - B_1(\mu^*) + \int_{\mu^*}^{Z} B_2[h(B_2|\mu_1) - h(B_2|\mu^*)]dB_2\} f_E(\mu_1)d\mu_1 \geq NM \quad (4.11)$$

The left-hand side of expression (4.11) consists of two terms: the first term, β, represents the rewards that can be credibly promised to the workers irrespective of the realisation of the state μ_1: This is because when the manager retains control she always honours the implicit contract with the workers, and when debtholders intervene they enforce the implicit contract as long as the cost of rewarding the workers does not exceed the reputation cost of breach. Thus it is credible ex ante to promise rewards of value not exceeding β in all states. The second term in (4.11) represents the maximum additional state-contingent rewards that can be credibly promised to the workers because of the manager's willingness to honour implicit contracts even when it is not profit-maximising to do so ex post.

It is clearly easy to satisfy condition (4.11) when reputation effects are sufficiently strong (β is high): in this case workers can receive substantial rewards in all states. When reputation effects are weak (β is small), it is still possible to satisfy the condition as long as there are sufficient resources in the "good states" ($\mu_1 > \mu^*$) for the manager to repay the debt and reward both herself and the workers. In this case worker rewards will tend to increase with μ_1; thus more profitable states will be associated with higher (discretionary) bonus payments, salary increases, and non-pecuniary benefits. Going back to condition (C1) in Proposition 2, it is straightforward to verify that the additional terms, relative to (4.11), are due to the fact that the firm is protected by limited liability: when we allow for the possibility of sufficiently large negative shocks to returns during

the second period, some of the cost of breaching implicit contracts with workers, represented by ¸, will not be borne by the …rm.

In the scheme just described, a relatively dispersed ownership structure is needed to deter shareholders from replacing the manager and/or breaching implicit contracts: dispersion makes it costly to intervene, ensuring that shareholders remain relatively "passive". This naturally raises the question of whether the ownership structure determined by the entrepreneur at t=0 is likely to change subsequently, thereby altering shareholders' incentives. In particular, switching to a more concentrated ownership structure at t=1 (after the workers have provided e¤ort, but before they are rewarded) would lower the cost of intervention: this might be su¢cient to tilt the balance between costs and expected bene…ts in favour of intervention. However, this would require one of the existing shareholders, or a potential outside investor, to acquire a su¢ciently large fraction of the …rm's shares, in the expectation of bene…ting from subsequent intervention. This in turn would create incentives for existing dispersed shareholders to bargain over the price at which they are willing to sell their shares, and extract as much as possible of the expected surplus. Combined with the costs involved in such bargaining, the resulting loss of expected surplus makes this type of intervention unlikely.

4.3. Scheme 2: performance pay

This subsection investigates what can be achieved by o¤ering the manager a contractual bonus explicitly tied to performance. For the contract to be legally enforceable, the bonus has to depend on a veri…able measure of performance. By assumption (A6), realised pro…ts in each period, $¼_t$, t=1,2, are veri…able. By assumption (A5), returns in each period, R_t, t=1,2, are not veri…able, because the manager can manipulate the timing of returns. The sum of R_1 and R_2 is also non-veri…able, because $G(\mu_1)$ is not veri…able (assumption (A6)). On the other hand, the value of the …rm at t=2, denoted by V, is veri…able, and is given by:

$$V = ¼_1^r + ¼_2 + W$$

if the …rm has honoured the implicit contract with workers at t=1, and by:

$$V = ¼_1^r + ¼_2 + Z$$

if the …rm has breached the implicit contract at t=1. Second-period pro…ts, $¼_2$; are simply equal to returns, R_2, while $¼_1^r$ denotes pro…ts retained from the …rst period. Without loss of generality, consider the case of an all-equity …nanced …rm which pays no dividends, so that all pro…ts at t=1 are retained. Then $¼_1^r$ =

$¼_1 = R_1 - G(\mu_1)$ if the …rm rewards the workers at t=1, while $¼_1^r = ¼_1 = R_1$ if the …rm does not.

Clearly, given that the manager can manipulate the timing of returns, the bonus should depend either on $¼_1 + ¼_2$, or on V (or both), since these are the only veri…able measures of performance. Conditioning on $¼_1 + ¼_2$ would give the manager strong incentives to breach the implicit contract with workers, because the value of pro…ts over the …rst two periods can always be increased by deciding not to reward the workers. Attention can therefore be focused on performance bonuses contingent on V, denoted by s(V). Ideally, the entrepreneur would like to set the bonus so as to minimise managerial rent while ensuring that the manager provides e¤ort, and implements e¢cient implicit contracts with workers. This will only be feasible in certain circumstances, described in the following proposition.

Proposition 3 (Scheme 2) The entrepreneur can choose the performance bonus $s^¤(V)$ so as to minimise managerial rent, while inducing the manager to provide the e¢cient level of e¤ort and implement e¢cient implicit contracts with workers, if, and only if, $G(\mu_1) \geq \mu_1$. The bonus $s^¤(V)$ takes the form:

$$s^¤(V) = 0 \qquad \forall V < V^¤$$

$$s^¤(V) = 1 \qquad \forall V \geq V^¤$$

for some critical value $V^¤$:

Proof: see Appendix.

Proposition 3 resembles Proposition 1, in the sense that in both cases it is optimal to give the manager a …xed reward of value one as long as performance is satisfactory, and zero otherwise. This follows from the manager's preferences, together with the assumption that the distribution of B satis…es the MLRP. The intuition for the enforceability condition $G(\mu_1) \geq \mu_1$ is very simple. When the manager's reward depends on V, the manager's interests at t=1 are aligned with those of shareholders: they all wish to maximise V. The manager will therefore reward the workers as promised if, and only if, the cost of doing so, equal to $G(\mu_1)$, does not exceed the cost of reneging on the promise, equal to μ_1. It is worth noting that ownership structure does not matter when managerial incentives are provided through performance pay. This is because there are no expected gains from shareholder intervention at t=1: intervention would leave the manager's reward, which is contractually tied to the realisation of V, una¤ected; moreover, shareholders would take exactly the same decision as the manager concerning workers' rewards.

We can now compare Scheme 2 (performance pay) with Scheme 1 (…nancial structure and low-powered incentives). The schemes di¤er in two important respects. Firstly, with regard to the set of implicit contracts that are feasible under each scheme. When reputation e¤ects are su¢ciently strong (ϕ is high), both schemes allow implementation of e¢cient implicit contracts with workers. However, when reputation e¤ects are weak (small ϕ), it becomes di¢cult to sustain implicit contracts under Scheme 2: the reason is that the cost of enforcing the contract cannot exceed ϕ in any state, otherwise the manager will renege. Scheme 1, on the other hand, has the advantage that the manager can be relied on to honour the implicit contract with the workers even when the cost of doing so exceeds ϕ, as long as she also has su¢cient resources to repay current debt obligations and retain control. Thus Scheme 1 allows e¢cient implicit contracts to be implemented under a wider range of circumstances (values of ϕ).

The other important di¤erence between the two schemes is that Scheme 1 e¤ectively ties managerial rewards directly to μ_1; while Scheme 2 ties them to V. In general, tying managerial rewards to V is likely to be less e¢cient: V is less informative about managerial e¤ort than μ_1 because of the additional noise due to the possibility of random shocks a¤ecting returns during the second period. The following proposition summarises the key di¤erences between the two schemes.

Proposition 4 (a) If $\phi \geq \phi^{NM}$, (i) e¢cient implicit contracts between the …rm and the workers are feasible under Scheme 1 (…nancial structure) and under Scheme 2 (performance pay); (ii) managerial rents are at least as high under Scheme 2 as under Scheme 1.

(b) If $\phi < \phi^{NM}$, e¢cient implicit contracts are feasible under Scheme 1 provided condition (C1) is satis…ed; they are not feasible under Scheme 2.

Proof: see Appendix.

Proposition 4 shows that in general Scheme 1 (…nancial structure) will be preferred to Scheme 2 (performance pay). It is worth emphasizing that the results described by Propositions 3 and 4 depend on the assumed stochastic nature of second-period returns. Because of the possibility of a large negative shock to second-period returns, the manager can never be certain, at t=1, that V will be at least equal to V^{α}. As a consequence, the manager always chooses the action that maximises V, thereby maximising the probability of obtaining her reward (Proposition 3). If on the other hand we restricted the variability of B_2; intuition suggests that it might become easier to enforce implicit contracts, because the manager would be willing to reward the workers even when this does not maximise V, as long as μ_1; and hence B_1, is su¢ciently high to ensure that V will not fall below V^{α}. Similarly, the manager would be willing to reward the workers even when this does not maximise V if μ_1; and hence B_1, is so low that V will always fall below V^{α}. This can be seen most clearly by considering the case when all

uncertainty over second-period returns is resolved at t=1. Speci…cally, assume there are no random shocks to returns during the second period, and returns at t=2 are equal to returns at t=1: $R_2 \acute{} R_1$: We then have the following result:

Proposition 5 Suppose $R_2 \acute{} R_1$. Let the manager's incentive scheme take the form:

$$s^{\alpha}(V) = 0 \qquad 8\, V < V^{\alpha}$$

$$s^{\alpha}(V) = 1 \qquad 8\, V \, ¸ \, V^{\alpha}$$

for some critical value V^{α}: Then: (1) the manager will enforce the implicit contract with the workers if, and only if, (a) $G(\mu_1)$ ¸, or (b) $G(\mu_1) >$ ¸ and $2B_1(\mu_1) + W \, ¡ \, G(\mu_1) \, ¸ \, V^{\alpha}$; or (c) $G(\mu_1) >$ ¸ and $2B_1(\mu_1) + Z < V^{\alpha}$.

(2) Suppose ¸ ¸ NM: Then V^{α} can be chosen suc(p)8 0 .0486 Tc (r) 6 Tc (r) 6e

When the above conditions do not hold, managerial incentives can be provided more e¤ectively through a …nancial structure combining leverage with relatively dispersed ownership. In this case the manager should be given low-powered monetary incentives. This result may help to explain the empirical evidence showing that managerial compensation is not very sensitive to performance, whether measured in terms of stock market value or accounting pro…ts (see, for example, Jensen and Murphy (1990) and Rosen (1990))[19]. Moreover, the analysis in this paper suggests that increasing the sensitivity of managerial pay to performance would not necessarily increase e¢ciency; in fact, it might even have the opposite e¤ect, by restricting the scope for e¢cient contracting with workers. Obviously, as noted in the introduction, there are other possible explanations for low-powered managerial incentives. Several testable predictions distinguish the one o¤ered in this paper:

(1) low-powered monetary incentives for managers should be positively correlated with the use of leverage for incentive purposes;

(2) …rms with volatile cash‡ow should be more likely to use leverage for incentive purposes (as well as less likely to rely on high-powered managerial incentives, as noted above);

(3) managerial severance pay is likely to be lower in the presence of risky debt. This is because debt can be an e¤ective managerial disciplinin

also on managers being willing to reward workers as promised even when it is no longer pro…table to do so.

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7. Appendix

Proof of Proposition 1

Program 1 is given by:

$$\text{Min} \int y(\mu_1) f_E(\mu_1) d\mu_1$$

$$\text{s.t.} \int y(\mu_1)[f_E(\mu_1) - f_0(\mu_1)]d\mu_1 \geq K$$

The manager's assumed preferences mean that attention can be focused on solutions satisfying the condition $0 \leq y(\mu_1) \leq 1$. Denoting by L the Lagrangian for program 1 and by λ the Lagrange multiplier associated with the incentive constraint, the first-order condition for $y(\mu_1)$ is given by:

$$\partial L/\partial y = -f_E(\mu_1) + \lambda[f_E(\mu_1) - f_0(\mu_1)] \leq 0 \quad \text{if} \quad y(\mu_1) = 0$$

$$\partial L/\partial y = -f_E(\mu_1) + \lambda[f_E(\mu_1) - f_0(\mu_1)] = 0 \quad \text{if} \quad 1 > y(\mu_1) > 0$$

$$\partial L/\partial y = -f_E(\mu_1) + \lambda[f_E(\mu_1) - f_0(\mu_1)] \geq 0 \quad \text{if} \quad y(\mu_1) = 1$$

Since the program is linear, a solution satisfying the first-order condition will be a global optimum. Using the MLRP, it is straightforward to verify that the following satisfies the first-order condition:

$$y^*(\mu_1) = 0 \quad \forall \mu_1 < \mu^*$$

$$y^*(\mu_1) = 1 \quad \forall \mu_1 \geq \mu^*$$

where μ^* is defined by:

$$f_E(\mu^*) = \lambda[f_E(\mu^*) - f_0(\mu^*)]$$

Proof of Proposition 2

(if) Suppose condition (C1) holds. Let $G(\mu_1) = G^L(\mu_1)$ for $\mu_1 < \mu^*$; and $G(\mu_1) = G^H(\mu_1)$ for $\mu_1 \geq \mu^*$. This satisfies all the necessary conditions for implementing the managerial reward scheme described by Proposition 1, given by (4.4), (4.7) and (4.9). Moreover, it satisfies the necessary condition for efficient implicit contracts, given by (4.1). It remains to show that shareholders will not

intervene when $\mu_1 \geq \mu^{\alpha}$. Just set Á and ^{1} such that the following condition holds: $^1 f 1 + E_{\mu_1}[\max(0; G(\mu_1) - \bar{\cdot})]g \quad c(Á)$. (only if) Suppose condition (C1) does not hold. Then the maximum rewards that can credibly be promised to workers are not su¢cient to compensate them for the disutility of e¤ort, M.

Proof of Proposition 3

(only if) Any performance bonus s(V) which induces the manager to provide the e¢cient level of e¤ort, E_H; must reward higher values of V relatively more than lower values. Given such an incentive scheme, the manager at t=1 will choose the action (honour/breach implicit contract) which maximises the expected value of V. This means rewarding the workers if and only if $G(\mu_1) \quad \bar{\cdot}$.

(if) As long as the enforceability condition $G(\mu_1) \quad \bar{\cdot} \; 8\,\mu_1$ holds, the manager will enforce the implicit contract with the workers at t=1. V will therefore be equal to $B_1(\mu_1) - G(\mu_1) + B_2 + W$. Moreover, there is nothing to be gained by letting the workers' rewards vary with the state μ_1, since the enforceability condition is the same in every state. Thus we can assume, without loss of generality, that $G(\mu_1) = G$. Let $g_i(V)$ $(i = E; 0)$ denote the density of V at t=0, conditional on the manager's e¤ort choice: the assumptions made so far imply that this satis…es the MLRP. The performance bonus which minimises managerial rent while inducing the manager to provide the e¢cient level of e¤ort can be obtained by choosing s(V) to solve program 2 below.

Program 2

$$\text{Min} \quad \int s(V) g_E(V) dV$$

$$\text{s:t:} \quad \int s(V)[g_E(V) - g_0(V)]dV \geq K$$

The manager's assumed preferences mean that attention can be focused on solutions satisfying the condition $0 \quad s(V) \quad 1$. Denoting by L the Lagrangian for program 1 and by º the Lagrange multiplier associated with the incentive constraint, the …rst-order condition for s(V) is given by:

$$@L=@s = -g_E(V) + º[g_E(V) - g_0(V)] \quad 0 \qquad \text{if} \qquad s(V) = 0$$

$$@L=@s = -g_E(V) + º[g_E(V) - g_0(V)] = 0 \qquad \text{if} \qquad 1 > s(V) > 0$$

$$@L=@s = -g_E(V) + º[g_E(V) - g_0(V)] \geq 0 \qquad \text{if} \qquad s(V) = 1$$

Since the program is linear, a solution satisfying the …rst-order condition will be a global optimum. Using the MLRP, it is straightforward to verify that the following satis…es the …rst-order condition:

$$s^{\alpha}(V) = 0 \qquad 8\, V < V^{\alpha}$$

$$s^{\alpha}(V) = 1 \qquad 8\, V \geq V^{\alpha}$$

where V^{α} is de…ned by:

$$g_E(V^{\alpha}) = \rho[g_E(V^{\alpha}) - g_0(V^{\alpha})]$$

Proof of Proposition 4

(a) Just set $G(\mu_1) = NM$ $8\, \mu_1$.

(b) Follows from Proposition 2 and Proposition 3.

Proof of Proposition 5

(1) The manager's expected returns from honouring the implicit contract with the workers are equal to one if $2B_1(\mu_1) - G(\mu_1) + W \geq V^{\alpha}$; and zero otherwise. Her expected returns from breach are equal to one if $2B_1(\mu_1) + Z \geq V^{\alpha}$; and zero otherwise. The manager will honour the implicit contract whenever she can obtain her reward by doing so, and whenever she cannot obtain her reward irrespective of whether she honours the contract or not. These two cases correspond to the following conditions:

(i) $2B_1(\mu_1) - G(\mu_1) + W \geq V^{\alpha}$;

(ii) $2B_1(\mu_1) - G(\mu_1) + W < V^{\alpha}$ and $2B_1(\mu_1) + Z < V^{\alpha}$:

Thus breach will occur if, and only if, $2B_1(\mu_1) - G(\mu_1) + W < V^{\alpha}$ and $2B_1(\mu_1) + Z \geq V^{\alpha}$: This condition implies, but is not implied by, the following: $G(\mu_1) > \gamma$: It follows that the manager always enforces the implicit contract when (a) $G(\mu_1) \leq \gamma$: Moreover, the manager also enforces the implicit contract (b) when $G(\mu_1) > \gamma$ and $2B_1(\mu_1) - G(\mu_1) + W \geq V^{\alpha}$, as well as (c) when $G(\mu_1) > \gamma$ and $2B_1(\mu_1) + Z < V^{\alpha}$:

(2) When $\gamma \geq \gamma \geq NM$, can simply let $G(\mu_1) = NM$ $8\, \mu_1$ under both schemes. Then just set $V^{\alpha} = 2B_1(\mu^{\alpha}) - NM + W$.