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Earnings management in two-periode principal-agent models

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Earnings Management

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by

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Abstract

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Theory suggests that in a multiperiod principal-agent setting optimal cash flow based contracts should exhibit memory of wages (Lambert, Bell Journal of Economics, p. 447); that is, wages should depend on both present and past outcomes. There is only weak empirical evidence such as raises/pay cuts and promotions/demotions for this theoretical result. Thus the conclusion can be made that real management compensation is in fact rather memoryless. In addition, these memoryless contracts are usually based on reported earnings, not on cash flows. This paper offers an explanation for this phenomenon.

Although cash flow based contracts with memory c. p. strictly Pareto-dominate memoryless ones, the welfare improvement may be outweighed by an increment of transaction costs, i. e., costs of writing and specifying the memory contract. This paper focuses on the second question: Why does practice prefer earnings-based to cash flow-based memoryless contracts even if the agent has discretion to manage earnings to maximize her own utility? It will be proven that at least in a setting without the agent's access to capital markets, the former contracts strictly Pareto-dominate the latter. To present a strictly formal proof, a model modifying Lambert's (1983) scenario is introduced in which the agent is allowed to manage earnings in period 1; in period 2 there is the reverse effect resulting from the „clean surplus" or „tidiness" property of accrual accounting. The interpretation for the result is that earnings management enables the agent to smooth consumption over time. Thus the (risk-neutral) principal can lower the expected wage payment to implement the optimal action pair without violating the agent's reservation utility. Consequently the agency is strictly better off. A brief analysis of earnings management in a dynamic principal-agent setting with access to capital markets concludes the paper.

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I Introduction

It is well known that in a world with optimal contracts, principals should restrict their agents' discretion over effort and other choices, as additional moral hazard never can be beneficial from the principals' point of view. This paper shows that in a suboptimal contractual arrangement, there are constellations under which the principal is better of by giving more discretion to the agent, even if the agent uses the additional choice in order to maximize her own expected utility. The main result are conditions for a Pareto improvement in a suboptimal contractual arrangement, which will be outlined in the following:

Theory suggests that in a multiperiod principal-agent setting optimal cash flow based contracts should exhibit memory of wages, that is wages should depend on both present and past outcomes.[1] Lambert[2] offers some weak empirical evidence such as raises/pay cuts and promotions/demotions for this theoretical result. Thus the conclusion is allowable that real management compensation is in fact memoryless. From a theoretical perspective, it may be argued that the welfare improvement due to memory may be outweighed by an increment of transaction costs, i.e. costs of writing and specifying the memory contract. Therefore, it is justified to consider a memoryless, suboptimal contractual arrangement. In addition the memoryless contracts are usually based on earnings, not on cash flows. This paper also offers an explanation for this gap between theory and practice. In a two-period hidden-action model, the agent is given the additional discretion to manage earnings at the end of the first period. In the suboptimal, memoryless context it will be proven that at least in a setting without the agent's access to capital markets, earnings-based contracts strictly Pareto-dominate cash flow-based contracts. Welfare gains can be attributed to improved risk sharing. More accurately, earnings management allows the agent to spread first-period risk over both periods. Thus the (risk-neutral) principal can lower the expected wage payment to implement the optimal action pair without violating the agent's reservation utility. Consequently the agency is strictly better off.

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[1] See Lambert (1983), p. 447.
[2] See Lambert (1981), p. 100 f.

Earnings management presumes that the revelation principle is not applicable. The revelation principle assumes (1) commitment to the prespecified use of communication, (2) an optimal contract and (3) a rich message space. Different lines in earnings management (often: smoothing) literature weaken distinct dimensions of this principle.[3] Fudenberg/Tirole (1995) and Araya/Glover/Sunder (1998) build on limited commitment to the contracted use of communication, while Healy (1985) and Boylan/Villadsen (1998) use presumed contract forms instead of optimal contractual agreements. This paper is part of the third stream which is grounded on blocked communication - it shall not be possible, without cost, to communicate all dimensions of a rich message space. The model by Evans/Sridhar (1996) is closely related to this paper. Whereas this paper does not limit the reporting discretion, Evans/Sridhar restrict the agent's report to lie in both periods in reporting regions which among others depend on independently distributed signals. The loss of generality in the present paper's model is outweighed by a gain in mathematical tractability. From the intention, Evans/Sridhar contrast a „truthful reporting"[4] with an „earnings management" regime, while this paper confronts the latter with a cash flow scenario. The contribution of Tzur/Yaari (1994) also leaves the reporting flexibility unrestricted. Furthermore, random outputs proxy for productive actions. Their main propositions are problematic, as will be pointed out in the course of the paper.

Demski (1998) also analysis conditions under which profits that are subject to earnings management dominate cash flows for incentive purposes. In his setting, the mechanism that drives the result is given exogenously: The agent only has access to earnings management if she chooses the higher of two possible actions. In contrast, the Pareto-improvement studied in this paper arises endogenously: It is the result of the agent's desire to smooth profits intertemporally.

This paper first introduces the earnings management regime and contrasts it with the memoryless cash flow scenario (section II.1). The agent's strategy is then investigated (section II.2) and optimal contracts under the earnings management regime are characterized from a commitment perspective (section II.3). The central point of the paper is a welfare comparison between (memoryless) cash flow and

[3] See Araya/Glover/Sunder (1998).
[4] Understood as a contract that induces the agent not to make use of the reporting system's flexibility.

earnings management regimes (section II.4). The paper concludes with a brief analysis of earnings management in a dynamic principal-agent setting with access to capital markets (section III).

II Earnings Management without Access to Capital Markets

1 The Model

A two-period, memoryless principal-agent model without access to capital markets is enriched by the agent's authority to manage earnings. Various assumptions are posed and the notation is introduced in the following:

At the beginning of period 1 the principal offers the agent a two-period contract $\{l_1(\cdot),\ l_2(\cdot)\}$ with l_t = wage in period t for $t = 1, 2$. If the agent accepts the contract, both parties are committed to remaining in the contract for both periods. The principal has access to a stochastic production technology, parameterized by her agent's productive action a_t. By selecting her first-period action a_1 the agent determines the density $f_1(x_1/a_1)$ representing first period's technology. She privately observes the first period's cash flow x_1 and makes a report y_1 (also referred to as „earnings") with

(1) $$y_1 = x_1 + B,$$

where *B* denotes the extent, positive or negative, of earnings management. Thus the revelation principle is not applicable (see introduction).

Subsequently the agent chooses her second period action a_2 and $f_2(x_2/a_2)$. She privately learns second period's cash flow x_2 and reports y_2 with

(2) $$y_2 = x_2 - B.$$

Definitions (1) and (2) imply that the firm's reporting system has the *tidiness, summing up* or *clean surplus property.*

The principal is supposedly not able to observe each period's cash flow, but she learns the cummulative cash flow x:

(3) $$x = x_1 + x_2 .$$

As the contract has to be based on mutually observable variables, the agent's rewards have to be based on the reports:

(4) $$l_1 = l_1(y_1)$$ $$l_2 = l_2(y_2).$$

The principal is assumed to be risk-neutral. She is informed about the preferences of her strictly risk- and strictly work-averse agent whose utility is time-separable and separable in income and action with

(5) $$H_t(l_t, a_t) = U_t(l_t(\cdot)) - V_t(a_t) \text{ for } t = 1, 2.$$

The principal does not observe the effort a_t. Neither principal nor agent observe the random variables which influence the outputs x_t, but they share common perceptions about production technology $f_t(x_t/a_t)$. It is also assumed that the density functions $f_t(x_t/a_t)$ satisfy the Monotone Likelihood Ratio Property (MLRP) and the distribution functions $F_t(x_t/a_t)$ satisfy the Concavity of the Distribution Function Condition (CDFC).

The principal's problem now can be stated as:

Program EM („Earnings Management“):

$$\int_{\underline{x_1}}^{\overline{x_1}} \left\{ x_1 - l_1(y_1) + \int_{\underline{x_2}}^{\overline{x_2}} \left[x_2 - l_2(y_2) \right] f_2\left(x_2 / a_2(\cdot)\right) dx_2 \right\} f_1\left(x_1 / a_1\right) dx_1 \xrightarrow[l_1(\cdot), l_2(\cdot), a_1, a_2(\cdot), B(\cdot)]{} Max!$$

(EM.1)

subject to:

$$E\left[H_0\right] =$$
$$\int_{\underline{x_1}}^{\overline{x_1}} \left\{ U_1\left[l_1(y_1)\right] + \int_{\underline{x_2}}^{\overline{x_2}} U_2\left[l_2(y_2)\right] f_2\left(x_2 / a_2(\cdot)\right) dx_2 - V_2\left[a_2(\cdot)\right] \right\} f_1\left(x_1 / a_1\right) dx_1 - V_1\left(a_1\right) \geq 0$$

with $y_1 = x_1 + B$ and $y_2 = x_2 - B$. (EM.2)

$$a_1 \in \arg\max_{\hat{a}_1} E\left[H_0\right]$$ (EM.3)

$$B \in \arg\max_{\hat{B}} \left\{ U_1\left[l_1(y_1)\right] + \int_{\underline{x_2}}^{\overline{x_2}} U_2\left[l_2(y_2)\right] f_2\left(x_2 / a_2(\cdot)\right) dx_2 - V_2\left[a_2(\cdot)\right] \right\}$$

for every $x_1 \in X_1$,

with $y_1 = x_1 + B$ and $y_2 = x_2 - B$. (EM.4)

$$a_2 \in \arg\max_{\hat{a}_2} \left\{ \int_{\underline{x_2}}^{\overline{x_2}} U_2\left[l_2(y_2)\right] f_2\left(x_2 / \hat{a}_2(\cdot)\right) dx_2 - V_2\left[\hat{a}_2(\cdot)\right] \right\}$$

for every $x_1 \in X_1$ and $B(x_1)$ with $y_2 = x_2 - B$. (EM.5).

The principal maximizes the expected residuum (EM.1) subject to the constraints (EM.2) to (EM.5). The individual rationality constraint (EM.2) ensures that the agent receives at least a reservation level of expected utility which is normalized to zero. Constraints (EM.3) and (EM.5) are the incentive compatibility constraints w. r. t. (with regard to) first and second period actions a_2 and a_1 respectively.

(EM.4) implies that the agent will choose earnings management B to maximize her expected utility from that point onwards up to the end of the contracting horizon.

As a proper benchmark a standard two-period principal-agent model without memory, without access to capital markets and without the agent's authority to manage earnings is used.

Program CF (Cash Flow)

$$\int_{\underline{x}_1}^{\overline{x}_1} \left\{ x_1 - l_1(x_1) + \int_{\underline{x}_2}^{\overline{x}_2} \left[x_2 - l_2(x_2) \right] f_2(x_2/a_2)\, dx_2 \right\} f_1(x_1/a_1)\, dx_1 \to \underset{l_1(\cdot),\, l_2(\cdot),\, a_1,\, a_2}{Max!} \qquad \text{(CF.1)}$$

$$\int_{\underline{x}_1}^{\overline{x}_1} \left\{ U_1\left[l_1(x_1)\right] + \int_{\underline{x}_2}^{\overline{x}_2} U_2\left[l_2(x_2)\right] f_2(x_2/a_2)\, dx_2 - V_2\left[a_2\right] \right\} f_1(x_1/a_1)\, dx_1 - V_1(a_1) \geq 0 \qquad \text{(CF.2)}$$

$$a_1^* \in \underset{\hat{a}_1}{\arg\max} \left\{ \int_{\underline{x}_1}^{\overline{x}_1} \left\{ U_1\left[l_1(x_1)\right] + \int_{\underline{x}_2}^{\overline{x}_2} U_2\left[l_2(x_2)\right] f_2(x_2/a_2^*)\, dx_2 - V_2\left[a_2^*\right] \right\} f_1(x_1/\hat{a}_1)\, dx_1 - V_1(\hat{a}_1) \right\} \qquad \text{(CF.3)}$$

$$a_2^* \in \underset{\hat{a}_2}{\arg\max} \left\{ \int_{\underline{x}_2}^{\overline{x}_2} U_2\left[l_2(x_2)\right] f_2(x_2/\hat{a}_2)\, dx_2 - V_2(\hat{a}_2) \right\} \qquad \text{(CF.4).}$$

Constraint (CF.2) is the individual rationality constraint and (CF.3) and (CF.4) are the incentive compatibility constraints w. r. t. first and second period actions respectively.

As the *dynamic cash flow based program with memory* is standard and not crucial for the main proposition, it is omitted. In this case a_2 and l_2 would be also referenced to x_1. If *earnings based* *remuneration functions with memory of wages* are used in the following, then in the above program EM, $l_2(y_2)$ would be changed to $l_2(y_1, y_2)$.

2 The Agent's Strategy

Consider first a *contract without memory*. In the equilibrium of the optimal cash flow-based contract $(l_1(x_1), l_2(x_2))$, the agent systematically has an incentive to manage earnings at the end of period 1. She will either underreport or overreport her first period earnings in order to balance the marginal utility of the first period with the expected marginal utility of the second period. The agent thus acts as a *smoother*.[5]

Consider now a *memory-contract*. It can be easily proven that in the equilibrium of the optimal contract $(l_1(x_1), l_2(x_1, x_2))$, the agent always has the incentive to manage earnings, i.e., $B(x_1)$ is not zero for every x_1. Furthermore, the memory contract implies the agent's tendency to underreport first period's earnings (also referred to as *conservative reporting*), i. e. $B < 0$.[6] But there are two other determinants of the agent's reporting behaviour: the forms of the wage functions in the benchmark program CF in both periods and - if considered - the principal's time preference. They may outweigh or overcompensate the underreporting effect inherent in the memory contract.

Both of the following propositions briefly summarize additional properties of the agent's behaviour. As only insufficient information on the shape of the wage schedules l_t is available, the agent's equilibrium behaviour cannot be characterized completely. Restrictions on the forms of wage and utility functions have to be imposed (part (i) of each proposition). Reference is made to earnings-based contracts without memory $(l_1(y_1), l_2(y_2)) = (l_1(x_1+B), l_2(x_2-B))$. In contrast to proposition 1 which can easily be

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5 This contrasts Tzur/Yaari (1994), p. 60, who state that the manager always underreports in their scenario without memory. But as the wages of the first and second periods are not interrelated by the memory- (or a similar) condition, earnings management cannot have a systematic direction (in the sense of either under- or overreporing).

6 A proof following the arguments of Rogerson's (1985) proposition 4 fails because earnings management has only an indirect effect on the agent's utility. The link is the wage on which only insufficient information is available.

extended to memory contracts *($l_1(y_1)$, $l_2(y_1, y_2)$)*, the second proposition is only valid for memoryless contracts *($l_1(y_1)$, $l_2(y_2)$)*.

Proposition 1:

The agent is offered a earnings-based memoryless contract $(l_1(y_1), l_2(y_2)) = (l_1(x_1+B), l_2(x_2-B))$. Her second period action a_2 is a strictly monotonically increasing function of earnings management B if

(i) $U_2''\left[l_2(x_2-B)\right]\cdot\left[l_2'(x_2-B)\right]^2 + U_2'\left[l_2(x_2-B)\right]\cdot l_2''(x_2-B) < 0$,

(ii) $\dfrac{\partial f_2(x_2/a_2)/\partial a_2}{f_2(x_2/a_2)}$ is strictly monotonically increasing in x_2 by strict MLRP,

(iii) the agent is risk-averse with $U_2'' < 0$, the utility function U_2 is twice continuously differentiable.

In addition, it is assumed that the second order condition w. r. t. the agent's second period action choice a_2 is negative.

Proof:

Let $I_1 = 0$ denote the first order condition w. r. t. the agent's second period action choice a_2 (compare the corresponding „argmax"-condition EM.5). As I_1 is continuously partially differentiable w. r. t. a_2 and B, the equation $I_1 = 0$ implicitly defines a_2 contingent on B.

Implicit function theorem then requires

$$\frac{\partial a_2}{\partial B} = -\frac{\partial I_1/\partial B}{\partial I_1/\partial a_2} \overset{!}{>} 0.$$

$\partial I_1/\partial a_2$ is the second order condition w. r. t. the agent's second period action choice a_2 and can be supposed to be negative for a utility-maximizing agent. Stating $\partial I_1/\partial B \overset{!}{>} 0$ gives assumptions (i) to (iii) of the above proposition. Q. e. d.

Assumption (i) can be interpreted that - under the standard suppositions on the shape of the utility function - the wage schedule l_2 has to be concave or not „too convex“ in earnings. The intuition of the proposition is that the (negative) reverse effect $-B$ resulting from positive earnings management B in period 1[7] provides incentives for the agent to work harder in period 2, i. e. $\partial a_2 / \partial B > 0$.

The next proposition offers conditions under which the agent smoothes income by earnings management, i. e. $\partial B / \partial x_1 < 0$.

Proposition 2:

The agent is offered an earnings-based memoryless contract $(l_1(y_1),\ l_2(y_2)) = (l_1(x_1+B),\ l_2(x_2-B))$. Earnings management B is a strictly monotonically decreasing function of first period's cash flow x_1 if

(i) $U_t''[l_t(y_t)] \cdot [l_t'(y_t)]^2 + U_t'[l_t(y_t)] \cdot l_2''(y_t) < 0$ for t = 1, 2 and

(ii) the agent is risk-averse with $U_t'' < 0$, the utility functions U_t are twice continuously differentiable.

In addition, it is assumed that the second order condition w. r. t. earnings management B is negative.

Proof:

Let $I_2 = 0$ denote the first order condition w. r. t. earnings management B (compare the corresponding „argmax“-condition EM.4). As I_2 is continuously partially differentiable w. r. t. B and x_1, the equation $I_2 = 0$ implicitly defines B contingent on x_1.

Implicit function theorem then requires

$$\frac{\partial B}{\partial x_1} = -\frac{\partial I_2 / \partial x_1}{\partial I_2 / \partial B} \overset{!}{<} 0.$$

[7] The reverse effect is due to the „tidiness“ or „clean surplus“ property of accrual accounting.

$\partial I_2 / \partial B$, the second order condition w. r. t. earnings management *B*, may supposed to be negative for a utility-maximizing agent. Nevertheless, this at least requires assumptions (i) and (ii) of the above proposition. Then setting $\partial I_2 / \partial x_1 \overset{!}{<} 0$ leads to assumption (i) and (ii) for the first period. Q. e. d.

Again, assumption (i) is always fulfilled for concave wage schedules. An equilibrium characterization is desirable, but the Lagrangian for program EM cannot be solved.

3 Inefficiency Result

Proposition 3:

Let *(l₁(y₁), l₂(y₂)) = (l₁(x₁+B), l₂(x₂-B))* solve program EM. Then the ex-ante optimal solution *(l₁(y₁), l₂(y₂))* is ex-post, that is at the beginning of period 2, inefficient.

Proof:

$$\int_{\underline{x_2}}^{\overline{x_2}} U_2\left[l_2\left(x_2 - B^*\right)\right] f_2\left(x_2 / a_2^*\right) dx_2 - V_2\left(a_2^*\right)$$

$$\geq \int_{\underline{x_2}}^{\overline{x_2}} U_2\left[l_2\left(x_2 - \tilde{B}\right)\right] f_2\left(x_2 / \tilde{a}_2\right) dx_2 - V_2\left(\tilde{a}_2\right)$$

$$> \int_{\underline{x_2}}^{\overline{x_2}} U_2\left[l_2\left(x_2 - B^*\right)\right] f_2\left(x_2 / \tilde{a}_2\right) dx_2 - V_2\left(\tilde{a}_2\right) \qquad (7)$$

with B^*, a_2^*: optimal earnings management and second period action pair

and $\tilde{B}$, $\tilde{a}_2$: every other earnings management and second period action pair.

The first inequality is another formulation of the agent's second period action selection constraint (EM.5), the second follows because $\tilde{a}_2$ is the unique optimal choice for an agent of type $\tilde{B}$. Thus after choosing earnings management B^*, the agent is predetermined to select action a_2^*. An ex-post efficient (or interim incentive compatible) second period contract would leave the agent of type B^* indifferent between a_2^* and any other action $\tilde{a}_2$, i. e.

$$\int_{\underline{x_2}}^{\overline{x_2}} U_2\left[l_2^{\circ}\left(x_2 - B^*\right)\right] f_2\left(x_2 / a_2^*\right) dx_2 - V_2\left(a_2^*\right)$$

$$= \int_{\underline{x_2}}^{\overline{x_2}} U_2\left[l_2^{\circ}\left(x_2 - B^*\right)\right] f_2\left(x_2 / \tilde{a}_2\right) dx_2 - V_2\left(\tilde{a}_2\right) \qquad (8). \text{ Q.e.d.}$$

This proof extends Fudenberg/Holmstrom/Milgrom (1990), p. 11 f., example 2, to a continuous effort - continuous output - setting and transforms their argumentation to an earnings management regime.

The ex-post inefficiency of the ex-ante efficient contract $(l_1^*(y_1), l_2^*(y_2))$ can be attributed to a kind of adverse selection: as at the end of period 1 the principal is able to observe neither earnings management *B* nor first period's cash flow x_1, *B* (and x_1) cannot be contracted upon in the second period.[8] [9] Thus *B* can be viewed as the type of the agent which is not exogenously given but determined endogenously in the first period.[10]

In order to overcome the problem of ex-post inefficiency, theory would suggest renegotiation-proof contracts, which may imply menus of contracts for the second period, i. e. one contract for each type *B*, and mixed strategies. Such earnings-based contracts are not common in reality, which may be because of confidence between the parties that the agent will not renegotiate at the beginning of the second period.

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8 Contractible is the sole public information $y_1 = x_1 + B$.

9 If *B* were monitorable, there would be two alternatives for how it could be incorporated in the contract. First, the principal may undo the earnings management, effectively compensating the agent on a cash flow basis, protecting the principal from being worse off compared to a dynamic cash flow based contract. Second, principal and agent may select *B* cooperatively. For the first alternative compare Lambert (1981), pp. 165; for the second Chiappori et al. (1996), p. 1541; for scenarios with the agent's access to capital markets.

10 Compare Chiappori et al. (1996), p. 1541, in a context with the agent's free access to capital markets.

4 Earnings Management versus Cash Flow Regime

The result can be stated as follows:

Proposition 4:

Let $(l_1(y_1), l_2(y_2))$ solve Program EM and $(l_1(x_1), l_2(x_2))$ solve the benchmark Program CF.

If:

(i) $\frac{\P\ f_1(x_1 / a_1) / \P\ a_1}{f_1(x_1 / a_1)}$ is a strictly monotonically increasing function of x_1 by strict MLRP,

(ii) $B(x_1)$ is strictly monotonically decreasing in x_1 (see Proposition 2),

(iii) the principal is risk-neutral and

(iv) the agent is risk-averse, the utility functions U_t are twice continuously differentiable,

then contracts $(l_1(y_1), l_2(y_2))$ strictly Pareto dominate contracts $(l_1(x_1), l_2(x_2))$.

The proof is delegated to the Appendix. It is based on a variation of the optimal solution[11] to program CF $(l_1(x_1), l_2(x_2))$ of the form

(6) $$l_1[y_1] = l_1\left[x_1 + e\frac{B(x_1)}{U_1^{'}l_1^{'}}\right]$$

(7) $$l_2[y_2] = l_2\left[x_2 - e\frac{B(x_1)}{U_2^{'}l_2^{'}}\right]$$

with

$$U_t^{'} = \frac{\P\ U_t(l_t(x_t))}{\P\ l_t}, \quad l_t^{'} = \frac{\P\ l_t(x_t)}{\P\ x_t}.$$

e is a sufficiently small, positive constant. The variations then represent marginal earnings management.

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[11] A similar proof technique is used by Holmström (1979), pp. 84-86; Dye (1983), pp. 520-522; Sivaramakrishnan (1989), pp. 74-76, 80-81, 93-94; Sivaramakrishnan (1994), pp. 1233-1234.

In the appendix it is shown that the agent is indifferent to the variation, however the principal is strictly better off.[12] As the variation is chosen so that the optimal actions (a_1, a_2) are the same under the variations as under the benchmark Program CF, welfare gains can be attributed to improved risk sharing. More accurately, earnings management allows the agent to spread first-period risk over both periods.[13] Therefore the (risk-neutral) principal can lower the expected wage payment to implement the optimal action pair without violating the agent's reservation utility. Consequently the agency is strictly better off.

The reverse effect $-B$ is a constant at the beginning of the second period and from this standpoint does not affect second period risk. As B is a function in x_1, risk is carried from the first to the second period. Proposition 4 thus can be understood that the risk-decreasing effect of earnings management in the first period dominates the risk-increasing effect of the reverse effect $-B$ in the second period.

Be aware that the Pareto improvement caused by earnings management in the agent's self interest is the consequence of the fact that the memoryless benchmark contract is not the optimal dynamic cash flow-based contract. This naturally leads to

Proposition 5:

Let $(l_1(x_1),\ l_2(x_1,\ x_2))$ be the optimal dynamic, cash flow based contract with memory and $(l_1(y_1), l_2(y_1, y_2))$ be the corresponding earnings based contract with moral hazard w. r. t. the reporting of y_1. First period profits y_1 are subject to earnings management. Then, even if the reporting system has the *tidiness property*, contracts $(l_1(x_1), l_2(x_1, x_2))$ strictly Pareto dominate contracts $(l_1(y_1), l_2(y_1, y_2))$.

Proof:

A formal proof, following the lines of the preceding proof, may be provided. As proposition 5 is not central, the proof is omitted. Reference is made to the motivation of Rogerson (1985).

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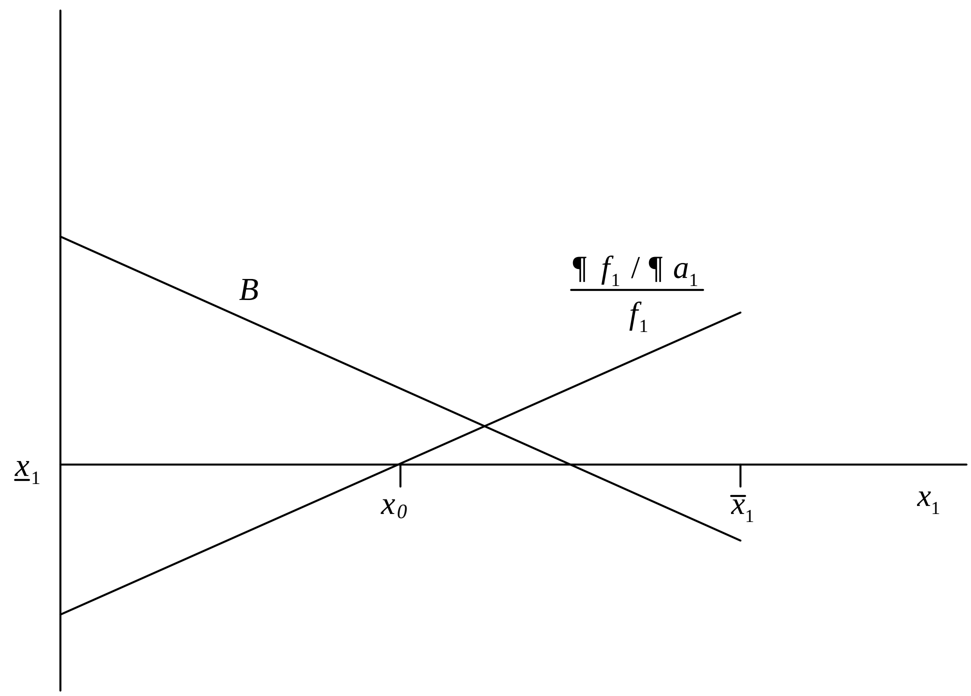
[12] The consequences of the agent's access to capital markets compared to a no-access regime can be assessed with the same proof technique if the variations are changed slightly.

[13] As B cannot depend on the realisation of x_2, it is reasonable and easy to show that earnings management does not alleviate second-period risk.

The analysis presented in this paper can help to understand why real dynamic remuneration schemes tend to be based on earnings, not on cash flows, even if the agent is allowed to manipulate earnings in her own best interest. Although cash flow based contracts with memory c. p. strictly Pareto-dominate memoryless ones, the welfare improvement may be outweighed by an increment of transaction costs, i. e., costs of writing and specifying the memory contract. Or agent's will not accept memory contracts because they feel to carry bad results of former periods until the end of the agency relationship. Then, the principal has to offer memoryless contracts and Proposition 4 is applied, stating the Pareto dominance of earnings-based contracts over cash flow-based contracts.

The assumption that the agent has no access to capital markets tends to be rather strong. Nevertheless, the results are of relevance as they can proxy cases in which the agent's access to credit markets is constrained. To see this, consider the following diagram which illustrates the sign of marginal changes in the principal's expected utility (see Appendix (18)) induced by the variations ((6) and (7)).



The graphs can be interpreted that the likelihood ratio weights the decreasing function *B*. The left part of graph *B* represents earnings management in order to realize higher profits and thus is of relevance for the agent in the presence of constrained credit markets. From the proof it becomes clear that in many constellations, the left part is sufficient for a Pareto improvement in the presence of credit constraints. Thus, also if profit diminishing earnings management is possibly substituted by the agent's saving decisions, the principal is better off by providing a flexible reporting system which allows the agent increasing first period profit. The intuition for the welfare improvement may be that the agent manages earnings, but works harder in the second period (see Proposition 1). The analysis of earnings management in a scenario with unconstrained borrowing and lending is offered in the concluding section III.

Finally, proposition 4 is illustrated by an example. The scenario of programs BP and CF is specified by the additional assumptions of the „LEN-Model“[14] in order to obtain explicit solutions. Therefore attention again is restricted to the situation in which the principal is risk-neutral and the agent's periodical utility is CARA with $H_t(l_t, a_t) = -\exp\left[-g\ \left(l_t - a_t^{\,2}\right)\right]$, where g denotes the coefficient of absolute risk aversion. Principal's and agent's utility functions are additively separable by periods. Although time-preferences could be allowed for, they are omitted to simplify matters. The agent's reservation level of utility is denoted by H^{min}. Stochastic production technology $f_t(x_t/a_t)$ is supposed to be normally distributed with mean a_t and variance $s_t^{\,2} > 0$.[15] Feasible payment schemes are assumed to be linear. The agent receives a fixed fee m_y (or m_x under the cash flow regime), the variable part of the reward is determined by compensation basis y_t (or x_t) and share n_y (or n_x):

compensation based on earnings $l_t(y_t) = m_y + n_y\, y_t$ with $0 \le n_y \le 1$

compensation based on cash flow $l_t(x_t) = m_x + n_x\, x_t$ with $0 \le n_x \le 1$.

While the agent realizes the reservation level of utility H^{min} under both scenarios, the principal's expected utility under the earnings management regime (EM) $E^{EM}\left[W_o\right] = \dfrac{1}{2\left(1+\frac{3}{2}g\ s^2\right)} + \dfrac{2}{g}\ln\left(-\dfrac{H^{\min}}{2}\right)$ is strictly greater than the expectation in the cash flow

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[14] Linear-Exponential-Normal-Model, see Spremann (1987) pp. 17-22.

[15] Thus the agent's action choice a_t has no influence on production risk $s^{\,2}$.

programme (CF) $E^{CF}\left[W_0\right]=\frac{1}{2\left(1+2g\ s^2\right)}+\frac{2}{g}\ln\left(-\frac{H^{\min}}{2}\right)$. Thus, the agency is strictly better off (a detailed calculation of the example is available from the author).

III Earnings Management with Access to Capital Markets

1 The Agent's Strategy

The scenario of paragraph 2.1 is enriched by the agent's access to capital markets which is assumed not to be monitorable by the principal. To keep the analysis simple I assume that the interest rate and time preference are zero. k_1 denotes the agent's first period consumption. Consequently her second period consumption k_2 can be expressed by

(8) $$k_2 = l_2\left(x_2 - B\left(x_1\right)\right) + l_1\left(x_1 + B\left(x_1\right)\right) - k_1 .$$

At the end of the first period the agent chooses earnings management and consumption to maximize her expected utility from that point onwards up to the end of the contracting horizon. That is,

(9) $$k_1, B \in \arg\max_{\hat{k}_1,\ \hat{B}} \left\{ U_1\left(\hat{k}_1\right) + \int_{\underline{x_2}}^{\overline{x_2}} U_2\left[l_2\left(x_2 - \hat{B}\left(x_1\right)\right) + l_1\left(x_1 + \hat{B}\left(x_1\right)\right) - \hat{k}_1\right] f_2\left(x_2 / a_2\left(\cdot\right)\right) dx_2 - V_2\left(a_2\left(\cdot\right)\right) \right\}.$$

It is supposed that (9) can be represented by the following first order conditions:

(10) $$U_1'\left(k_1\right) - \int_{\underline{x_2}}^{\overline{x_2}} U_2'\left[l_2\left(\cdot\right) + l_1\left(\cdot\right) - k_1\right] f_2\left(x_2 / a_2\left(\cdot\right)\right) dx_2 \overset{!}{=} 0$$

(11) $$\int_{\underline{x_2}}^{\overline{x_2}} U_2'\left[l_2(\cdot)+l_1(\cdot)-k_1\right]\left[l_1'\left(x_1+B(\cdot)\right)-l_2'\left(x_2-B(\cdot)\right)\right] f_2\left(x_2/a_2(\cdot)\right)dx_2 \overset{!}{=} 0\,.$$

Hence the agent changes her strategy: from (11) it follows that she maximizes her *remuneration* (first period's wage plus expected second period wage) by earnings management; (10) means that she maximizes her *utility* (first period's utility plus expected second period utility) via borrowing or lending from capital markets. Condition (11) therefore indicates that the agent smoothes earnings independently of whether or not the earnings based contract exhibits memory.[16] This has to be compared to the tendency for conservative reporting in the case of a memory contract without access to capital markets (see section II.2). The capital market now takes over the earnings management's former role (see II.2) as the device to give the agents consumption the optimal intertemporal structure, whereas earnings management's unique function is the maximization of wages.[17]

2 Welfare Aspects

The above given interpretation of the first order conditions ((10) and (11)), noticing a change in the agent's strategy, motivates the following proposition:

Proposition 6:

Let $(l_{1KM}(x_1),\ l_{2KM}(\cdot,\ x_2))$ denote the optimal cash flow based contract and $(l_{1KM}(y_1),\ l_{2KM}(\cdot,\ y_2))$ the optimal earnings based contract. The agent has access to capital markets. First period profits y_1 are subject to earnings management, and the reporting system has the *tidiness property.* Then, contract $(l_{1KM}(x_1),\ l_{2KM}(\cdot,\ x_2))$ strictly Pareto dominates contract $(l_{1KM}(y_1),\ l_{2KM}(\cdot,\ y_2))$.

The Pareto improvement resulting from earnings management under moral hazard (Proposition 4) crucially depends on intertemporal smoothing of earnings under constrained access to capital markets.

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[16] The agent's attempt to maximize compensation will be achieved by smoothing behaviour if the sharing rules of both periods have the same shape (reasonable assumption if preferences and production technology are similar in both periods).

[17] The deduction and result contrast Tzur/Yaari (1994), p.60, who propose that the manager either smoothes or overreports.

As explained, with free access to borrowing and saving, the agent uses capital markets to smooth consumption over time. Thus, the mechanism driving Proposition 4 cannot be effective. Consequently, the principal is strictly worse off under the earnings management regime.

IV Conclusion

The paper focuses on welfare aspects of earnings management in dynamic agency relationships with full commitment. The main result are conditions for a Pareto improvement in a suboptimal contractual arrangement. The positive welfare effect can be attributed to improved risk sharing. This can be traced back to the agent's intertemporal smoothing behaviour which follows from utility-maximizing earnings management. Although the formal proof is derived in a setting without access to capital markets, it is shown that the intuition of the result extends to constrained access to credit markets.

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Appendix:

Proof of Proposition 4

Consider variations of the optimal solution[18] to program CF *($l_1(x_1)$, $l_2(x_2)$)* of the form

$$l_1[y_1] = l_1\left[x_1 + e\,\frac{B(x_1)}{U_1^{'} l_1^{'}}\right] \tag{1}$$

$$l_2[y_2] = l_2\left[x_2 - e\,\frac{B(x_1)}{U_2^{'} l_2^{'}}\right] \tag{2}$$

e is a sufficiently small, positive constant. The following notation is used:

$$U_1^{'} = \frac{\partial\, U_1(l_1(x_1))}{\partial\, l_1}, \quad l_1^{'} = \frac{\partial\, l_1(x_1)}{\partial\, x_1}$$

$$U_2^{'} = \frac{\partial\, U_2(l_2(x_2))}{\partial\, l_2}, \quad l_2^{'} = \frac{\partial\, l_2(x_2)}{\partial\, x_2} \tag{3}$$

Second-Period Action:

Substituting the specific variation (2) in (EM.5), the agent's decision for the second period action is

$$a_2 \in \arg\max_{\hat{a}_2}\left\{\int_{\underline{x}_2}^{\overline{x}_2} U_2\left[l_2\left(x_2 - \frac{e\,B(x_1)}{U_2^{'}\,l_2^{'}}\right)\right] f_2(x_2 / \hat{a}_2)\,dx_2 - V_2(\hat{a}_2)\right\} \tag{4}$$

Using a first order Taylor polynomial to approximate U_2 and signing the first order condition w. r. t. a_2 we get

$$\int_{\underline{x}_2}^{\overline{x}_2} \left[U_2\left(l_2\left(x_2\right)\right) - U_2^{'}\, l_2^{'}\, \frac{e\ B\left(x_1\right)}{U_2^{'}\, l_2^{'}} \right] \frac{\partial\ f_2\left(x_2 / a_2\right)}{\partial\ a_2}\, dx_2 - \frac{\partial\ V_2\left(a_2\right)}{\partial\ a_2} \overset{!}{=} 0 \qquad (5).$$

Rearranging gives

$$\left\{ \int_{\underline{x}_2}^{\overline{x}_2} U_2\left(l_2\left(x_2\right)\right) \frac{\partial\ f_2\left(x_2 / a_2\right)}{\partial\ a_2}\, dx_2 - \frac{\partial\ V\left(a_2\right)}{\partial\ a_2} \right\} - e\ B\left(x_1\right) \int_{\underline{x}_2}^{\overline{x}_2} \frac{\partial\ f_2\left(x_2 / a_2\right)}{\partial\ a_2} dx_2 = 0 \qquad (6).$$

The term in curly brackets on the left hand side (l. h. s.) is the first order condition for the second period action choice under the cash flow regime, the term subtracted is zero. Consequently, for sufficiently small variations, the optimal second-period action remains unchanged.

Next I have to prove that the perturbations (1) and (2) leave $E\left[H_1\right]$, the agent's expected utility from the end of the first period onwards, unchanged.

Earnings management in the agent's self-interest:

The benchmark program does not contain an incentive compatibility constraint w. r. t. earnings management. Therefore it has to be determined how the variations (1) and (2) influence the agent's expected utility after the decision on earnings management. For this purpose, $E\left[H_1\right]$ is differentiated w. r. t. e, evaluated at $e = 0$:

[18] A similar proof technique is used by Holmström (1979), pp. 84-86; Dye (1983), pp. 520-522; Sivaramakrishnan (1989), pp. 74-76, 80-81, 93-94; Sivaramakrishnan (1994), pp. 1233-1234.

$$\frac{\P\, E[H_1]}{\P\, e}\Big|_{e=0} = \frac{\P}{\P\, e}\left\{ U_1\left[l_1\left(x_1 + \frac{e\, B(x_1)}{U_1^{'} l_1^{'}} \right)\right]\right.$$

$$\left. + \int_{\underline{x}_2}^{\overline{x}_2} U_2\left[l_2\left(x_2 - \frac{e\, B(x_1)}{U_2^{'} l_2^{'}} \right)\right] f_2(x_2 / a_2) dx_2 - V_2(a_2) \right\} \quad (7).$$

Using first order Taylor approximations at x_1 and x_2 and noting that by the previous argument, a_2 is not affected by small perturbations, we get:

$$\frac{\P\, E[H_1]}{\P\, e}\Big|_{e=0} = \frac{\P}{\P e}\left\{ U_1\left(l_1\left(x_1\right)\right) + U_1^{'}\, l_1^{'}\, \frac{e\, B(x_1)}{U_1^{'}\, l_1^{'}} \right.$$

$$\left. + \int_{\underline{x}_2}^{\overline{x}_2} \left[U_2\left(l_2\left(x_2\right)\right) - U_2^{'}\, l_2^{'}\, \frac{e\, B(x_1)}{U_2^{'}\, l_2^{'}} \right] f_2\left(x_2 / a_2\right) dx_2 - V_2\left(a_2\right) \right\} \quad (8).$$

$$= +B(x_1) - B(x_1) = 0$$

Therefore, the agent is indifferent w. r. t. very small earnings management-like variations (e close enough to zero). This harmonizes with the fact that larger perturbations (as a first order Taylor polynomial is no longer an appropriate approximation) will modify the agent's expected utility and thus could be used in the utility-maximizing manner described in the model.

First-period action:

As a_2 remains unchanged and $E[H_1]$, the agent's expected utility from the end of the first period onwards, is unaffected by the variations, we can conclude that the agent's first-period action a_1 is the same in the earnings management and cash flow regime. The formal proof is presented to be complete.

.

Under the variation, the agent chooses the first period action maximizing the expected utility over both random variables X_1 and X_2:

$$a_1 \in \arg\max_{\hat{a}_1} E\left[H_0\right] = \left\{ \int_{\underline{x}_1}^{\overline{x}_1} U_1\left[l_1\left(x_1 + \frac{e\,B(x_1)}{U_1^{'}\,l_1^{'}}\right)\right] f_1\left(x_1 / \hat{a}_1\right)dx_1 - V_1\left(\hat{a}_1\right)\right.$$

$$\left. + \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} U_2\left[l_2\left(x_2 - \frac{e\,B(x_1)}{U_2^{'}\,l_2^{'}}\right)\right] f_2\left(x_2 / a_2\right) f_1\left(x_1 / \hat{a}_1\right)dx_2 dx_1 - V_2\left(a_2\right)\right\}$$

(9).

Using first order Taylor approximations for $U_1(\cdot)$ and $U_2(\cdot)$ at x_1 and x_2, the first order condition corresponding to a_1 is:

$$\int_{\underline{x}_1}^{\overline{x}_1}\left[U_1\left(l_1\left(x_1\right)\right) + U_1^{'}\,l_1^{'}\frac{e\,B(x_1)}{U_1^{'}\,l_1^{'}}\right]\frac{\P\, f\left(x_1 / a_1\right)}{\P\, a_1}dx_1 - \frac{\P\, V_1\left(a_1\right)}{\P\, a_1}$$

(10).

$$+\int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2}\left[U_2\left(l_2\left(x_2\right)\right) - U_2^{'}\,l_2^{'}\frac{e\,B(x_1)}{U_2^{'}\,l_2^{'}}\right] f_2\left(x_2 / a_2\right)\frac{\P\, f\left(x_1 / a_1\right)}{\P\, a_1}dx_2 dx_1 \overset{!}{=} 0$$

Simplifying and rearranging gives:

$$\left\{ \int_{\underline{x}_1}^{\overline{x}_1} U_1\left(l_1\left(x_1\right)\right) \frac{\partial f_1\left(x_1 / a_1\right)}{\partial a_1} dx_1 - \frac{\partial V\left(a_1\right)_1}{\partial a_1} + \int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} U_2\left(l_2\left(x_2\right)\right) f_2\left(x_2 / a_2\right) \frac{\partial f_1\left(x_1 / a_1\right)}{\partial a_1} dx_2 dx_1 \right\}$$

$$+ \int_{\underline{x}_1}^{\overline{x}_1} \left[\varepsilon B\left(x_1\right) - \int_{\underline{x}_2}^{\overline{x}_2} \varepsilon B\left(x_1\right) f_2\left(x_2 / a_2\right) dx_2 \right] \frac{\partial f_1\left(x_1 / a_1\right)}{\partial a_1} dx_1 \overset{!}{=} 0$$

(11).

The terms in curly brackets are the first order condition corresponding to the first period action choice in the benchmark case, the remaining integral on the l. h. s. is zero. Therefore, for sufficiently small perturbations, the optimal first-period action remains unchanged.

Individual rationality constraint:

With this specific (and sufficiently small) variation the first and second period actions remain unchanged, and the agent's expected utility over both periods is the same as in the cash flow regime. Consequently the agent's participation constraint is not violated. It remains to show that the principal is strictly better off.

Principal's expected utility:

Substituting the variations (1) and (2) in the principal's expected utility over both random variables X_1 and X_2 gives:

$$E[W_0] = \int_{\underline{x}_1}^{\overline{x}_1} \left[x_1 - l_1\left(x_1 + \frac{e\ B(x_1)}{U_1^{'}\ l_1^{'}} \right) \right] f_1(x_1 / a_1) dx_1$$

$$+ \int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} \left[x_2 - l_2\left(x_2 - \frac{e\ B(x_1)}{U_2^{'}\ l_2^{'}} \right) \right] f_2(x_2 / a_2)\, f_1(x_1 / a_1) dx_2 dx_1 \quad (12).$$

First order Taylor approximations for l_1 and l_2 at x_1 and x_2 result in:

$$E[W_0] = \int_{\underline{x}_1}^{\overline{x}_1} \left[x_1 - l_1(x_1) - l_1^{'} \frac{e\ B(x_1)}{U_1^{'}\ l_1^{'}} \right] f_1(x_1 / a_1) dx_1$$

$$+ \int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} \left[x_2 - l_2(x_2) + l_2^{'} \frac{e\ B(x_1)}{U_2^{'}\ l_2^{'}} \right] f_2(x_2 / a_2)\, f_1(x_1 / a_1) dx_2 dx_1 \quad (13).$$

In order to assess the effect of earnings management on the principal's expected utility, $E[W_0]$ is differentiated w. r. t. e, evaluated at $e = 0$:

$$\left. \frac{\partial\ E[W_0]}{\partial\ e} \right|_{e=0} = \int_{\underline{x}_1}^{\overline{x}_1} B(x_1) \left\{ -\frac{1}{U_1^{'}\left(l_1(x_1)\right)} + \int_{\underline{x}_2}^{\overline{x}_2} \frac{1}{U_2^{'}\left(l_2(x_2)\right)}\ f_2(x_2 / a_2) dx_2 \right\} f_1(x_1 / a_1) dx_1 > 0! \quad (14).$$

The optimal benchmark contracts *($l_1(x_1)$, $l_2(x_2)$)* satisfy:

$$E_{x_2}\left[\frac{1}{U_1^{'}\left(l_1(x_1)\right)} \middle| x_1 \right] = \frac{1}{U_1^{'}\left(l_1(x_1)\right)} = l + m_1 \frac{\dfrac{\partial\ f_1(x_1 / a_1)}{\partial\ a_1}}{f_1(x_1 / a_1)} \quad (15)$$

$$E_{x_2}\left[\frac{1}{U_2^{'}\left(l_2\left(x_2\right)\right)}\left|x_1\right.\right]=\int_{\underline{x}_2}^{\overline{x}_2}\left\{\lambda+\mu_2\frac{\frac{\partial f_2\left(x_2/a_2\right)}{\partial a_2}}{f_2\left(x_2/a_2\right)}\right\}f_2\left(x_2/a_2\right)dx_2=\lambda \qquad (16).$$

λ , μ_2 and μ_1 are the Lagrangian multipliers corresponding to the individual rationality constraint (CF.2) and the incentive compatibility constraints w. r. t. first and second period action (CF.3) and (CF.4) in the benchmark program, respectively.

Plugging (15) and (16) into (14) yields:

$$\left.\frac{\partial E\left[W_0\right]}{\partial e}\right|_{e=0}=\int_{\underline{x}_1}^{\overline{x}_1}B(x_1)\left[-\lambda-\mu_1\frac{\frac{\partial f_1\left(x_1/a_1\right)}{\partial a_1}}{f_1\left(x_1/a_1\right)}+\lambda\right]f_1\left(x_1/a_1\right)dx_1>0! \qquad (17).$$

Rearranging gives:

$$\frac{\partial E\left[W_0\right]}{\partial e}=-\mu_1\int_{\underline{x}_1}^{\overline{x}_1}\left[B(x_1)\frac{\frac{\partial f_1\left(x_1/a_1\right)}{\partial a_1}}{f_1\left(x_1/a_1\right)}\right]f_1\left(x_1/a_1\right)dx>0! \qquad (18).$$

The following assumptions are used to prove the above inequality:

(A.1) $\frac{\partial f_1\left(x_1/a_1\right)/\partial a_1}{f_1\left(x_1/a_1\right)}$ is a strictly increasing function of x_1 by strict MLRP,

(A.2) $B(x_1)$ is strictly decreasing in x_1 (see Proposition 2).

Two properties are already known:

(P.1) $\mu_1 > 0$ [19] and

(P.2) $\int_{\underline{x}_1}^{\overline{x}_1} \frac{\partial f_1(x_1 / a_1)}{\partial a_1} dx_1 = 0.$

The proof is illustrated by the diagram contained in section II.4.

As $\frac{\partial f_1(x_1 / a_1) / \partial a_1}{f_1(x_1 / a_1)}$ is increasing[20] in x_1 by (A.1) and, according to (P.2), the integral $\int_{\underline{x}_1}^{\overline{x}_1} \frac{\partial f_1(x_1 / a_1)}{\partial a_1} dx_1$ reduces to zero, there exits one and only one $x_0 \in [\underline{x}_1, \overline{x}_1]$ with

$$\left. \frac{\partial f_1(x_1 / a_1) / \partial a_1}{f_1(x_1 / a_1)} \right|_{x_0} = 0.$$

By reasons of monotony

$$\left. \frac{\partial f_1(x_1 / a_1) / \partial a_1}{f_1(x_1 / a_1)} \right|_{x_1} < 0 \text{ for } x_1 < x_0$$

$$\left. \frac{\partial f_1(x_1 / a_1) / \partial a_1}{f_1(x_1 / a_1)} \right|_{x_1} > 0 \text{ for } x_1 > x_0 .$$

Suppose $x_1 \in]\underline{x}_1, x_0[$. As B is decreasing in x_1 by (A.2), it is $B(\underline{x}_1) > B(x_1) > B(x_0)$. Multiplication with $\left. \frac{\partial f_1 / \partial a_1}{f_1} \right|_{x_1}$ (< 0) gives:

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[19] Reference is made to Holmström, B. (Hazard), S. 78, Proposition 1, as the solution of the benchmark program is the repetition of the optimal static contract.

[20] For the purpose of the remainder of the proof „increasing“ respectively „decreasing“ means „strictly increasing“ respectively „strictly decreasing“.

$$(*) \quad B(\underline{x}_1)\left.\frac{\partial f_1/\partial a_1}{f_1}\right|_{x_1} < B(x_1)\left.\frac{\partial f_1/\partial a_1}{f_1}\right|_{x_1} < B(x_0)\left.\frac{\partial f_1/\partial a_1}{f_1}\right|_{x_1}.$$

Correspondingly for $x_1 \in]x_0, \overline{x_1}[$:

$B(x_0) > B(x_1) > B(\overline{x_1})$ and by $\left.\frac{\partial f_1/\partial a_1}{f_1}\right|_{x_1} (>0)$

$$(**) \quad B(\underline{x_0})\left.\frac{\partial f_1/\partial a_1}{f_1}\right|_{x_1} > B(x_1)\left.\frac{\partial f_1/\partial a_1}{f_1}\right|_{x_1} > B(\overline{x}_1)\left.\frac{\partial f_1/\partial a_1}{f_1}\right|_{x_1}.$$

Integration of (*) gives by monotony of the integral:

$$\int_{\underline{x}_1}^{x_0} B(x_1)\frac{\partial f_1(x_1/a_1)/\partial a_1}{f_1(x_1/a_1)} f_1(x_1/a_1)dx_1 < \int_{\underline{x}_1}^{x_0} B(x_0)\frac{\partial f_1(x_1/a_1)/\partial a_1}{f_1(x_1/a_1)} f_1(x_1/a_1)dx_1 \qquad (19).$$

Integration of (**) mutatis mutandis:

$$\int_{x_0}^{\overline{x_1}} B(x_1)\frac{\partial f_1(x_1/a_1)/\partial a_1}{f_1(x_1/a_1)} f_1(x_1/a_1)dx_1 < \int_{x_0}^{\overline{x_1}} B(x_0)\frac{\partial f_1(x_1/a_1)/\partial a_1}{f_1(x_1/a_1)} f_1(x_1/a_1)dx_1 \qquad (20).$$

Addition of the last two inequalities results in:

$$\int_{\underline{x_1}}^{\overline{x_1}} B(x_1)\frac{\partial f_1(x_1/a_1)/\partial a_1}{f_1(x_1/a_1)} f_1(x_1/a_1)dx_1 < B(x_0)\int_{\underline{x_1}}^{\overline{x_1}} \frac{\partial f_1(x_1/a_1)/\partial a_1}{f_1(x_1/a_1)} f_1(x_1/a_1)dx_1 = 0 \qquad (21).$$

The r. h. s. of the above inequality is zero as the integral reduces to zero (s. (P.2)). Finally, multiplication with $-m_1 < 0$ (s. P.1) gives:

$$\left.\frac{\partial E\left[W_0\right]}{\partial e}\right|_{e=0} = -\mu_1 \int_{\underline{x_1}}^{\overline{x_1}} B(x_1) \frac{\frac{\partial f_1\left(x_1 / a_1\right)}{\partial a_1}}{f_1\left(x_1 / a_1\right)} f_1\left(x_1 / a_1\right) dx_1 > 0$$

(22).

Thus, the principal is strictly better off. Q. e. d.

References

Araya, A. / Glover, J. / Sunder, S.: Earnings Management and the Revelation Principle, Working Paper, January 1998.

Boylan, R. T. / Villadsen, B.: Contracting and Income Smoothing in an Infinite Agency Model, Working Paper, April 1998.

Chiappori, P.-A. et al.: Repeated Moral Hazard: The Role of Memory, Commitment, and the Access to Credit Markets, in: European Economic Review, 1994, p. 1527 ff.

Demski, J. S.: Performance Measure Manipulation, Working Paper, University of Florida, April 1998.

Dye, R. A.: Communication and Post-Decision Information, in: Journal of Accounting Research, 1983, p. 514 ff.

Evans III, J. H. / Sridhar, S. S.: Multiple Control Systems, Accrual Accounting, and Earnings Management, in: Journal of Accounting Research, 1996, p. 45 ff.

Fudenberg, D. / Holmstrom, B. / Milgrom, P.: Short-Term Contracts and Long-Term Agency Relationships, Journal of Economic Theory, 1990, p. 11 ff.

Fudenberg, D. / Tirole, J.: A Theory of Income and Dividend Smoothing Based on Incumbency Rents, in: Journal of Political Economy, 1995, p. 75 ff.

Healy, P. M.: The Effect of Bonus Schemes on Accounting Decisions, in: Journal of Accounting and Economics, 1985, p. 85 ff.

Holmström, B.: Moral Hazard and Observability, in: The Bell Journal of Economics, 1979, p. 74 ff.

Lambert, R. A.: Managerial Incentives in Repeated Agency Relationships, Ph. D. Thesis, Stanford University, 1981.

Lambert, R. A.: Long-Term Contracts and Moral Hazard, in: The Bell Journal of Economics, 1983, p. 441 ff.

Rogerson, W. P.: Repeated Moral Hazard, in: Econometrica, 1985, S. 69 ff.

Sivaramakrishnan, K.: Information Content of Earnings Components, Reporting Choice and Long Term Contracts, Ph. D. Thesis, Northwestern University, 1989.

Sivaramakrishnan, K.: Information Asymmetry, Participation, and Long-term Contracts, in: Management Science, 1994, p. 1228 ff.

Spremann, K.: Agent and Principal, in: Bamberg, G. / Spremann, K. (Editors.): Agency Theory, Information, and Incentives, Heidelberg, 1987, p. 3 ff.

Tzur, J. / Yaari, V.: Management´s Reporting Strategy and Imperfection of the Capital Market, in: Managerial and Decision Economics, 1994, p. 57 ff.