Hiring insiders or outsiders to the firm and its effect on accounting system choice

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Abstract:

In this paper we investigate whether it is more favorable for a firm to offer an open management position to an insider or to hire someone from outside the firm. The insider is assumed to hold private information about the working environment, such as specific characteristics and challenges of the job. An applicant from outside the firm, in contrast, does not hold any superior knowledge. Rather, he possesses the same information and holds the same expectations as the principal in charge of hiring.
On top of the hiring choice, the firm has some discretion with regard to the accounting system to be implemented. The more rigid the system the more expensive earnings management/window dressing activities become for the manager.
We analyze both choice problems individually as well as possible interrelations.

We find that it is optimal for the principal to hire a manager from outside the firm when alternative working environments are not too distinct. Otherwise, he would prefer an insider. With regard to the accounting system effect, our analysis shows that a more rigid system is always preferred to a less rigid one if an outsider is hired. If the firm hires an insider, however, this is no longer the case. Our results show that opting for a more rigid accounting system can be both, favorable or detrimental, depending on the specifics of the agency problems in place.

1. Introduction

When a management position needs to be filled, firms in general face two alternatives. They can promote an ambitious candidate from inside the firm or they can offer the job to an external applicant. Both alternatives are commonly used in firms. With regard to the special case of US CEO appointments, it seems that outside appointments became more popular over time. As reported in Murphy (2013) the percentage of outside appointments increased from 15% in the 1970s to roughly a third at the end of the century.[1]

Even though external versus internal hiring is likely to differ with respect to various aspects, an important one is different information endowment of the applicants. A candidate that already holds a position within the firm is probably well informed about the firm's processes, the work climate, the firm's specifics, latest developments, and what to expect from the new position. Such information is not available to an external candidate nor to (external) directors or compensation committee members in charge of hiring a manager.

We focus on these differences in information endowment when analyzing whether it benefits the principal to hire an outsider or an insider. Obviously, the insider holds private information that facilitates decision making. However, he can exploit this knowledge for his private benefit and at the expense of the principal. In contrast, an uninformed manager cannot exploit any informational advantage, but suffers from poorer choices due to lack of information.

In terms of the model we use, hiring an outside manager results in a moral hazard problem. Ex ante both parties to the contract, principal and agent, are symmetrically informed but the agent performs a private work effort in our model. If, in contrast, an internal applicant is hired, an adverse selection problem and moral hazard problem are present simultaneously. The agent holds private pre contract information and can use them to extract rents from the principal.

Along with the hiring choice, we model some discretion with regard to the accounting system to be implemented within the firm. Keeping the model simple, we assume that accounting systems that are more rigid increase the manager's cost related to a window dressing activity. We investigate which accounting system to choose and whether this choice is related to the hiring decision. Implementation costs as well as costs of operating the system are neglected throughout the analysis.

We find that the choice of hiring an outsider versus an insider critically depends on the degree of uncertainty present with regard to the type of working environment within the firm. If possible working environments are no too distinct, the principal prefers to hire an uninformed outside manager. Beyond some threshold hiring an insider becomes the better choice.

With regard to the accounting system it turns out that once an outsider is hired, a more rigid accounting system is always preferred to a less rigid one. As a consequence, the principal goes for the most rigid system available. If an insider is hired, this is not necessarily the case but depends on the magnitude of the adverse selection problem. If the adverse selection problem is sufficiently strong, a more rigid accounting system decreases the principal's welfare as compared to a less rigid one, in general or at least within some range.

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[1] See Murphy (2013), p.331f.

2. Related literature

Our paper studies whether a principal benefits mostly from hiring an informed or an uninformed manager. Formally, we juxtapose a moral hazard type agency problem and one of joint moral hazard and adverse selection. In both settings, the agent performs two unobservable efforts, a productive one and a window dressing activity. The cost of the latter is affected by the accounting system in place.

Given these inputs, our model somewhat builds on the classical literature on moral hazard, e.g. Holmström (1979), Grossmann and Hart (1983), and Holmström and Milgrom (1991), and on the literature on multi-task problems such as Feltham and Xie (1994). It is also related to the adverse selection literature e.g. Laffont and Tirole (1993) and Rajan and Saouma (2006), and the joint moral hazard and adverse selection literature, e.g. Sappington (1984) and Melumad and Reichelstein (1989). As the manager performs a window dressing activity that is restricted by a rigid accounting system, further ties exist to the literature on earnings management, e.g. Dye (1988), Demski (1998) and Arya, Glover, and Sunder (1998), and on effects of tighter accounting standards, e.g. Ewert and Wagenhofer (2005).

A paper that is closely related to our work is Rajan and Saouma (2006). In their paper a manager performs several tasks that affect the principal's payoffs. Different types of risk neutral managers differ in disutility related to performing each task as in our model. Rather than to learn his type, however, the manager in Rajan/Saouma receives a signal that is informative about his type before he signs the contract and chooses his effort. They allow for a continuum of informational states ranging from perfectly informative to perfectly uninformative. Moreover, in their paper the principal's payoff is contractible and used as a performance measure. As a consequence, the congruity problem arising in our paper is absent in Rajan/Saouma. They find that the principal's expected net payoff is decreasing and convex in the extent of information asymmetry. It follows that either a perfectly informed manager or a perfectly uninformed manager is optimal. If the agent's types are not very distinct an uninformed manager is preferred. This result somewhat resembles the one we obtain in our two-type setting.

Also close to our model is the paper by Beyer, Guttman, and Marinovic (2014). They consider a joint adverse selection and moral hazard problem where an agent performs a productive effort and a window dressing activity. Firm value is non-contractible and earnings is the only performance measure available for contracting. The agent is privately informed about his type. Types differ with regard to their disutility of effort. Thus, they use a very similar model setup as we do in our paper. Even a pure moral hazard problem is analyzed in their paper to serve as a benchmark. In contrast to our paper, however, both, the principal and the agent are assumed to know the agent's type in this benchmark setting. The moral hazard problem therefore is coupled with superior information in their paper but comes along with reduced information in ours. Consequently, and in contrast to our results, their moral hazard setting is preferable in terms of the principal's payoffs to the joint problem. Moreover, Beyer et al focus on a research question quite different from ours as they are interested in the shape of the optimal compensation contract and the effects that the agent's ability to manipulate earnings has on this shape.

Finally, the paper by Marinovic and Povel (2017) is related to our work as it studies the contracting choice of a principal in a joint moral hazard and adverse selection setting which allows for misreporting. The main distinction from our paper is that Marinovic/Povel assume that firms compete for talented managers. They find that competition results in increased

incentives. Therefore, it corrects inefficiently low incentives resulting in adverse selection settings due to downward distorted incentives for bad types. However, in the presence of misreporting, competition may also lead to severe over-incentives. Marinovic/Povel juxtapose the inefficiencies related to the agency problem with and without competition and identify conditions under which competition for talent either benefits or harms the principal.

3. The model

We consider a one shot game between a principal and an agent. The principal aims at maximizing firm value. In order to motivate the agent to work hard, he offers an incentive contract at the beginning of the game. We assume, however, that firm value itself is un-contractible and thus the principal has to revert to a contractible performance measure. This measure is affected by two types of efforts, each performed privately by the agent. The first effort is a productive effort in the sense that it increases firm value along with the performance measure. The second effort, in contrast, increases the performance measure only and can be referred to as a window dressing activity.[2] If the agent accepts the contract, he provides both efforts and is paid according to his contract at the end of the game.

The performance measure y is defined as follows:

$$y = \beta_1 e_1 + \beta_2 e_2$$

e_1 refers to the productive effort and e_2 is window dressing. $\beta_i, i = 1,2$ depict the sensitivity of the performance measure with regard to both efforts.

For simplicity, we assume that firm value F increases in e_1 at a similar rate as y does, such that $F = \beta_1 e_1$.

Both, the principal and the agent are risk neutral.

The agent maximizes expected pay less disutility from working hard. We assume that two scenarios exist with regard to the amount of disutility from effort the agent suffers from.

If the working environment at the firm is good, the agent faces a relatively low disutility when providing effort. With regard to the productive effort, disutility in the presence of the good environment is characterized by $\frac{k_L e_1^2}{2}$, and $k_L > 0$. In the bad environment, in contrast, disutility is higher and denoted $\frac{k_H e_1^2}{2}$ and $k_H = k_L + \Delta$ with $\Delta \geq 0$.

The agent's disutility on the window dressing activity, however, is not only affected by the working environment, characterized by $k_j, j = L, H$, but also by the accounting system in place. To reflect that, we presume that a rigid system imposes an extra cost on the window dressing activity that is absent for productive effort. The extra cost possibly differs, however, depending on the type of environment.

If the working environment the agent faces is good, disutility from the window dressing effort equals $\frac{\alpha_B k_L e_2^2}{2}$. In a bad environment, it equals $\frac{(\alpha_B k_L + \alpha_E \Delta) e_2^2}{2}$. To achieve increased disutility for window

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[2] See e.g. Feltham/Xie (1994) or Goldman/Slezak (2006) for a similar interpretation.

dressing as opposed to productive effort we assume that $\alpha_B > 1$ and $\alpha_E > 1$. We do not predetermine, however, whether $\alpha_B > \alpha_E$ or v.v.

Note that the presence of a good and bad environment can be interpreted in terms of two different types of agents. The good type faces a lower disutility and the bad type a higher one. We will use this interpretation interchangeably with the good and bad environment whenever convenient in what follows.

Summing up, total disutility in each environment is characterized by

$\frac{k_L e_1^2}{2} + \frac{\alpha_B k_L e_2^2}{2}$ in the good setting and

$\frac{(k_L + \Delta)e_1^2}{2} + \frac{(\alpha_B k_L + \alpha_E \Delta)e_2^2}{2}$ in the bad one.

The underlying rationale for the above expressions is as follows: α_B reflects a basic effect the accounting system has on the cost of window dressing that is common in each environment. α_E, in contrast, depicts an "extra" cost effect that aggravates the additional disutility the agent faces in a bad environment. Note that this setup is carefully chosen in order to ensure several properties we consider important: First, it makes sure that the presence of a rigid accounting system renders window dressing more expensive no matter which environment is present. Second, disutility in the bad environment is always larger than in the good environment. Third, in the extreme case where both our settings integrate into a single one, disutility becomes identical as well. In other words if $\Delta \to 0$, the disutility is the same in both expressions as it should be.

With the above specifications in place, we are ready to model the consequences of internal versus external hiring. As stated above, we assume that both alternatives differ with regard to the information endowment of the agent.

If an external applicant is hired, we assume that the agent does not know whether the working environment at the firm is good or bad when he signs the contract. Thus, private information of the agent is limited to post contract information about effort choice. With regard to the working environment, we assume that both, agent and principal, share a common probability distribution for each environment to be present. We denote the probability for a good working environment to be present as p and thus a bad one occurs with probability $(1 - p)$. The agency problem at hand is a (pure) moral hazard problem.

If an insider is hired instead, we assume that he is aware of the type of environment he faces when he accepts the contract. The principal does not have such knowledge. Thus, pre- and post-contracting information asymmetry is present simultaneously, tantamount to an adverse selection problem on top of the moral hazard problem described above.

In what follows we analyze the hiring choice problem and consider a particular accounting system as unique to the two settings and given. We begin analyzing the poorer informational setting. The principal hires an uninformed manager resulting in a pure moral hazard problem. In section 5 solutions to the joint moral hazard and adverse selection setting are derived.

4. Optimal contracts if an uninformed manager is hired

In this setting, the principal hires an outsider. Neither the principal nor the agent know which working environment is present. The principal offers an incentive contract $s(y)$ that specifies some performance level y to be achieved by the agent. If the agent reaches the required performance level, he receives a payment. Otherwise, he endures negative consequences T.

$$s(y) = \begin{cases} s(y^*) \ if \ y^* \\ T \ else \end{cases}$$

T can be regarded as some kind of penalty or even dismissal due to failure. It is assumed to be sufficiently unattractive to ensure that the manager always prefers to perform and to obtain $s(y^*)$, rather than F. Given this contract, the agent chooses his efforts minimizing expected costs for achieving the required performance measure value y^*.

As the agent does not know the type of working environment, expected disutility equals

$$\frac{\overline{k}e_1^2}{2} + \frac{\overline{\overline{k}}e_2^2}{2},$$

$$\text{with } \overline{k} = pk_L + (1-p)k_H \text{ and } \overline{\overline{k}} = p\alpha_B k_L + (1-p)(\alpha_B k_L + \alpha_E \Delta)$$

and the agent's optimization problem can be stated as follows.

$$\min_{e_1,e_2} \frac{\overline{k}e_1^2}{2} + \frac{\overline{\overline{k}}e_2^2}{2}$$

$$\text{s.t.} \quad \beta_1 e_1 + \beta_2 e_2 = y^*.$$

Solving the problem we obtain $e_1^* = \frac{y^*\overline{\overline{k}}\beta_1}{\overline{\overline{k}}\beta_1^2 + \overline{k}\beta_2^2}$ and $e_2^* = \frac{y^*\overline{k}\beta_2}{\overline{\overline{k}}\beta_1^2 + \overline{k}\beta_2^2}$.

Given the agent's conditionally optimal choice of effort, the principal chooses y in order to maximize his objective function

$$\max_{y^*} OF = \beta_1 e_1 - s(y^*)$$

$$\text{s.t.} \quad s(y^*) - \left(\frac{\overline{k}e_1^2}{2} + \frac{\overline{\overline{k}}e_2^2}{2}\right) \geq 0$$

$$e_1 = \frac{y^*\overline{\overline{k}}\beta_1}{\overline{\overline{k}}\beta_1^2 + \overline{k}\beta_2^2}$$

$$e_2 = \frac{y^*\overline{k}\beta_2}{\overline{\overline{k}}\beta_1^2 + \overline{k}\beta_2^2}$$

Solving the problem results in $y^* = \frac{\beta_1^2}{\overline{\overline{k}}}$

Inserting into the optimal effort expressions and the objective function of the principal we obtain lemma 1.

Lemma 1: The optimal solution to the moral hazard problem is characterized by

$$e_1^* = \frac{\bar{\bar{k}}\beta_1^3}{(\bar{k}\beta_1^2+\bar{\bar{k}}\beta_2^2)\bar{k}}, \ e_2^* = \frac{\beta_1^2\beta_2}{\bar{\bar{k}}\beta_1^2+\bar{k}\beta_2^2}, \ OF^{MH} = \frac{\beta_1^4\bar{\bar{k}}}{2\bar{k}(\bar{k}\beta_1^2+\bar{\bar{k}}\beta_2^2)}.$$

5. Optimal contracts if an informed manager is hired

Now an insider is hired. Given the agent is aware of the type of working environment present, it is optimal for the principal to offer a menu of contracts for the agent to choose from. We denote y_L the performance measure level to be reached if the agent claims to be in a good environment and y_H the level relevant in a bad environment. Thus, the incentive contract will be designed as follows:

$$s(y) = \begin{cases} s(y_L) \ if \ y_L \\ s(y_H) \ if \ y_H \\ \quad T \ else \end{cases}$$

Again, we assume that T is well below reservation pay and thus ensures that either y_L or y_H will be the observed performance measure levels.

Given the distinct settings, the optimization problem faced by the agent differs with his privately known type.

Starting with the good type his effort choice problem can be stated as follows:

$$\min_{e_{1L},e_{2L}} \frac{k_L e_{1L}^2}{2} + \frac{\alpha_B k_L e_{2L}^2}{2}$$

$$s.t. \quad \beta_1 e_{1L} + \beta_2 e_{2L} = y_L$$

The agent's optimal effort choice is given by $e_{1L}^* = \frac{\alpha_B y_L \beta_1}{\alpha_B \beta_1^2+\beta_2^2}$ and $e_{2L}^* = \frac{y_L \beta_2}{\alpha_B \beta_1^2+\beta_2^2}$.

If the agent is of type H his optimization problem becomes

$$\min_{e_{1H},e_{2H}} \frac{k_H e_{1H}^2}{2} + \frac{\tilde{k} e_{2H}^2}{2}$$

$$s.t. \quad \beta_1 e_{1H} + \beta_2 e_{2H} = y_H$$

with $k_H = k_L + \Delta$ and $\tilde{k} = \alpha_B k_L + \alpha_E \Delta$

Solving the problem we obtain $e_{1H}^* = \frac{\tilde{k} y_H \beta_1}{\tilde{k}\beta_1^2+k_H\beta_2^2}$ and $e_{2H}^* = \frac{k_H y_H \beta_2}{\tilde{k}\beta_1^2+k_H\beta_2^2}$.

Note that we have assumed above that both types of agents self select into the contract designed for them. If they do not, optimal effort differs. We omit explicit derivation at this point but the resulting expressions are shown in the r.h.s. of (3) and (4) below.

Given the optimal effort reactions of each type, the principal maximizes expected net payoff, ensuring that the agent is willing to participate and to choose the right contract.

$$\max_{y_L, y_H} OF = p[\beta_1 e_{1L} - s(y_L)] + (1-p)[\beta_1 e_{1H} - s(y_H)]$$

s.t.

$$s(y_L) - \frac{k_L e_{1L}^2}{2} - \frac{\alpha_B k_L e_{2L}^2}{2} \geq 0 \qquad (1)$$

$$s(y_H) - \frac{k_H e_{1H}^2}{2} - \frac{\tilde{k} e_{2H}^2}{2} \geq 0 \qquad (2)$$

$$s(y_L) - \frac{k_L e_{1L}^2}{2} - \frac{\alpha_B k_L e_{2L}^2}{2} \geq s(y_H) - \frac{k_L}{2}\left(\frac{\alpha_B y_H \beta_1}{\alpha_B \beta_1^2 + \beta_2^2}\right)^2 - \frac{\alpha_B k_L}{2}\left(\frac{y_H \beta_2}{\alpha_B \beta_1^2 + \beta_2^2}\right)^2 \qquad (3)$$

$$s(y_H) - \frac{k_H e_{1H}^2}{2} - \frac{\tilde{k} e_{2H}^2}{2} \geq s(y_L) - \frac{k_H}{2}\left(\frac{\tilde{k} y_L \beta_1}{\tilde{k}\beta_1^2 + k_H \beta_2^2}\right)^2 - \frac{\tilde{k}}{2}\left(\frac{k_H y_L \beta_2}{\tilde{k}\beta_1^2 + k_H \beta_2^2}\right)^2 \qquad (4)$$

$$e_{1L} = \frac{\alpha_B y_L \beta_1}{\alpha_B \beta_1^2 + \beta_2^2}$$

$$e_{2L} = \frac{y_L \beta_2}{\alpha_B \beta_1^2 + \beta_2^2}$$

$$e_{1H} = \frac{\tilde{k} y_H \beta_1}{\tilde{k}\beta_1^2 + k_H \beta_2^2}$$

$$e_{2H} = \frac{k_H y_H \beta_2}{\tilde{k}\beta_1^2 + k_H \beta_2^2}$$

Constraints (1) and (2) ensure that the agent is willing to work for the firm. (3) and (4) are self-selection constraints.

It is well known from the literature, that not all of the constraints are binding at the optimum.[3] Precisely, (1) is not binding so that the good type receives a rent payment. The rent motivates the good type to self-select into the good state contract rather than to pretend that the bad state is present. Optimally the minimal rent that prevents imitation of the bad type is paid. It follows that (3) is binding. From the bad type's perspective, imitating the good one is too expensive and therefore (4) is not binding. As a consequence, the bad type can be kept at his reservation utility level such that (2) ins binding.

It follows that (1) and (4) can be ignored for further analysis. Doing so and maximizing with respect to y_L and y_H we obtain the following expressions:

$$y_L = \frac{\beta_1^2}{k_L}$$

[3] See, e.g., Laffont/Martimort (2002), p.42.

$$y_H = \frac{\beta_1^2}{k_H + R}$$

$$\text{with } R = \frac{\Delta p(\alpha_B \tilde{k}\beta_1^2 + \alpha_E k_H \beta_2^2)}{\tilde{k}(1-p)(\alpha_B \beta_1^2 + \beta_2^2)}$$

Note that only y_H, but not y_L, is a function of α_k , $k = B, E$ and p.

Inserting once again into the optimal effort expressions and the objective function of the principal we obtain the results stated in lemma 2.

Lemma 2: The optimal solution to the joint moral hazard and adverse selection problem is characterized by

$$e_{1L}^* = \frac{\alpha_B \beta_1^3}{(\alpha_B \beta_1^2 + \beta_2^2)k_L}$$

$$e_{2L}^* = \frac{\beta_1^2 \beta_2}{(\alpha_B \beta_1^2 + \beta_2^2)k_L}$$

$$e_{1H}^* = \frac{\tilde{k}\beta_1^3}{(\tilde{k}\beta_1^2 + k_H \beta_2^2)(k_H + R)}$$

$$e_{2H}^* = \frac{k_H \beta_1^2 \beta_2}{(\tilde{k}\beta_1^2 + k_H \beta_2^2)(k_H + R)}$$

$$OF^{MHAS} = \frac{\begin{array}{c} \beta_1^4[(\alpha_B\beta_1^2+\beta_2^2)k_L\tilde{k}^2+\tilde{k}(\alpha_B\beta_1^2+\beta_2^2)[\alpha_B(\alpha_E\beta_1^2+\beta_2^2)\Delta^2+(\alpha_B-\alpha_E)(\alpha_B\beta_1^2+2\beta_2^2)\Delta k_L-\alpha_B(\alpha_B\beta_1^2+\beta_2^2)k_L^2]p \\ +(\alpha_E-\alpha_B)\beta_2^2\Delta k_L[(2\alpha_B\alpha_E\beta_1^2+(\alpha_B+\alpha_E)\beta_2^2)\Delta+2\alpha_B(\alpha_B\beta_1^2+\beta_2^2)k_L]p^2] \end{array}}{2(\alpha_B\beta_1^2+\beta_2^2)k_L(\beta_1^2\tilde{k}+\beta_2^2 k_H)[(\alpha_B\beta_1^2+\beta_2^2)k_H\tilde{k}-\alpha_B k_L(\beta_1^2\tilde{k}+\beta_2^2 k_H)p]}.$$

6. Simplified Settings A-C

In order to be able to interpret the above results properly we will proceed looking at several simplified settings bevor we tackle the full model.

An overview of the results is presented in the table below and each setting is discussed in detail in sections 6.1-6.3.

Setting n	Type of agency problem	e_{1j}^*	e_{2j}^*	y_j^*	OF^*	$D^n = OF^{MHAS} - OF^{MH}$
A. $\beta_2 = 0$	MH	$e_1^* = \dfrac{\beta_1}{k}$	$e_2^* = 0$	$y^* = \dfrac{\beta_1^2}{k}$	$\dfrac{\beta_1^2}{2k}$	$\dfrac{(\Delta - k_L)*\beta_1^2\Delta(1-p)p}{2k_L[(1-p)\Delta + k_L][\Delta + k_L(1-p)]}$
	MHAS	$e_{1L}^* = \dfrac{\beta_1}{k_L}$ $e_{1H}^* = \dfrac{\beta_1(1-p)}{\Delta + k_L(1-p)}$	$e_{2L}^* = e_{2H}^* = 0$	$y_L^* = \dfrac{\beta_1^2}{k_L}$ $y_H^* = \dfrac{\beta_1^2}{k_H + \dfrac{p\Delta}{1-p}}$	$\dfrac{\beta_1^2[p\Delta + (1-p)k_L]}{2k_L(k_H - pk_L)}$	
B. $\alpha_B = \alpha_E = 1$	MH	$e_1^* = \dfrac{\beta_1^3}{k(\beta_1^2 + \beta_2^2)}$	$e_2^* = \dfrac{\beta_1^2\beta_2}{k(\beta_1^2 + \beta_2^2)}$	$y^* = \dfrac{\beta_1^2}{k}$	$\dfrac{\beta_1^4}{2k(\beta_1^2 + \beta_2^2)}$	$\dfrac{(\Delta - k_L)*\beta_1^4\Delta(1-p)p}{2k_L(\beta_1^2 + \beta_2^2)[(1-p)\Delta + k_L][\Delta + k_L(1-p)]}$
	MHAS	$e_{1L}^* = \dfrac{\beta_1^3}{k_L(\beta_1^2 + \beta_2^2)}$ $e_{1H}^* = \dfrac{\beta_1^3(1-p)}{(\beta_1^2 + \beta_2^2)(k_L(1-p) + \Delta)}$	$e_{2L}^* = \dfrac{\beta_1^2\beta_2}{k_L(\beta_1^2 + \beta_2^2)}$ $e_{2H}^* = \dfrac{\beta_1^2\beta_2(1-p)}{(\beta_1^2 + \beta_2^2)(k_L(1-p) + \Delta)}$	$y_L^* = \dfrac{\beta_1^2}{k_L}$ $y_H^* = \dfrac{\beta_1^2}{k_H + \dfrac{p\Delta}{1-p}}$	$\dfrac{\beta_1^4(k_L(1-p) + \Delta p)}{2k_L(\beta_1^2 + \beta_2^2)(k_L(1-p) + \Delta)}$	
C. $\alpha_B = \alpha_E = \alpha > 1$	MH	$e_1^* = \dfrac{\alpha\beta_1^3}{k(\alpha\beta_1^2 + \beta_2^2)}$	$e_2^* = \dfrac{\beta_1^2\beta_2}{k(\alpha\beta_1^2 + \beta_2^2)}$	$y^* = \dfrac{\beta_1^2}{k}$	$\dfrac{\alpha\beta_1^4}{2k(\alpha\beta_1^2 + \beta_2^2)}$	$\dfrac{(\Delta - k_L)*\alpha\beta_1^4\Delta(1-p)p}{2k_L(\alpha\beta_1^2 + \beta_2^2)[(1-p)\Delta + k_L][\Delta + (1-p)k_L]}$
	MHAS	$e_{1L}^* = \dfrac{\alpha\beta_1^3}{k_L(\alpha\beta_1^2 + \beta_2^2)}$ $e_{1H}^* = \dfrac{\alpha\beta_1^3(1-p)}{(\alpha\beta_1^2 + \beta_2^2)(k_L(1-p) + \Delta)}$	$e_{2L}^* = \dfrac{\beta_1^2\beta_2}{k_L(\alpha\beta_1^2 + \beta_2^2)}$ $e_{2H}^* = \dfrac{\beta_1^2\beta_2(1-p)}{(\alpha\beta_1^2 + \beta_2^2)(k_L(1-p) + \Delta)}$	$y_L^* = \dfrac{\beta_1^2}{k_L}$ $y_H^* = \dfrac{\beta_1^2}{k_H + \dfrac{p\Delta}{1-p}}$	$\dfrac{\alpha\beta_1^4(k_L(1-p) + \Delta p)}{2k_L(\alpha\beta_1^2 + \beta_2^2)(k_L(1-p) + \Delta)}$	

Table 1: Results from simplified settings.

6.1 Setting A

As a first step, and to provide the most basic insights into the trade-off between moral hazard and the joint setting, we assume $\beta_2 = 0$. This implies that only the productive effort enters the performance measure. Performing a window dressing activity therefore is of no value for the agent. Accordingly, $e_{2i} = 0$ is optimal and introducing an accounting system that renders window dressing activities more costly is of no effect and useless for the principal.

If a pure moral hazard problem is present, the first best solution can be implemented. All the risk, which is entirely related to the unknown actual disutility of effort, is transferred to the agent. As the agent is risk neutral, this is without costs. The result thus resembles a "selling the shop to the agent" type of solution. Choosing y^* appropriately allows the principal to induce the first best effort at first best cost.

Given an adverse selection problem is present on top, first best can no longer be achieved. Rather, agency costs occur due to incentives of the good type to imitate the bad type. Incentives of the bad type are downward distorted in equilibrium in order to reduce rent payments to the good type at the cost of sacrificing effort incentives for the bad type. At the same time, incentives for the good type remain undistorted, a result known from the literature as "no distortion at the top". It is reflected in our model by $y_H^* < y_L^* = y^{FB}$ along with $e_{1H}^* < e_{1L}^* = e_1^{FB}$.

Achieving first best in the moral hazard setting while achieving second best in the joint setting, however, by no means implies that pure moral hazard is generally preferred to joint moral hazard and adverse selection. This shows if we compare objective function values in both settings and leads to proposition 1.

Proposition 1: The principal prefers to hire an informed agent, if $\Delta = k_H - k_L$ is greater than k_L. Otherwise, he prefers to hire an uninformed manager.

Inspecting the difference in setting A,

$$D^A = OF^{MH} - OF^{MHAS} = \frac{\beta_1^2 \Delta (1-p)p}{2k_L[(1-p)\Delta + k_L][\Delta + k_L(1-p)]} (\Delta - k_L)$$

we observe that it is composed of a difference $(\Delta - k_L)$ multiplied by a positive factor.[4] It follows that the difference in objective function values is positive, whenever $(\Delta - k_L) = (k_H - k_L - k_L) = (k_H - 2k_L)$ is positive. k_j is a factor that puts some weight on the disutility of effort the agent suffers from. If the weights are sufficiently different depending on the working environment, the adverse selection/moral hazard setting is preferred to the pure moral hazard setting.

In a pure moral hazard setting the manager is uninformed. This keeps him from exploiting private knowledge to the detriment of the principal. It also keeps him, however, from fine-tuning his effort to the situation at hand. If the states of nature, tantamount to the working environments, are not too distinct, costs related to the lack of fine-tuning are lower than costs from exploiting private knowledge. Hiring an uninformed manager is preferred. If, in contrast, the states of nature become more distinct, private knowledge and fine-tuning of effort becomes more valuable and related benefits beat the cost resulting from asymmetric information. It becomes preferable for the principal to hire an informed

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[4] We assume at this point that $\Delta > 0$ and $p < 1$, such that two distinct types exist at all.

manager, even though this involves a rent payment if working conditions are good along with downward distorted incentives for the agent in the bad environment.

6.2 Setting B

In the second simplified setting, we add a window dressing activity to the single effort problem from setting A. Formally, we assume $\beta_2 > 0$. A rigid accounting system, however, is absent, resulting in $\alpha_B = \alpha_E = 1$.

In the pure moral hazard setting first best is now no longer achievable. Rather, being unable to observe the agent's effort choice, the principal cannot prevent the agent from performing a positive window dressing activity. Agency costs arise from a ***congruity problem***. Precisely, the agent minimizes his effort cost, given he has to achieve a certain performance measure level specified by the principal. Doing so, it is optimal to split effort between productive and unproductive activities in order to keep the convex effort cost as low as possible. From the principal's perspective, a suboptimal effort allocation arises along with agency costs. The objective function value in setting B as compared to setting A decreases by $\frac{\beta_1^2 \beta_2^2}{2\overline{k}(\beta_1^2 + \beta_2^2)} > 0$.

Adding an adverse selection problem on top affects the agency conflict in similar fashion as in setting A. Comparing objective function values, however, shows structurally quite similar results to setting A. This becomes apparent from the rightmost column of table 1 and is stated explicitly in proposition 2.

Proposition 2: The principal prefers to hire an informed agent if $\Delta = k_H - k_L$ is greater than k_L. Otherwise, he prefers to hire an uninformed manager.

Proposition 2 shows that the cutoff point that renders pure moral hazard unfavorable and the joint setting favorable is the same. The difference in objective function values at each point of Δ, however, differs. Moreover, the presence of a window dressing activity renders not only the objective function values but also the difference in objective function values smaller. It follows that for any Δ choosing a suboptimal type of manager is less costly. If a firm in the presence of window dressing opts for an informed manager even though an uninformed one would be advisable ($\Delta - k_L < 0$), the costs of doing so are lower than in the absence of a window dressing activity. The same logic holds true, if a firm hires an uninformed manager and an informed one would maximize payoffs, that is $\Delta - k_L > 0$.

6.3 Setting C

In a final step we add a rigid accounting system to the structure from setting B. The only simplification left as compared to the full model pertains to the specifics of the accounting system. For now we assume that the additional cost imposed on the agent for window dressing is insensitive to the working environment. Accordingly, we stick to $\beta_2 > 0$ and in addition assume $\alpha = \alpha_B = \alpha_E > 1$. Obviously, the higher α, the more rigid the accounting system.

In a pure moral hazard setting an accounting system that renders window dressing more costly turns out to be beneficial for the principal. At the optimum, the agent reduces effort in the window dressing activity in favor of the productive effort. The optimal performance measure level as prescribed by the

principal, y^*, remains unaffected. A stricter accounting system thus helps to mitigate the congruity problem and increases the principal's objective function. The effect is stronger the higher α.

The identified effects remain if an adverse selection problem is added. A stricter accounting system increases productive effort, decreases window dressing and increases the principal's objective function value for any given k_j. The optimal performance measure values y_j are still independent of α, too.

Proposition 3: The principal again prefers to hire an informed agent, if $\Delta = k_H - k_L$ is greater than k_L. Otherwise, he prefers to hire an uninformed manager.

Proposition 3 shows that the solutions are structurally similar to both the previous settings. The cutoff point is once more the same. The difference in objective function values at each point of Δ again differs. As compared to the setting with $\alpha = 1$ differences are larger for each Δ and thus it becomes more costly again if the wrong type of manager is chosen.

In all scenarios, however, we find that it is optimal to hire an uninformed manager if Δ is sufficiently low and an informed manager if it becomes sufficiently high. There is only a single point of indifference beyond the one when $\Delta \to 0$. When Δ increases, objective function values obtained from hiring either type of manager are decreasing. To the left hand side of the point of indifference, the objective function value from the joint setting decreases at a higher rate. On the right hand side of the point of indifference, the objective function value obtained in the pure moral hazard setting decreases at a higher rate.

To demonstrate the general pattern we use a numerical example and plot the optimal objective function values varying Δ.

Numerical example 1: $\alpha = \alpha_B = \alpha_E = 1{,}5$; $\beta_1 = 2$; $\beta_2 = 1{,}5$; $p = 0.6$; $k_L = 1{,}2$
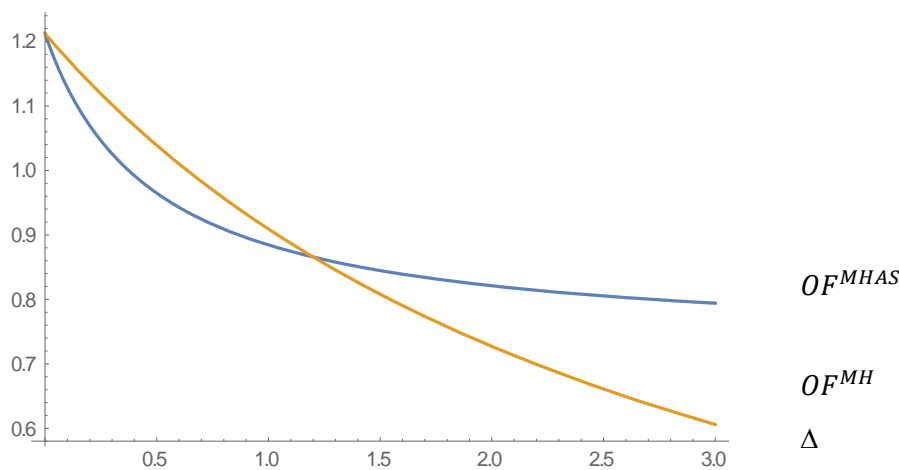

Figure 1: Change in objective function values in Δ, example 1.

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7. Back to the full model

Now we not only allow for a window dressing activity that is restricted by an accounting system but also for the basic cost factor α_B to differ from the extra one, a_E.

Inspecting the differences in objective function values again, we find that several characteristics from the simplified settings above continue to hold in this setting. We formalize them again in proposition 4 i), ii) and iv). Proposition 4 iii), however, identifies a structural difference that will be discussed below.

Proposition 4:

i) Both objective function values coincide in the lower limit, that is $\lim_{\Delta \to 0} OF^{MH} = \lim_{\Delta \to 0} OF^{MHAS}$.

ii) If Δ approaches infinity $OF^{MHAS} > OF^{MH}$ always holds.

iii) Arbitrarily close to zero the objective function value under pure moral hazard decreases at a higher rate or increases at a lower rate than the objective function value in the joint setting, that is $\frac{dOF^{MH}}{d\Delta}(0) < \frac{dOF^{MHAS}}{d\Delta}(0)$ always holds.

iv) There is a single point of indifference where $OF^{MH} = OF^{MHAS}$.

Given i) to iv), it follows that there is always a lower range of Δ in which the objective function value is higher in the pure moral hazard setting and an upper range in which the joint setting results in higher objective function values. To that extent the results are structurally similar to the ones derived in the simplified settings A-C. A difference worth looking into, however, is that objective function values are not necessarily continuously decreasing in Δ anymore as stated in iii). Rather, there might be an increase in objective function values for sufficiently low Δ, and a decrease after a maximum is reached.

Possible (additional) shapes are depicted for two numerical examples.

In the first example objective function values in both settings are increasing in Δ if Δ is small. We used the following parameter values for numerical example 2: $\alpha_B = 1,5, \alpha_E = 15$; $\beta_1 = 2$; $\beta_2 = 1,5$; $p = 0.1$; $k_L = 1,2$.
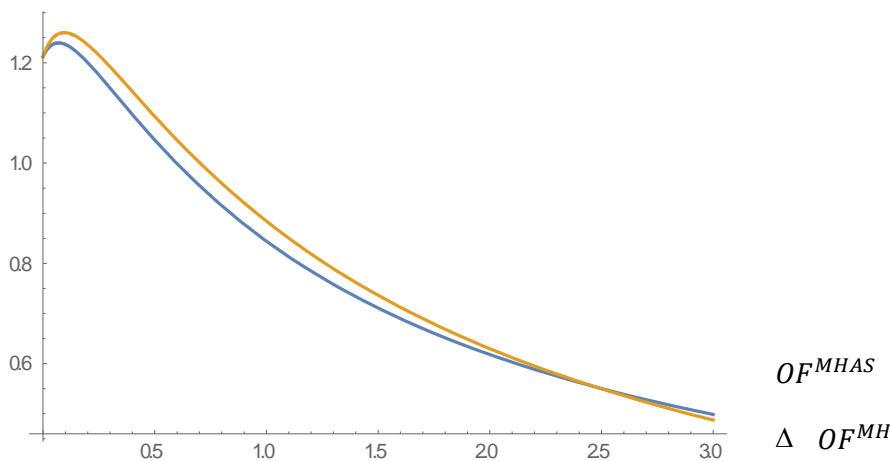

Figure 2: Change in objective function values in Δ, example 2.

In the second example OF^{MH} increases for Δ sufficiently small, reaches a maximum and then decreases. In the joint setting, in contrast, OF^{MHAS} is strictly decreasing over the feasible range. Parameters used in numerical example 3 are : $\alpha_B = 1{,}5, \alpha_E = 15; \beta_1 = 2; \beta_2 = 1{,}5; p = 0.6; k_L = 1{,}2$.
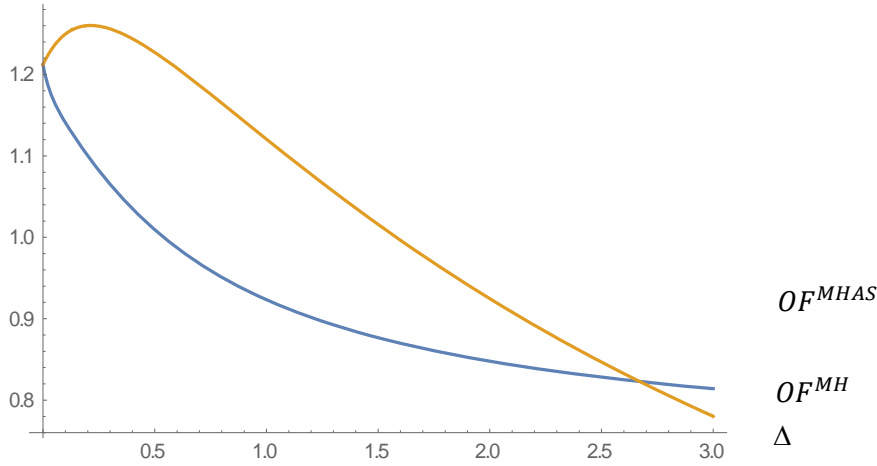

Figure 3: Change in objective function values in Δ, example 3.

The distinct shapes, that is the existence of an inner maximum of objective function values in some settings, result from our model assumptions with respect to disutility of both types. Recall that we assume the disutility of effort for the good type equals $\frac{k_L e_1^2}{2} + \frac{\alpha_B k_L e_2^2}{2}$ and it is $\frac{(k_L+\Delta)e_1^2}{2} + \frac{(\alpha_B k_L + \alpha_E \Delta)e_2^2}{2}$ for the bad type.

As argued above already, disutility of both types becomes identical if the types vanish, that is $\Delta \to 0$. All our graphs start from that very point, $\Delta = 0$. At this point the cost factor α_E is of no effect and the amount of window dressing depends on α_B only. Once Δ becomes positive, however, α_E gets relevant. If α_E is sufficiently high (note in example 2 and 3 we assume $\alpha_E = 15$ along with $\alpha_B = 1.5$), even a small increase in Δ results in extraordinary costs of window dressing and in turn leads to a strong decrease of window dressing and a shift towards productive effort. This is what drives the increase in the objective function value for a lower range of Δ. Once the difference in types increases further, however, costs of disutility still increase but the already small amount of window dressing declines with limited cost effects. Rather, costs from a lack of fine-tuning due to missing information (MH) and costs from the threat of imitation (MHAS) become predominant again and after reaching a maximum, objective function value starts to decrease.

Differences in the objective function shape in both settings as shown in figure 3, result from distinct effects of ex ante probability for the good and the bad type, p. In the pure moral hazard setting the agent does not know his own type. Even if the probability for a good environment is relatively high, $p = 0{,}6$ in example 3, there is still a 0,4 probability to suffer extreme disutility from window dressing. As a result, the agent refrains strongly from window dressing and the positive effect on the objective function value as described above arises. In the joint setting, in contrast, with ex ante probability of

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0,6 a good type is present and this type knows perfectly well that his disutility is unaffected by α_E. Thus, he will opt for window dressing in the good environment and refrain only if the bad environment is present. More expected window dressing takes place in the joint setting leading to objective function values strictly decreasing in Δ.

So far we have analyzed in detail, to what extent the difference in types affects the objective function values in both settings and under which conditions either pure moral hazard or a joint moral hazard/ adverse selection setting is preferred.

We find that in all scenarios considered, A-C as well as our full model, the principal always prefers to hire an uninformed manager if Δ is within some lower range and an informed one if it is beyond that range. The presence of highly distinct types thus calls for the joint setting while a pure moral hazard setting is preferred for fairly similar types. Throughout the analysis, however, we assumed identical accounting systems to be present.

8. Accounting system effects

In a next step, we investigate to what extent the accounting system at hand affects agency problems and agency costs.

To do so, we consider setting C from above as well as the full model. Both of these scenarios include an extra cost factor for window dressing, reflecting the existence of some kind of rigid accounting system.

8.1 Setting C

In setting C we assume that disutility related to the window dressing activity increases by a factor $\alpha > 1$ as compared to productive effort, no matter which type is present. Thus, the window dressing activity results in disutility of $\alpha \frac{k_L}{2} e_{2L}^2$ for the good type and in $\alpha \frac{k_L + \Delta}{2} e_{2H}^2$ for the bad type.

The higher α, the more expensive window dressing and the stronger the shift from window dressing effort towards productive effort, no matter which type is present. Higher α therefore reduces the congruity problem in the pure moral hazard as well as in the joint setting. Introducing α, in contrast, does not affect the adverse selection problem in the joint setting. To see this, note that the optimal performance levels y_j^* remain the same as in setting B with $\alpha = 1$. The reason is that y_j^* results from trading off expected marginal payoff and expected marginal costs. At the optimum, expected marginal payoff equals expected marginal costs. With regard to the good type this reads

$$\underbrace{\frac{\alpha}{\alpha\beta_1^2 + \beta_2^2}\beta_1^2}_{\text{exp. marg. payoff}} = \underbrace{\frac{\alpha}{\alpha\beta_1^2 + \beta_2^2}k_L y_L^*}_{\text{exp. marg. costs}} \qquad (5)$$

Likewise, for the bad type we get

$$\underbrace{\frac{\alpha}{\alpha\beta_1^2+\beta_2^2}(1-p)\beta_1^2}_{\text{exp. marg. payoff}} = \underbrace{\frac{\alpha}{\alpha\beta_1^2+\beta_2^2}y_H^*(k_L(1-p)+\Delta)}_{\text{exp. marg. costs}} \qquad (6)$$

Note that for the good type marginal costs equals marginal disutility from efforts while for the bad type an extra cost factor captures marginal costs from rent payments, that is $y_H^*\Delta$. More important, however, we observe that α always is part of a common multiplicative factor on both sides of the equations. Thus, any increase of α affects marg. payoff and marg. costs in identical fashion and leaves y_j^* the same. It follows that the downward distortion of the bad type's performance level remains the same as in setting B and so are agency costs related to the adverse selection problem. It follows that the objective function values in both settings increase in α. Summing this up results in proposition 5.

Proposition 5:

In a pure moral hazard setting we find that

$\frac{de_1^*}{d\alpha} > 0, \frac{de_2^*}{d\alpha} < 0, \frac{dy^*}{d\alpha} = 0$, and $\frac{dOF^{MH*}}{d\alpha} > 0$

It is optimal to choose $\alpha \to \infty$, or, alternatively, as large as possible.

In the joint setting we find

$\frac{de_{1L}^*}{d\alpha} > 0, \frac{de_{1H}^*}{d\alpha} > 0, \frac{de_{2L}^*}{d\alpha} < 0, \frac{de_{2H}^*}{d\alpha} < 0, \frac{dy_H^*}{d\alpha} = 0, \frac{dy_L^*}{d\alpha} = 0$, and $\frac{dOF^{MHAS*}}{d\alpha} > 0.$

It is optimal to choose $\alpha \to \infty$, or, alternatively, as large as possible.

It follows directly from proposition 5 that in both settings, pure moral hazard and joint setting, any accounting system that exhibits higher α is preferred to one with lower α.

8.2 Full model

Considering the full model that allows for $\alpha_B \neq \alpha_E$, we find that results in the pure moral hazard setting are structurally identical to those from setting C. Higher factors α_B and α_E shift effort from the window dressing activity towards the productive activity in equilibrium. Increasing α_B and α_E reduces the congruity problem and in turn increases the objective function value for the principal. This will be stated formally in proposition 6 a) below.

In the joint setting, the effects of α_B and α_E on the congruity problem remain unchanged as compared to setting C (and the pure moral hazard problem in this section) as well, as is shown in proposition 6 b) below.

The effects on the adverse selection problem, in contrast, are fundamentally different. With respect to the good type, y_L^* is still independent of any increase in α_ks. It is independent from changes in α_E as the good type by definition is unaffected by the extra cost. Recall his disutility has been defined $\frac{k_L e_1^2}{2} + \frac{\alpha_B k_L e_2^2}{2}$. Moreover, it is independent from α_B as the expected marginal payoffs and costs resemble those from (5) if we replace α by α_B. The common factor argument remains valid.

For the bad type, in contrast, this is no longer true. Different from (6) there is no longer a common factor that affects marginal payoff and costs in similar fashion if $\alpha_B \neq \alpha_E$. Rather, the bad type's performance level becomes a function of both, α_B and α_E and equals

$$y_H^* = \frac{\beta_1^2}{k_H + R} = \frac{\beta_1^2}{k_H + \frac{\Delta p(\alpha_B \bar{k}\beta_1^2 + \alpha_E k_H \beta_2^2)}{\bar{k}(1-p)(\alpha_B \beta_1^2 + \beta_2^2)}}.$$

Note that in the absence of any incentive to imitate, the performance level for the bad type chosen by the principal would be $y_H^{FB} = \frac{\beta_1^2}{k_H}$. In settings A-C a unique level of downward distortion of this performance level has been identified as $y_H^* = \frac{\beta_1^2}{k_H + \frac{p\Delta}{1-p}} < y_H^{FB}$. It follows that agency costs from adverse selection have been present already in settings A-C. The distortion factor, $\frac{p\Delta}{1-p}$, can be regarded as a measure of the strengths of the adverse selection problem.

Now, in the full model, the downward distortion factor is R. It can be larger or smaller than $\frac{p\Delta}{1-p}$. The distortion is larger (smaller) in the full model if $\alpha_E > (<)\alpha_B$ as $R > (<) \frac{\Delta p}{1-p}$ if $\alpha_E > (<)\alpha_B$. It is therefore not clear whether the adverse selection problem is more or less severe in the full model as in the simplified ones. We can identify, however, a combination of α_B and α_E that minimizes R. It holds that $R^{min} < \frac{p\Delta}{1-p}$. This is presented in proposition 6 b) ii) below.

Proposition 6:

a) In a pure moral hazard setting

$$\frac{de_1^*}{d\alpha_B} > 0, \frac{de_1^*}{d\alpha_E} > 0, \frac{de_2^*}{d\alpha_B} < 0, \frac{de_2^*}{dE} < 0, \frac{dy^*}{d\alpha_B} = 0, \frac{dy^*}{d\alpha_E} = 0, \text{ and } \frac{dOF^{MH*}}{d\alpha_B} > 0, \frac{dOF^{MH*}}{d\alpha_E} > 0.$$

It is optimal to choose each of $\alpha_k \to \infty$ with $k = B, E$, or, alternatively, as large as possible.

b) In the joint setting
i)   the congruity problem is minimized for $\alpha_k \to \infty$ with $k = B, E$.
ii)   the downward distortion in y_H^*, is minimized if distortion factor R is minimal. This is

achieved for $\alpha_B \to 1 + \frac{\sqrt{k_L k_H (\beta_1^2 + \beta_2^2)}}{\beta_1 k_L}$ and $\alpha_E \to 1$.

It follows from proposition 6 that it is not necessarily optimal any longer to choose α_B and α_E as large as possible in the joint setting. Doing so reduces the congruity problem but may increase the adverse selection problem. As shown in proposition 6b) ii), the distortion factor R is minimized when α_E is chosen as small as possible and an inner solution is obtained for α_B. To see the economic rationale of

this result, note that the adverse selection problem becomes stronger if the types become more distinct. As the types in our model differ in their disutility, an increase in α_E increases the bad type's disutility from effort relative to the good type's. Both types drift apart and in turn the adverse selection problem becomes harder.

The optimal α_E results from trading off costs from the congruity problem and costs from the adverse selection problem. We find that the optimal α_E critically depends on the probability for a good or bad environment to be present. If the probability for a good type is smaller than for a bad one, that is $p < 0.5$, the adverse selection problem is sufficiently small to be dominated by the congruity problem. Any increase in α_E increases the objective function value for any given α_B. If, in contrast, the good type is more likely, the adverse selection problem becomes more important. The principal's objective function is strictly decreasing in α_E or it decreases in lower ranges of α_E, reaches a minimum, and then increases. Both is shown in proposition 7 and also illustrated in figure 4 and figure 5 below.

Proposition 7:

i)   For $p < 0.5$, $\frac{dOF^{MHAS}}{d\alpha_E} > 0 \; \forall \; \alpha_B, \alpha_E$. Thus, agency costs are minimized by choosing α_E as large as possible for any α_B.

ii) If $p > 0.5$, $\frac{dOF^{MHAS}}{d\alpha_E} < 0$ for $\alpha_B k_L\big(\beta_1^2 \tilde{k} + \beta_2^2 k_H\big)(1 - 2p) + \alpha_B \beta_1^2 \tilde{k} + \alpha_E \Delta k_H \beta_2^2 < 0$.

In that case OF^{MHAS} is either strictly decreasing for all α_E or it decreases for a lower range of $\alpha_E s$, reaches a minimum, and increases for larger $\alpha_E s$.

Demonstrating the effects described in proposition 7 ii) we use the following numerical examples.

Example 4: $\alpha_B = 1{,}5$; $\beta_1 = 2$; $\beta_2 = 1{,}5$; $p = 0.9$; $k_L = 10$; $\Delta = 0{,}5$.
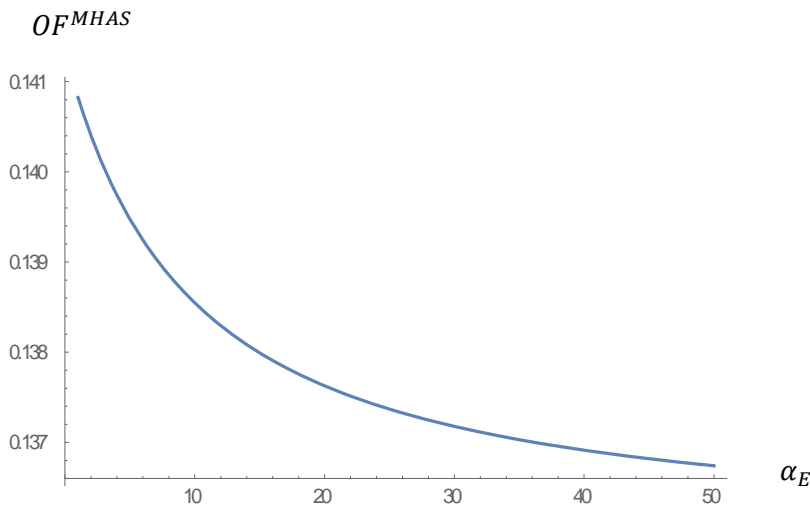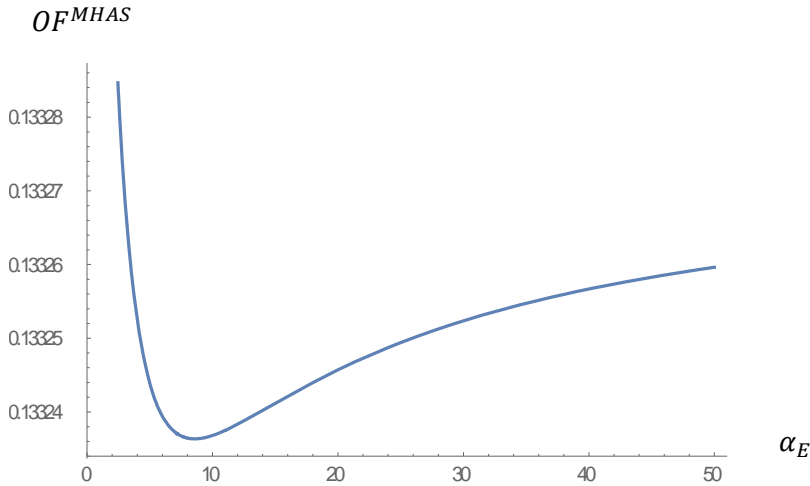
OF^{MHAS}

Figure 4: Effect of an increase in the bad type's disutility factor α_E on the principal's objective function with an informed manager given parameter values from example 4.

Example 5: $\alpha_B = 1{,}5$; $\beta_1 = 2$; $\beta_2 = 1{,}5$; $p = 0.9$; $k_L = 10$; $\Delta = 5$.

OF^{MHAS}

Figure 5: Effect of an increase in the bad type's disutility factor α_E on the principal's objective function with an informed manager given parameter values from example 5.

To summarize, we find that the choice of hiring an uninformed manager versus an informed manager and the choice of an appropriate accounting system are interrelated. If an uninformed manager is hired, it is always favorable to implement an accounting system that increases the manager's disutility from window dressing by any amount. The most favorable system is the one that increases costs as much as possible. If an informed manager is hired, in contrast, it can be detrimental to replace an accounting system that exposes the bad type to a low cost factor of disutility, α_E, by one that exhibits a higher cost factor. Two scenarios are possible. In the first one any accounting system that increases α_E is detrimental. In the second, it might be detrimental to increase α_E by a small amount but beneficial to increase it by a sufficiently large amount.

9. Conclusion

In this paper we analyze, under which conditions a principal benefits from hiring an outside manager as opposed to an inside manager. We find that the principal prefers to hire an outside manager if the manager's types, reflected in the disutility related to effort, are not too distinct.

Intuitively the principal trades off costs and benefits from private managerial pre-contract information. An outside manager has no such information. He cannot fine-tune his effort choice nor can he exploit his private knowledge to extract rents from the principal. An insider, in contrast, has both these options. If the types are quite similar, costs related to suboptimal effort choice are lower than costs from rent extraction. It follows that the principal optimally hires an outsider. For very distinct types, costs related to a lack of fine tuning in effort choice increase and exceed costs from rent extraction. In such a setting the principal is better off, hiring an insider. Given an identical accounting system in place,

no matter which hiring choice is made by the principal, we identify some critical type difference at which the principal is indifferent with respect to his hiring choice in all our settings.

Analyzing the effect of a more or less rigid accounting system in both, a moral hazard and a joint moral hazard and adverse selection setting separately, we find that a more restrictive system is always preferred with moral hazard. In the joint setting this is no longer the case. Rather, the principal's payoff may decrease if the accounting system becomes more rigid. This is the case when the system renders the types of managers more distinct and thus amplifies the adverse selection problem.

While we have interpreted the distinct information endowment of managers as due to "inside" versus "outside" applicants to the firm, this is certainly not the only possible story to be told. Alternatively, we could assume that information asymmetry arises if one applicant is an insider to the industry but not the firm, while another one is an outsider to the industry. Another interpretation could be that private information results from work experience in management positions in general while a rookie manager does not possess this type of information.

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Appendix

Proof of proposition 4:

i) $\quad \lim_{\Delta \to 0} OF^{MH} = \lim_{\Delta \to 0} OF^{MHAS} = \frac{\alpha_B \beta_1^4}{2k_L(\alpha_B \beta_1^2 + \beta_2^2)}.$

ii) $\quad \lim_{\Delta \to \infty} OF^{MH} = 0, \lim_{\Delta \to \infty} OF^{MHAS} = \frac{\alpha_B \beta_1^4 p}{2k_L(\alpha_B \beta_1^2 + \beta_2^2)}$

iii) $\quad$ First order condition for a maximum of OF^{MH} equals:

$\frac{dOF^{MH}}{d\Delta} = 0$

Solving for Δ we obtain:

$$\Delta_1 = \frac{-\alpha_B k_L(\alpha_E \beta_1^2 + \beta_2^2)(1-p) + \sqrt{(\alpha_E - \alpha_B)^2 \beta_2^2 (\alpha_E \beta_1^2 + \beta_2^2)k_L^2(1-p)^2}}{\alpha_E(\alpha_E \beta_1^2 + \beta_2^2)(1-p)^2} >< 0$$

$$\Delta_2 = \frac{-\alpha_B k_L(\alpha_E \beta_1^2 + \beta_2^2)(1-p) - \sqrt{(\alpha_E - \alpha_B)^2 \beta_2^2 (\alpha_E \beta_1^2 + \beta_2^2)k_L^2(1-p)^2}}{\alpha_E(\alpha_E \beta_1^2 + \beta_2^2)(1-p)^2} < 0$$

It follows that an inner extreme value exists if and only if $\Delta_1 > 0$. Otherwise, no inner extreme value exists. There cannot be more than one inner extreme value as Δ_2 is not in the allowable range.

Using the same procedure with regard to OF^{MHAS} we obtain similar results:

Solving for Δ we obtain: $\Delta_1 >< 0$ and $\Delta_2 < 0$. Again, one inner extreme value exists if and only if $\Delta_1 > 0$. Otherwise no inner extreme value exists.

If an inner extreme value exists, it has to be a maximum. To see this, recall from i) and ii) that $\lim_{\Delta \to 0} OF^{MH} = \frac{\alpha_B \beta_1^4}{2k_L(\alpha_B \beta_1^2 + \beta_2^2)} > \lim_{\Delta \to \infty} OF^{MH} = 0$. In addition $\lim_{\Delta \to 0} OF^{MHAS} = \frac{\alpha_B \beta_1^4}{2k_L(\alpha_B \beta_1^2 + \beta_2^2)} > \lim_{\Delta \to \infty} OF^{MHAS} = \frac{\alpha_B \beta_1^4 p}{2k_L(\alpha_B \beta_1^2 + \beta_2^2)}$. Both objective function values are decreasing overall. If the extreme value was a minimum, some objective function values below $\lim_{\Delta \to \infty} OF^{MH} = 0$ and $\lim_{\Delta \to \infty} OF^{MHAS} = \frac{\alpha_B \beta_1^4 p}{2k_L(\alpha_B \beta_1^2 + \beta_2^2)}$ would have to exist. This, however, is not the case as $OF^{MH} > 0$ and $OF^{MHAS} > \frac{\alpha_B \beta_1^4 p}{2k_L(\alpha_B \beta_1^2 + \beta_2^2)}$ for all Δ.

It follows that the objective function values in both settings can either be decreasing in Δ or they can be increasing for small Δ, reach a maximum, and decrease beyond.

Define $D' = \frac{dOF^{MH}}{d\Delta}(0) - \frac{dOF^{MHAS}}{d\Delta}(0)$.

$$D' = \frac{\beta_1^4 \left(\alpha_B^2 \beta_1^2 + \alpha_E \beta_2^2 \right) p}{2k_L^2 (\alpha_B \beta_1^2 + \beta_2^2)^2} > 0 \tag{A1}$$

From the above findings and A1 it follows that arbitrarily close to zero the objective function value under pure moral hazard decreases at a higher rate or increases at a lower rate than the objective function value in the joint setting.

iv) Because of iii) it can either be the case that

$\frac{dOF^{MH}}{d\Delta}(0) < 0$ and $\frac{dOF^{MHAS}}{d\Delta}(0) < 0$, that is both objective functions are decreasing in Δ and no inner maximum exists in either setting, or

$\frac{dOF^{MH}}{d\Delta}(0) > 0$ and $\frac{dOF^{MHAS}}{d\Delta}(0) > 0$, that is both objective functions are increasing for sufficiently small Δ and decrease beyond a maximum in both settings, or

$\frac{dOF^{MH}}{d\Delta}(0) > 0$ and $\frac{dOF^{MHAS}}{d\Delta}(0) < 0$, that is in the moral hazard setting the objective function value increases and reaches a maximum before decreasing in Δ. In the joint setting, the objective function value decreases for all Δ.

No matter which of the above scenarios is present, given the conditions identified in i), ii) and iii) there can be only a single point of indifference. For values smaller (greater) than a critical Δ, $OF^{MH} > (<) OF^{MHAS}$. $\square$

Proof of proposition 6:

a)

$$\frac{dOF^{MH}}{d\alpha_B} = \frac{\beta_1^4\beta_2^2 k_L}{2[\alpha_B\beta_1^2 k_L + \alpha_E\beta_1^2\Delta(1-p) + \beta_2^2(\Delta(1-p)+k_L)]^2} \qquad (A2)$$

$$\frac{dOF^{MH}}{d\alpha_E} = \frac{\beta_1^4\beta_2^2\Delta(1-p)}{2[\alpha_B\beta_1^2 k_L + \alpha_E\beta_1^2\Delta(1-p) + \beta_2^2(\Delta(1-p)+k_L)]^2} \qquad (A3)$$

A2 and A3 are positive. Objective function values therefore are increasing in α_B and α_E.

b)

Taking the first derivative of R with respect to α_B we obtain two solutions:

$$\alpha_{B1} = \alpha_E + \frac{\sqrt{\alpha_E\beta_1^2(\alpha_E\beta_1^2+\beta_2^2)k_L\ (\Delta+k_L)}}{\beta_1^2 k_L^{"}} \qquad (A4)$$

and $\alpha_{B2} = \alpha_E - \dfrac{\sqrt{\alpha_E\beta_1^2(\alpha_E\beta_1^2+\beta_2^2)k_L\ (\Delta+k_L)}}{\beta_1^2 k_L^{"}} \qquad (A5)$

Inserting α_{B1} into R and taking the first derivative w.r.t. α_E we obtain:

$$\frac{dR(\alpha_{B1})}{d\alpha_E} > 0$$

It follows that a corner solution is present such that $\alpha_E^* = 1$.

Inserting α_{B2} into R and taking the first derivative w.r.t. α_E and solving for α_E we obtain:

$$\alpha_{E2} = -\frac{\beta_2^2 k_H}{\beta_1^2\Delta} \qquad (A6)$$

As by definition $\alpha_E > 1$ must hold A6 is outside the allowable range and solutions α_{B2}

and α_{E2} can be ignored.

It remains to show that A4 constitutes a minimum. Taking the second derivative of R w.r.t. α_B and determining the value at α_{B1} we obtain

$\dfrac{ddR}{dd\alpha_B}(\alpha_{B1}) > 0.$

The only solution is $\alpha_E^* = 1$ and $\alpha_B^* = 1 + \dfrac{\sqrt{(\beta_1^2+\beta_2^2)k_L\ (\Delta+k_L)}}{\beta_1\ k_L^{"}}.$ $\qquad\qquad\square$

Proof of proposition 7:

i) Note that

$$\frac{dOF^{MHAS}}{d\alpha_E} = \frac{\beta_1^4\beta_2^2(\alpha_B\beta_1^2+\beta_2^2)\Delta k_H\tilde{k}(1-p)^2[\alpha_B k_L(\beta_1^2\tilde{k}+\beta_2^2 k_H)(1-2p)+\alpha_B\beta_1^2\tilde{k}+\alpha_E\Delta k_H\beta_2^2]}{2(\beta_1^2\tilde{k}+\beta_2^2 k_H)^2[(\alpha_B\beta_1^2+\beta_2^2)k_H\tilde{k}-\alpha_B k_L(\beta_1^2\tilde{k}+\beta_2^2 k_H)p]^2} \qquad (A7)$$

The denominator of A7 is positive. The numerator is always positive if $(1 - 2p) > 0$, that is $p < 0.5$. In that case $\frac{dOF^{MHAS}}{d\alpha_E} > 0 \ \forall \alpha_E, \alpha_B$.

ii) With $p > 0.5$ the numerator of A7 can be positive or negative. Solving the optimality condition $\frac{dOF^{MHAS}}{d\alpha_E} = 0$ for α_E we get a single solution that might be in the allowable range of $\alpha_E > 1$.

$$\alpha_E^* = \frac{\alpha_B k_L [\beta_2^2 k_H (2p - 1) + \alpha_B \beta_1^2 (k_L (2p - 1) - \Delta)]}{\Delta [\beta_2^2 k_H + \alpha_B \beta_1^2 (\Delta + k_L (1 - 2p))]}$$

Taking the second derivative of OF^{MHAS} and evaluate at α_E^* we obtain

$$\frac{dOF^{MHAS}(\alpha_E^*)}{d\alpha_E} = \frac{\Delta^2 (1 - p)^2 [\beta_1 \beta_2 k_H + \alpha_B \beta_1^3 (\Delta + k_L (1 - 2p))]^4}{\alpha_B \beta_2^4 (\alpha_B \beta_1^2 + \beta_2^2)^3 k_L k_H^6 p} > 0$$

It follows that any extreme value that might exist constitutes a minimum.

Note that $\frac{dOF^{MHAS}}{d\alpha_E} < 0$ if $\alpha_B k_L (\beta_1^2 \tilde{k} + \beta_2^2 k_H)(1 - 2p) + \alpha_B \beta_1^2 \tilde{k} + \alpha_E \Delta k_H \beta_2^2 < 0$.

If this condition holds for all $\alpha_E > 1$, OF^{MHAS} is strictly decreasing. If α_E^* is in the allowable range, OF^{MHAS} is decreasing for low α_E, reaches a minimum at α_E^* and increases for larger α_E.

□