The influence of uncertainty on the standard setting-decision between fair value and historical cost accounting under asymmetric information

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Abstract

The design of accounting rules by the international standard setters takes place in consideration of the tradeoff between relevance and reliability. An example for this tradeoff is the standard setting-decision between fair value accounting - associated with more relevant information - and historical cost accounting - associated with reliable information. This paper examines in which way the decision of a standard setter between fair value and historical cost accounting is influenced by the uncertainty of the underlying assets, if the standard setter wants to minimise the social costs of his standard setting-decision. For the analysis the paper uses on a first stage a common signalling model: Good firms signal their firm type to an analyst by using accounting discretion. On a second stage the resulting signalling costs are compared with the analyst's costs for determining the firm type by using his own analysing technology. The standard setter accordingly chooses the accounting rule that minimises the social costs.

JEL-Classification: C72, D82, M41

1 Introduction

Accounting rules are designed in a field of conflict, which shows up in the tradeoff between relevance and reliability. This tradeoff is discussed in both the IASB- and the FASB-framework.[1] In the standard setter's opinion relevance means that the information conveyed by the accounting system has influence on the decisions of investors. In this context forward looking information is of special interest. Because the future is always connected with uncertainty this objective is in a permanent conflict with the standard setter's second objective, which is to convey reliable accounting information. Reliability is interpreted in the way that the management has little discretion concerning the reported accounting numbers. This objective is rather achieved by using past information.

A prominent example for the relevance-reliability-tradeoff is the discussion about fair value vs. historical cost accounting.[2] On the one hand fair value accounting delivers relevent forward looking information. On the other hand it is comparatively easy to manipulate the reported fair value. Historical cost accounting in contrast is difficult to manipulate but it does not convey forward looking information to the users of financial statements.

In this paper the accounting information will be used for valuation purposes. That means an analyst uses the accounting report – either based on fair value accounting or on cost accounting – in order to determine the firm value. The decision to base the report either on fair values or on historical costs is implemented by a standard setter. The standard setter faces the tradeoff described above: On the one hand the use of fair value accounting enhances the valuation process. On the other hand fair value accounting makes a manipulation of the report easier so that the valuation process is hindered. In this situation cost accounting could be the better alternative. It is apparent that the standard setter's decision between fair value and historical cost accounting may be influenced by the uncertainty of the environment: In a relatively certain environment it can be expected that the use of fair values generates value relevant information without allowing too much manipulation. If the environment becomes extremely uncertain, however, the use of fair values may allow too much discretion. Then, the standard setter may implement accounting rules based on cost accounting.

To sum up the preceding discussion: This paper gives an intuition what kind of influence the degree of uncertainty has on the standard setting-process. Therefore it analyses the standard setter's decision to implement a specific accounting rule – fair value accounting vs. historical cost accounting – subject to the uncertainty

[1] Both standard setters mention relevance and reliability as "qualitative characteristics" at a prominent position within their frameworks. For the IASB-framework see F26 ff. For the FASB-framework see SFAC No. 2, par. 46 ff.

[2] See e. g. *Penman* (2007) and *Krumwiede* (2008).

of the underlying economic environment. The standard setter's decision is dependent on the ability of the accounting rules to enhance the valuation process on the one hand and not to allow too much discretion on the other hand. This tradeoff is appreciated by the standard setter as he chooses the cost-efficient accounting alternative, i. e. the standard setter prescribes fair value accounting if the signalling costs are low enough but he prescribes historical cost accounting if the social costs of signalling become to expensive.

On the first stage the paper deals with a common signalling-problem: Good firms signal their type to an analyst by using accounting policy. The resulting signalling costs of this first stage are determined subject to the uncertainty of the assets in question. On the second stage these signalling costs are contrasted with the analysts's costs for implementing his own analysing technology. As a result of this comparison the standard setter chooses the accounting rule which induces the lower social costs. Whereas typically the focus is on the response of the capital market to the signalling-activities this paper concentrates on the standard setter's considerations.

The literature to the subjects addressed in this paper is manifold. A discussion about arguments for using fair value accounting or historical cost accounting is found in *Penman* (2007) and the limits for the recognition of very speculative transactions in financial statements are discussed in *Penman* (2003). A paper by *Laux / Leuz* (2009) highlights the pros and cons of fair value accounting against the background of the recent financial crisis. The consequences of valuing inventory at historical cost or at fair value is discussed by *Reis / Stocken* (2007). The capital market literature that examines the usefulness of fair value accounting information to investors is broadly summarized by *Landsman* (2007). The model described in this paper uses on a first stage a signalling-problem. A paper by *Chaney / Lewis* (1995) provides a bases for the model used here. The paper deals with the consequences of earnings managements for the firm value under the assumption that the managers and the investors are asymmetrically informed. Well established in the signalling-literature is a model by *Hughes / Schwartz* (1988), which examines the possibility for firms to communicate the firm type by using the LiFo- instead of the FiFo-method. There are further papers which address earnings management and allow for the deliberate use of manipulated reporting, among these are *Verrecchia* (1986), *Lambert* (1984), *Lee / Li* (2006) and *Trueman / Titman* (1988). Another paper by *Healy / Wahlen* (1999) deals explicitly with the implications of earnings management for the standard setting-process. Other papers by *Woodlock / Young* (2001) and *Dye / Sridhar* (2004) deal with the mentioned trade-off between relevance and reliability. A good example for this tradeoff is the accounting for brand assets. *Kallapur / Kwan* (2004) empirically examine the value relevance and reliability of brand assets in the U.K. They find that brand assets are value relevant despite manager's incentives to overstate them and that there are substantial differences in the extent of the error in brand valuations of firms with different levels of contracting incentives. The *Kallapur / Kwan* (2004) paper is interesting concerning the discussion in this paper because it analyses the ambivalent consequences of taking rather uncertain brand assets on the balance sheet.

The paper is organised as follows: in section 2 the assumptions used in the model are presented. Section 3 presents the results of the model. This is carried out in different stages: First the model is evaluated under perfect information serving as a benchmark. Second the model is evaluated under asymmetric information: For a start there is established a reporting equilibrium based on a constant level of uncertainty. After that the level of uncertainty is regarded as variable and the consequences of this assumption for the reporting equilibrium are discussed. At last the signalling-costs resulting from the reporting equilibrium are compared to the costs induced by using the analyst's technology. The standard setter chooses the alternative which induces the lower social costs and selects his standard setting decision accordingly. Section 4 summarizes the findings of the paper.

2 The model

The model consists of three players: a firm, an analyst, who represents the role of the capital market, and a standard setter. The model covers three points in time. At $t = 0$ the firm acquires an asset. The asset generates a cash flow (X_j) at $t = 2$ given by the following process:

$$\tilde{X}_j = \mu_j + \tilde{e}_j \tag{1}$$

The error term $\tilde{e}_j$ is normally distributed and has an expected value of zero and a variance of σ^2. The variance is dependent on the nature of the acquired asset. For quite certain assets – think of a manufacturing facility e. g. – the variance is low, for assets in a rather uncertain environment – think of R&D-activities e. g. – the variance is higher. The expected value of the cash flow generated by the asset at $t = 2$ can take two values: The expected value can be high (μ_H) or low (μ_L). In the first case the asset exceeds expectations, in the second case the asset performs poorly resulting in a low expected value. Overall, the distribution of the cash flows of a good asset are characterised by the parameters (μ_H, σ^2), while the parameters of a bad asset are characterised by (μ_L, σ^2). The prior possibility of generating a high (low) expected value is denoted by p_H (p_L). It is assumed that $p_H \leq 0.5$. This assumption guarantees the existence of a separating equilibrium.[3] The analyst is

[3]See the calculations in appendix A.

aware of this probability and he also knows about the uncertainty of the asset's cash flows, i. e. the variance of the cash flows. Further it is assumed that the firm acquires the asset on a perfectly competitive market so that the purchase price equals the present value of the expected cash flows at $t = 0$, i. e. $\frac{p_H \cdot \mu_H + (1-p_H) \cdot \mu_L}{(1+r)^2}$. The asset is recognised on the balance sheet at $t = 0$ with that amount.

At $t = 1$ the firm learns more about the future prospects of the asset, i. e. the firm gains the information if the expected value of the cash flow at $t = 2$ is high (μ_H) or low (μ_L). At $t = 1$ the firm has to prepare a financial statement. This financial statement includes a report about the asset. Concerning the report there are two alternatives: It can be based either on fair value accounting or on historical cost accounting.

After the accounting report is issued at $t = 1$ the analyst values the firm by using a simple expected-value-calculation, i. e. he combines the expected cash flows for period $t = 2$ of an asset with high or low cash flows with his estimates concerning the probability of looking at a "good" or a "bad" firm.

If historical cost accounting is used the firm reports the same value as in period $t = 0$.[4] In this case the analyst gains no information at all about the type of the asset in $t = 1$. Thus the only way for the analyst to value the firm is to combine the expected cash flows with the prior probability of buying a good or a bad asset. When using fair value accounting in contrast it is possible for the firm to deliver a report at $t = 1$ that may deviate from the initial purchase price. This report communicates the expected value of the cash flows – μ_H or μ_L – to the analyst. This can be helpful for the analyst to update his believes. If the report signals a good asset the corresponding probability rises, which implicates a higher market value.

On the one hand the report has the ability to improve the market's valuation process, but on the other hand the use of accruals implies estimates. The use of estimates allows for accounting discretion. This fact is incorporated in the model as follows: The firm may deliver a report R_j which can deviate from the true expected value μ_j by the use of accounting discretion. The difference between the report and the true expected value is denoted by δ_j and can be interpreted as the degree of discretion performed by the firm. Thus, for R_j applies:

$$R_j = \mu_j + \delta_j \tag{2}$$

However, a deviation from the true expected value is not free of cost. A manip-

[4]This is a kind of prototypical historical accounting as no impairment rules are explicitly applied. Alternatively you can think of a case where the depreciation in the first period is large enough – and the corresponding cash flows in the case of a bad asset are high enough – so that there is no indication for an impairment.

ulated report[5] induces costs ($C_j^{Man}(\delta_j, \sigma^2)$), generated by time and effort required in order to convince the auditor that the report should be certified for example.[6] On the one hand these costs increase when the difference δ_j grows which implies: $\frac{\partial C_j^{Man}(\delta_j,\sigma^2)}{\partial \delta_j} > 0$. On the other hand these costs for manipulation decrease when the uncertainty of the transactions rises, i. e. the costs decrease with an increase of variance σ^2. This can be explained as follows: Manipulation in an extremely certain environment is very difficult and more expensive than manipulation in an uncertain environment. If the cash flows at $t = 2$ deviate extremely the specification of a point estimate at $t = 1$ is very difficult so that it becomes easier and cheaper to manipulate. Look e. g. at a provision for a lawsuit: If there is little uncertainty left about the amount of the provision, because there is already a final judgement to pay a certain amount, the recognition of a different amount could hardly be justified. At the outset of a lawsuit, however, different outcomes are possible. Then, there is discretion for the management in determining the probabilities for certain possible scenarios, so that manipulation is hard to detect for the auditor. Concerning the cost function this implies: $\frac{\partial C_j^{Man}(\delta_j,\sigma^2)}{\partial \sigma^2} < 0$. For the sake of simplicity I use the following cost function:

$$C_j^{Man}(\delta_j, \sigma^2) = \frac{c^{Man}}{\sigma^2} \cdot \delta_j^2 \, , \tag{3}$$

where c^{Man} is an arbitrary positive contant.

In order to analyse the incentives for the manager to manipulate the report – with the intention to be taken for a firm with a good asset – we have to examine the manager's objective function. We assume that the objective function is linear in the (expected) firm values of the periods $t = 1$ (V_{j1}) and $t = 2$ (V_{j2}).[7] The amount

[5]The way the firm reports at $t = 2$ is irrelevant in this model because at $t = 2$ the market is able to observe the cash flows, so that no accounting information is needed at that time. Nevertheless it should be pointed out that the proposed type of accounting in $t = 1$ does not necessarily imply a violation of the clean-surplus-relation. If the report at $t = 2$ (R_j^2) meets the following condition: $R_j^2 = \epsilon_j - \delta_j$, the clean-surplus-relation is not violated. The sum of both reports is $\mu_j + \epsilon_j$ which equals the cash flow at $t = 2$. But again: the report at $t = 2$ is not used for valuation purposes.

[6]Reasons why manipulated reports induce costs can be found e. g. in *Trueman / Titman* (1988) p. 135 f., where the manipulated report is originated by income smoothing. In other papers costs are induced because the report implies consequences concerning the tax base, so that a higher report means higher tax payments. See e. g. *Chaney / Lewis* (1995), p. 325.

[7]The assumption that the management's compensation is a linear combination of two (expected) firm values, is an assumption often used in literature. This assumption can be justified by the fact that at least considerable parts of the compensation of the top management are variable and these variable parts are typically based on the firm's market value or on accounting numbers. See e. g. *Hughes / Schwartz* (1988), p. 45; *Miller / Rock* (1985), p. 1041; *Chaney / Lewis* (1995), p. 328.

of the value-based compensation ($W_j(\delta_j)$), dependent on the reporting strategy δ_j chosen in $t = 1$, is calculated as follows:

$$W_j(\delta_j) = a_1 V_{j1}(\delta_j) + a_2 E_0[V_{j2}(\delta_j)] \,. \tag{4}$$

The parameters a_1 and a_2 balance the weight attributed to the firm value in $t = 1$ or $t = 2$ respectively. Moreover the following assumptions are applied: The investors and the managers are risk-neutral and the risk-free discount rate is r with $r \geq 0$. No dividends are paid until the firm is liquidated at $t = 2$.

Moreover the analyst is not forced to rely on the firm's report in any case. In fact the analyst can use his own analysing technology at $t = 1$ if required. This technology reveals the type of the asset with certainty. Of course the adoption of this technology induces costs denoted C^{An}. We assume that these costs rise with increasing uncertainty of the cash flows of the underlying asset, i. e. $\frac{\partial C^{An}(\sigma^2)}{\partial \sigma^2} > 0$: it is easier to judge the expected value in a rather certain environment; concerning a rather uncertain environment the judgement becomes more difficult and more expensive. However, it is assumed that the costs do not grow unbounded with increasing uncertainty. On the contrary the amount of the costs is assumed to be limited. This limitation seems to be plausible, because the consequence of an unbounded growth would be that the analysing costs rise above the expected value of the cash flows. A high uncertainty of the environment would eliminate the possibility to use the analysing technology which does not seem to be realistic. As an example, the following cost function will be used in the paper:

$$C^{An}(\sigma^2) = -\frac{c_{An}}{\sigma^2 + 1} + c_{An} \,. \tag{5}$$

I summarize the characteristics of the model in the following figure 1:

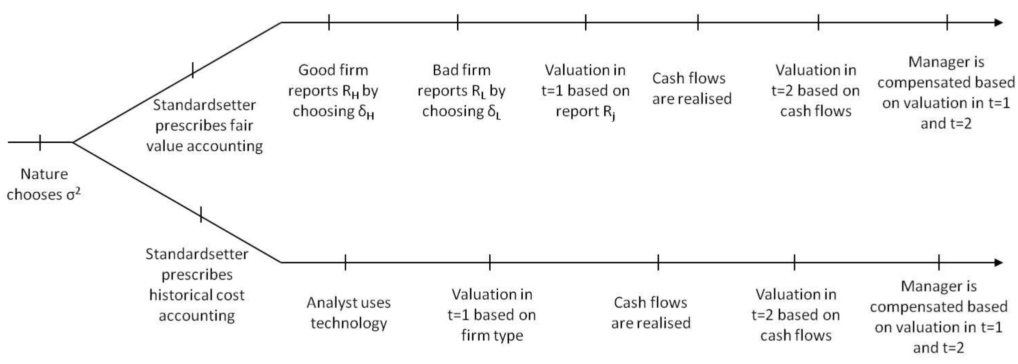

Figure 1: Timeline

To begin with nature determines the uncertainty of the environment. Subject to the degree of uncertainty the standard setter prescribes fair value or historical cost accounting. In order to ascertain which alternative results in lower social costs the standard setter has to balance the following decisions of both manager and analyst. When prescribing fair value accounting the standard setter has to take into account that there are signalling costs (C^{Man}) for the manager in order to reveal the asset type to the analyst. When prescribing historical cost accounting the standard setter has to take into account the costs for using the analyst's technology (C^{An}). The standard setter's objective function is to minimize the social costs (C^{SC}), i. e.:

$$C^{SC} = \min\{C^{Man}; C^{An}\},$$

by prescribing the appropriate accounting rule.

3 Results

3.1 Reporting strategy under perfect information

As a benchmark, we first take a look at the case of perfect information, in which the analyst can obeserve the asset type. The firm value under perfect information at $t = 1$ (V_{j1}^{PI}) equals the net present value of the expected cash flows. It has to be recognised that the costs caused by a manipulated report at $t = 1$ have to be deducted from the net present value of cash flows. Concerning the setting in the model this means:

$$V_{j1}^{PI} = \frac{\mu_j}{(1+r)} - C_j^{Man} \tag{6}$$

It appears that under perfect information the optimal decision for the manager is not to manipulate the report. In fact the manager will report truthfully. Every deviation from the expected value generates costs, but does not change the analyst's judgement concerning the asset type. Perfect information induces truthful reporting so that neither analysing costs nor costs for manipulation are induced.[8]

3.2 Asymmetric information: firm valuation

Now we consider the valuation under asymmetric information. First we assume that the degree of uncertainty is fixed. The managers are informed about the type

[8] This result differs from the findings of *Chaney/Lewis*. Concerning their model it is optimal for the manager to make the report as small as possible – i. e. to manipulate the report "downwards" – because the report has consequences concerning the tax base. See *Chaney / Lewis* (1995), p. 326.

of their asset at $t = 1$, the analyst can not observe the type. However, the analyst uses the manager's report to update his probability-assessment concerning the asset type. In doing so the prior probabilities are updated using Bayes' rule. That means:

$$pr(L|R_j) = \frac{\phi_L(R_j)p_L}{\phi_L(R_j)p_L + \phi_H(R_j)p_H} \tag{7}$$

$$pr(H|R_j) = \frac{\phi_H(R_j)p_H}{\phi_L(R_j)p_L + \phi_H(R_j)p_H} \tag{8}$$

Here $\phi_L(R_j)$ and $\phi_H(R_j)$ represent the probabilities that the report R_j is released by a firm with a bad or a good asset.

As the report does not necessarily reveal the firm type with certainty, the analyst's valuation of the firm after receiving report R_j ($V_{j1}(R_j)$) equals the following contingent expected value:

$$V_{j1}(R_j) = pr(H|R_j)v_H(R_j) + pr(L|R_j)v_L(R_j)\,, \tag{9}$$

where $v_H(R_j)$ and $v_L(R_j)$ represent the value of a firm with a good respectively a bad asset, that has released report R_j. If a good firm releases report R_j, $v_H(R_j)$ e. g. is calculated as follows:

$$v_H(R_j) = \frac{E_1[X_H]}{1+r} - C_j^{Man} = \frac{\mu_H}{1+r} - \frac{c^{Man}}{\sigma^2} \cdot \delta_H^2 \tag{10}$$

The value of a firm with a bad asset that reports R_j is calculated in the same way.

Now consider the firm value at $t = 2$ after the cash flows are realised but immediately before they are distributed. At $t = 2$ the firm is liquidated so that the analyst and the market achieve full information about the capital maintained by the firm. So the value of the firm equals the dividends distributed at $t = 2$:

$$V_{j2}(R_j) = X_j - (1+r) \cdot \frac{c^{Man}}{\sigma^2} \cdot \delta_j^2 \tag{11}$$

The expression contains the cash flows generated by the asset less the costs of a manipulated report in period $t = 1$ which are accumulated for one period.

3.3 Reporting strategy in equilibrium under a constant degree of uncertainty

The model contains two different incentives for the manager of a firm with a good or with a bad asset which influence the reporting strategy in equilibrium. First, the manager of a bad firm has the incentive to reduce the information content of the accounting report in order to increase the probability to be taken for a good firm. Second, the manager of a good firm may increase the information content of the accounting report in order to prevent the bad firm from imitating.[9]

What does the reporting strategy in equilibrium look like? It can be shown that there are in fact incentives for the bad firm to imitate the report of the good firm in order to block the information content of the accounting. But the manager of the good firm has the ability to counteract these incentives and to avoid such an imitating strategy. Because the manager of the good firm is able to increase the manipulation until a limit is reached so that the bad manager's imitating strategy no longer pays off this process could be described as limit reporting. And the limit at which the bad manager does not longer follow his imitating strategy will be referred to as the limit reporting equilibrium (LRE).

The manager of the bad firm can try to block the information conveyed by the accounting by imitating the report of the good firm. Then the report of a bad firm always equals the report of a good firm and, thus,

$$R_L^m = R_H^m. \tag{12}$$

If the manager of a good firm manipulates by the amount of δ_H, the manager of the bad firm has to manipulate likewise by the amount of δ_H and, additionally, he has to compensate for the difference between the two expected values. Together the bad firm has to manipulate – under consideration of equation (2) – by the following amount:

$$\delta_L^m = \delta_H^m + \mu_H - \mu_L \tag{13}$$

This imitating strategy leads to identical and thus completely uninfomative accounting reports. Therefore the ex ante assessment about the asset type remains unchanged by the accounting report so that the following applies: $pr(H|R_j^m) = p_H$ and $pr(L|R_j^m) = p_L$.

However, the good firm can increase the amount of manipulation on his part so that the bad firm her to follow this decision. So the bad firm has to increase the

[9]In *Chaney / Lewis* (1995) the managers of the good and the bad firm are faced with similar incentives, see *Chaney / Lewis* (1995), p. 328 f.

amount of her own manipulation in order to release an identical report. Therefore we now take a look at the bad manager's compensation under perfect information $(W_L(R_L^{PI}))$ and under using the described imitating strategy $(W_L(R_L^m))$ subject to the amount of manipulation. Both functions can be found in the following figure 2.[10]

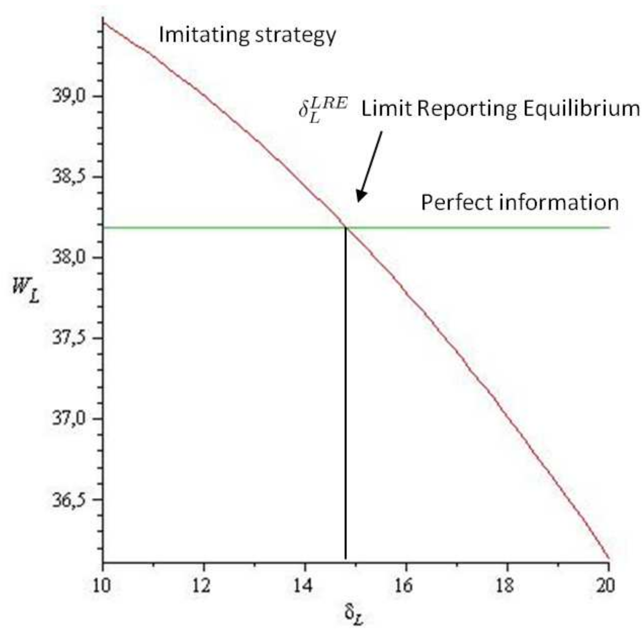

Figure 2: The bad manager's compensation

Under perfect information there is no manipulation as demonstrated in section 3.1. Therefore the compensation function is constant. The imitating strategy under asymmetric information results in a strictly decreasing compensation function. The compensation decreases with an increasing amount of manipulation δ_L.

There are two necessary and sufficient conditions for the existence of the limit reporting equilibrium, i. e. a separating equilibrium in which the firm with a good asset releases a manipulated report whereas the firm with a bad asset reports truthfully. The first condition ensures that the bad firm reports truthfully: If the amount of manipulation reaches δ_L^{LRE}, the manager is indifferent between the imitating strategy and a truthful report which delivers a compensation as under perfect information. Beyond δ_L^{LRE} the manager of the bad firm prefers truthful reporting.

[10]In the figure the following parameters are used: $\mu_H = 50$; $\mu_L = 40$; $p_H = p_L = 0.5$; $r = 0.1$; $c_{Man} = 0.05$;$c_{An} = 0.5$; $a_1 = a_2 = 0.5$ und $\sigma^2 = 4$.

The incentive to use an imitating strategy disappears because an extremely high amount of manipulation is needed to implement the imitating strategy. Formally the first condition concerning the bad manager can be described as follows:

$$W_L(R_L^m) = W_L(R_L^{PI}) \tag{14}$$

For a perfectly informative equilibrium a second condition must be satisfied concerning the firm with a good asset: A report that contains a sufficient amount of manipulation to prevent the bad firm from imitating has to imply a higher compensation for the good manager than a report that allows the imitating strategy. The following figure shows the good manager's compensation.

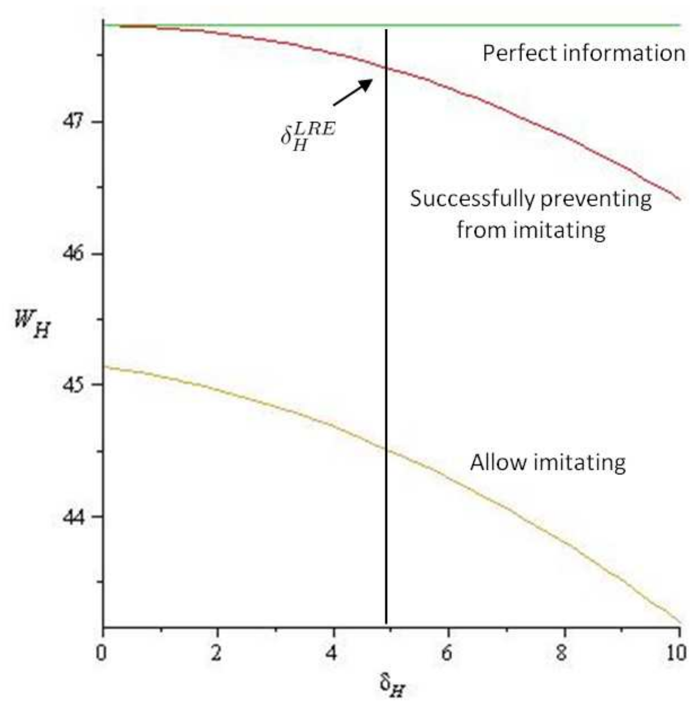

Figure 3: The good manager's compensation

The straight line shows the compensation under perfect information. The lower function shows the strictly decreasing compensation function of the good manager if the good manager manipulates and the bad manager follows the imitating strategy. The third, medial function shows the compensation if the manipulated good manager's report successfully prevents the bad manager from imitating. A report that allows a successful signalling by the good manager is denoted as R_H^{sig}. If we consider the previous considerations of the bad manager, we know that the good manager has to carry out a manipulation by the amount of at least $\delta_H^{LRE} = \delta_L^{LRE} + \mu_L - \mu_H$ in order to prevent the bad manager from imitating. A comparison of the compensation functions under ”imitating strategy” evaluated at zero or under the strategy ”successfully preventing from manipulation” evaluated at δ_H^{LRE} shows that the good manager can increase his compensation if he is able to prevent the bad manager from imitating. Formally the second condition concerning the good manager can be described as follows:

$$W(R_H^m, \delta_H^m = 0) \leq W(R_H^{sig}, \delta_H^{sig} = \delta_H^{LRE}) \quad (15)$$

The results are summarised in the following Proposition 1:

Proposition 1: With $p_H \leq 0.5$ there exists a perfect informative limit reporting equilibrium. The optimal reporting strategy of firms of type L is to report $R_L^* = \mu_L$, so that the firms of type L do not manipulate in the limit reporting equilibrium ($\delta_L^* = 0$). The optimal reporting strategy of firms of type H is to report $R_H^* = R_H^{LRE}$ so that firms of type H manipulate by the amount of $\delta_H^* = \delta_H^{LRE}$ in the limit reporting equilibrium. The manipulation has the following characteristics:

$$\delta_H^{LRE} = \frac{-b}{2a} + \sqrt{\frac{b^2}{4a^2} - \frac{c_2}{a} - \frac{c_1}{a}\sigma^2} \quad (16)$$

with:

$$a = -c_{Man}(a_1 + a_2(1+r)) \quad (17)$$

$$b = c_{Man}(-2a_1p_L - 2a_2(1+r))(\mu_H - \mu_L) \quad (18)$$

$$c_1 = \frac{a_1p_H}{1+r}(\mu_H - \mu_L) \quad (19)$$

$$c_2 = (-a_1p_Lc_{Man} - a_2(1+r)c_{Man})(\mu_H - \mu_L)^2 \quad (20)$$

Proof: see appendix A.

Concerning the parameters used in the illustrations as well the solution is: $\delta_H^{LRE} = 4.83$. In the limit reporting equilibrium the bad manager is indifferent between a truthful report and a manipulation in the amount of $\delta_H^{LRE} + \mu_H - \mu_L = 14.83$. Is the uncertainty of the environment fixed – represented by $\sigma^2 = 4$ in the example – the good manager has to overstate his report by the amount of at least $\delta_H^{LRE} = 4.83$ in order to prevent the bad manager from imitating. With an overstatement beyond δ_H^{LRE} the bad manager prefers to report truthfully because in this case a truthful report guarantees a higher compensation.

The assumption of $p_H \leq 0.5$ guarantees that a separating equilibrium exists which allows to distinguish between firms with a good and a bad asset. Otherwise the existence of a separating equilibrium is not guaranteed and the existence of a pooling equilibrium is possible in which firms with good assets allow firms with bad assets to imitate their reports.[11]

3.4 Reporting strategy in equilibrium under a variable degree of uncertainty

So far the limit reporting equilibrium is based on the assumption that a fixed amount of uncertainty is used in the model. In order to analyse the initial question – what are the consequences of a different degree of uncertainty with regard to the standard setter's decision to implement fair value or historical cost accounting – it is important to observe modifications of the limit reporting equilibrium when the amount of uncertainty changes. In this section I discuss how the limit reporting equilibrium established in Proposition 1 changes depending on the uncertainty of the asset's cash flows. For this purpose the intersection of the bad manager's compensation function under the imitating strategy and under perfect information has to be calculated. This intersection is relevant to establish the equilibrium. Observing Proposition 1, you will notice that the amount of uncertainty (σ^2) and the corresponding limit reporting equilibrium (δ_H^{LRE}) are related by the function expressed in equation (16).[12] The economic implication of this finding is that the limiting point at which the imitating strategy of the bad manager does no longer pay off is dependent on the degree of uncertainty of the underlying assets. This relation between σ^2 and δ_H^{LRE} is represented by the following figure 4:

[11] See appendix A.

[12] See equation (16) and the calculations in appendix A.

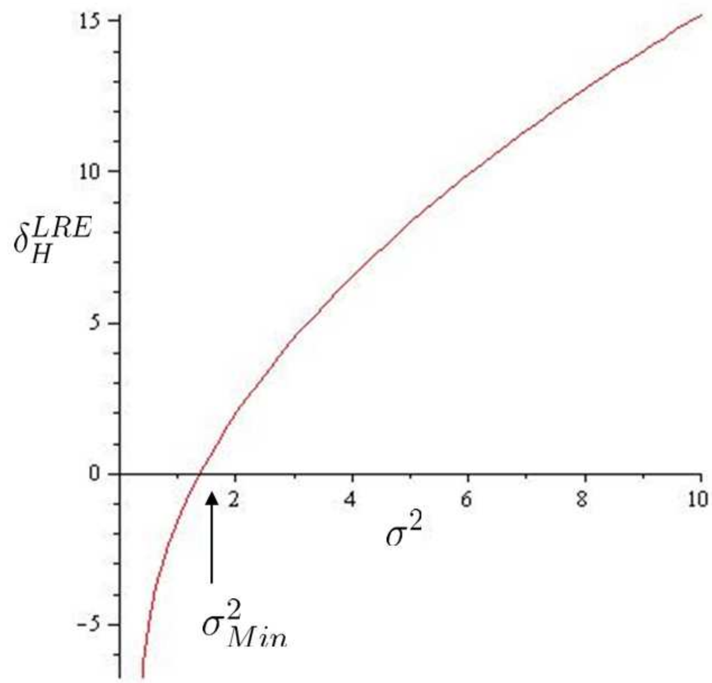

Figure 4: The relation between δ_H^{LRE} and σ^2 in reporting equilibrium

The figure shows that there exists a lower limit σ^2_{Min}.[13] If the uncertainty of the assets's cash flows is lower there is no need for the good manager to report untruthfully. In a very certain environment a manipulation in the necessary magnitude – in order to imitate successfully the bad manager has to overcome the difference between the expected values μ_L and μ_H at first – creates such high costs that the bad manager always prefers a truthful report. So the good manager is able to report truthfully as well.

Not until the uncertainty exceeds the lower limit σ^2_{Min} and manipulated reports become cheaper it is worthwhile for the bad manager to manipulate. After that however the good manager starts to manipulate his report as well in order to prevent the bad manager from imitating. It can be noticed that an increase in uncertainty always results in a higher level of manipulation.

[13]Using the parameters we have applied to all calculations up to now we have the following result concerning σ^2_{min}, the intersection with the X-axis: $\sigma^2_{min} = 1.70$.

3.5 Consideration of social costs by the standard setter

We summarize the following intermediate result: In a very certain environment ($\sigma^2 < \sigma^2_{Min}$) both managers report truthfully so that the analyst can distinguish between firms with good and bad assets. In a more uncertain environment ($\sigma^2 > \sigma^2_{Min}$) the good manager manipulates his report in a sufficient way so that manipulation does not pay off for the bad manager. So the bad manager does not imitate but he reports truthfully. A distinction between good and bad firms is possible as well. So at first sight there does not seem to be a problem from the standard setter's point of view because the analyst is always informed about the firm type.

But you can put into question whether the transport of information is carried out in an effective way from an economic point of view. The manipulation becomes cheaper with increasing uncertainty but this in turn is the reason why the amount of manipulation increases more and more. All in all the result is that the costs of manipulation – i. e. the signalling costs that have to accepted – will rise with increasing uncertainty. The consideration of the social costs will be analysed from the standard setter's point of view. In this connection the assumption concerning the analysing technology is used. By application of the analysing technology the firm type can be determined with certainty but this generates costs. The following cost function is used in accordance with equation (5):

$$C^{An}(\sigma^2) = -\frac{c_{An}}{\sigma^2 + 1} + c_{An}$$

Now we examine how the standard setter has to consider the costs for manipulation on the one hand and the costs for analysing on the other hand in order to minimise the social costs that are necessary to determine the firm type. By prescribing fair value accounting the standard setter forces the good manager to manipulate if necessary and burdens him with signalling costs. By prescribing historical cost accounting however the analyst is forced to use his own technology to determine the firm type. For the standard setter it is necessary to make his decision depending on the uncertainty of the environment, so that the social costs are minimised. This decision is implemented by releasing appropriate accounting standards. As the costs are dependend on the degree of uncertainty it is necessary to determine the point beyond which the application of the technology is cheaper than the signalling costs of the good manager. This point can be determined by equalising both cost functions:

$$p_H \cdot C^{Man} = C^{An} \quad \Leftrightarrow \quad p_H \frac{c_{Man}}{\sigma^2}\delta_H^2 = -\frac{c_{An}}{\sigma^2 + 1} + c_{An} \tag{21}$$

Attention should be paid to the fact that the signalling costs on the left side of the equation only affect a firm with a good asset – i. e. the corresponding probability is p_H – whereas a firm with a bad asset always reports truthfully and no signalling costs are incurred. The costs for analysing on the right side of the equation are incurred independently of the firm type.

Additionally it should be kept in mind that concerning the uncertainty σ^2 and the amount of manipulation δ_H^{LRE} the relation calculated in Proposition 1 is valid. If you insert the corresponding expression for δ_H in equation 21 the result is an equation which is only dependent on σ^2. So the interception of both cost functions can be determined subject to σ^2. The following figure 5 shows the shape of both cost functions:

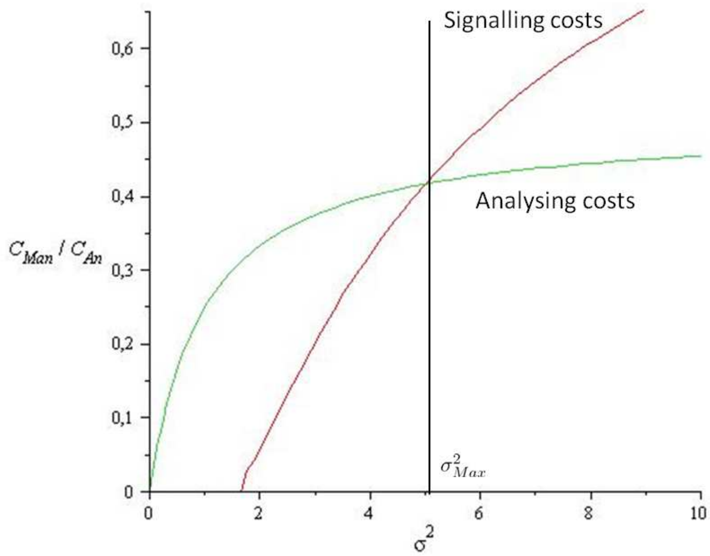

Figure 5: Signalling vs. analysing costs

The cost functions intersect at a degree of uncertainty of σ^2_{Max}.[14] Concerning an environment with a higher uncertainty the social costs are lower if the standard setter prescribes historical cost accounting which forces the analyst to make use of his technology.

The existence of an intersection point is subject to the following conditions which are summarised by proposition 2:

Proposition 2: There exists an intersection point of the cost functions for signalling and for using the analysing technology if the parameters fulfil the following condition:

[14]Using the same parameters as before we get the following result: $\sigma^2_{Max} = 5.01$.

$$\frac{-p_H c_{Man} c_1}{a} < c_{An} \tag{22}$$

Proof: see appendix B.

Summing up three intervals are constituted depending on the uncertainty of the environment: First in a very certain environment ($\sigma^2 < \sigma^2_{Min}$) the standard setter prescribes fair value accounting; thereby the manipulation in this interval is so expensive that firms with both types of assets report truthfully. In this interval no social costs are generated. In this context you may think e. g. of the accounting for financial instruments which are traded on an active market and you are able to use this market price as the fair value in the accounting system.

Second in an environment with an average degree of uncertainty ($\sigma^2_{Min} < \sigma^2 < \sigma^2_{Max}$) the standard setter prescribes fair value accounting as well. However, in this interval the good manager is forced to manipulate his own report in order to prevent the bad manager from imitating. This guarantees that the bad manager reports truthfully. In this interval the social costs contain the manipulation costs of the good manager. You could think of assets measured at fair value which are not traded on an active market, so that you can not use a market price as a reference for the determination of the fair value.

Third in a very uncertain environment ($\sigma^2 > \sigma^2_{Max}$) in contrast the standard setter prescribes historical cost accounting. In this interval the signalling costs exceed the costs of analysing so that it is cheaper to use the analyst's technology to determine the firm type. You may think of R&D costs, where the uncertainty about the future development is so high that the determination of a fair value would not be reliable.

4 Conclusion

The paper examines the influence of uncertainty on the standard setting-decision between fair value or historical cost accounting. The model used in the analysis has two stages: On the first stage I establish the limit reporting equilibrium in a signalling model. Subsequently the limit reporting equilibrium is varied depending on a change of the underlying uncertainty and the signalling costs are contrasted with the costs for applying the analyst's technology. We get the following findings: In a very certain environment the standard setter prescribes fair value accounting and both firms with good and firms with bad assets report truthfully – in this case manipulation is to expensive to be beneficial. In an environment with average uncertainty the standard setter prescribes fair value accounting as well. But in this interval the good manager has to manipulate his own report in order to prevent the bad manager from imitating. From the standard setter's point of view this signalling however is less expensive than the application of the technology. In a very uncertain environment however the standard setter prescribes historical cost accounting. In this interval the use of the analyst's technology is more effective than the good manager's signalling.

A The reporting strategy in equilibrium

Proof Proposition 1:

The first condition for establishing the limit reporting equilibrium is that the manager of a bad firm is indifferent between an imitating strategy and a truthful report or a report under perfect information respectively. Equalising both compensation functions provides the result named δ_H^{LRE} or δ_L^{LRE} respectively:

$$\begin{aligned}
W_L(R_L^m) &= W_L(R_L^{PI}) \\
a_1 V_{L1}(R_L^m) + a_2 E_1[V_{L2}(R_L^m)] &= a_1 V_{L1}^{PI} + a_2 E_1[V_{L2}^{PI}] \\
a_1(pr(H|R_j^m)v_H(R_H^m) + pr(L|R_j^m)v_L(R_H^m)) & \\
+a_2 E_1[V_{L2}(R_L^m)] &= a_1 V_{L1}^{PI} + a_2 E_1[V_{L2}^{PI}] \\
a_1 \left(p_H \left(-\frac{c_{Man}}{\sigma^2}\delta_H^2 + \frac{\mu_H}{1+r} \right) \right. & \\
\left. +p_L \left(-\frac{c_{Man}}{\sigma^2}(\delta_H + \mu_H - \mu_L)^2 + \frac{\mu_L}{1+r} \right) \right) & \\
+a_2 \left(\mu_L + (1+r) \left(-\frac{c_{Man}}{\sigma^2}(\delta_H + \mu_H - \mu_L)^2 \right) \right) &= a_1 \left(\frac{\mu_L}{1+r} \right) + a_2 \mu_L
\end{aligned}$$

Rearranging yields:

$$\begin{aligned}
& \underbrace{(-a_1 p_H c_{Man} - a_1 p_L c_{Man} - a_2(1+r)c_{Man})}_{a} \frac{1}{\sigma^2}\delta_H^2 \\
+ \quad & \underbrace{(-2a_1 p_L c_{Man}(\mu_H - \mu_L) - 2a_2(1+r)c_{Man}(\mu_H - \mu_L))}_{b} \frac{1}{\sigma^2}\delta_H \\
+ \quad & \underbrace{a_1 p_H \frac{\mu_H}{1+r} - a_1 p_H \frac{\mu_L}{1+r}}_{c_1} \\
+ \quad & \underbrace{-a_1 p_L c_{Man}(\mu_H - \mu_L)^2 - a_2(1+r)c_{Man}(\mu_H - \mu_L)^2}_{c_2} \frac{1}{\sigma^2} = 0
\end{aligned}$$

We maintain the following result:

$$\begin{aligned}
\delta_H^{LRE} &= \frac{-b\frac{1}{\sigma^2} + \sqrt{b^2\frac{1}{\sigma^4} - 4a\frac{1}{\sigma^2}(c_1 + c_2\frac{1}{\sigma^2})}}{2a\frac{1}{\sigma^2}} \\
&\Leftrightarrow \frac{-b}{2a} + \sqrt{\frac{b^2}{4a^2}\frac{\sigma^4}{\sigma^4} - \frac{4ac_1}{4a^2}\frac{\sigma^4}{\sigma^2} - \frac{4ac_2}{4a^2}\frac{\sigma^4}{\sigma^4}} \\
&\Leftrightarrow \frac{-b}{2a} + \sqrt{\frac{b^2 - 4ac_2}{4a^2} - \frac{4ac_1}{4a^2}\sigma^2} \\
&\Leftrightarrow \frac{-b}{2a} + \sqrt{\frac{b^2}{4a^2} - \frac{c_2}{a} - \frac{c_1}{a}\sigma^2}
\end{aligned}$$

The second condition for establishing the limit reporting equilibrium is that the good manager's compensation is higher if he prevents the bad manager from imitating (R_H^{sig}) than by allowing an imitating strategy (R_H^m). Looking at figure 3 shows, that this condition is always fulfilled if δ_H adopts low values which implies that σ^2 adopts low values as well. Because firm type H is clearly identifiable, the compensation function under strategy R_H^{sig} is located above the compensation function under strategy R_H^m. The question is what happens, if σ^2 adopts higher values: The costs for a successful signalling rise so that the corresponding compensation function declines. In this case it could be possible that it is reasonable for the good manager to stop his strategy to prevent the bad manager from imitating and to allow that the good firm can not be distinguished from the bad firm instead. So we have to compare the function value under strategy R_H^{sig} at point δ_H^{LRE} with the function value under strategy R_H^m at point zero. Especially we have to look at the limit when applying high values of σ^2. If the limit under strategy R_H^{sig} is larger than the function value under strategy R_H^m at point zero it is guaranteed that the good manager always prefers to prevent the bad manager from imitating.

The function value under strategy R_H^m at point zero is calculated as follows:

$$W(R_H^m, \delta_H^m = 0) = a_1 V_{H1}(\delta_H^m = 0) + a_2 E_1[V_{H2}(\delta_H^m = 0)]$$

Rearranging yields:

$$= a_1\left(p_H\frac{\mu_H}{1+r} + p_L\frac{\mu_L}{1+r}\right) + a_2\mu_H \tag{23}$$

The function value under strategy R_H^{sig} at point δ_H^{LRE} is calculated as follows:

$$\lim_{\sigma^2\to\infty}\left(W(R_H^{sig}, \delta_H^{sig} = \delta_H^{LRE})\right) = \lim_{\sigma^2\to\infty}\left(a_1 V_{H1}(\delta_H^{LRE}) + a_2 E_1[V_{H2}(\delta_H^{LRE})]\right)$$

Rearranging yields:

$$= a_1 \left((1 - p_H) \frac{\mu_H}{1 + r} + (1 - p_L) \frac{\mu_L}{1 + r} \right) + a_2 \mu_H \tag{24}$$

Comparing equations (23) and (24) you can establish the following result: If $p_H \leq 0,5$ the good manager prefers – even if σ^2 adopts high values – the strategy to prevent the bad manager from imitating. This guarantees the existence of a separating equilibrium. If $p_H > 0.5$ this cannot be guaranteed in every case: Here it is possible that the good manager prefers not to use a signalling strategy if σ^2 adopts high values. If $p_H > 0.5$ the second condition has to be checked explicitly and in this case it is possible that a pooling equilibrium exists in which the bad firm imitates the report of the good firm so that the analyst cannot distinguish both firm types. If $p_H \leq 0.5$ an explicit check of the second condition is not necessary because it is always fulfilled. If $p_H \leq 0.5$ we establish the following finding: In the limit reporting equilibrium the optimal reporting strategy for firms of type L is $R_L = \mu_L$ which implies that no manipulation takes place, i. e. $\delta_L = 0$. In the reporting equilibrium the optimal reporting strategy for firms of type H is $R_H = \mu_H + \delta_H^{LRE}$, which implies that firms of type H use manipulation in the limit reporting equilibrium. The manipulation amounts δ_H^{LRE}.

B Conditions for the existence of an intersection point

Proof Proposition 2:

The analyst's cost function provides positive values already beyond the origin. Costs related to a manipulated report arise not until the minimum limit of manipulation (σ^2_{min}) is exceeded. At first – with low uncertainty – the analyst's costs exceed the costs for a manipulated report. So there is an intersection of both cost functions if the following applies: The limit of the analyst's cost function when applying high values of σ^2 has to be lower than the costs of manipulation:

$$\lim_{\sigma^2 \to \infty} \left(-\frac{c_{An}}{\sigma^2 + 1} + c_{An} \right) < \lim_{\sigma^2 \to \infty} \left(p_H \frac{c_{Man}}{\sigma^2} \delta_H^2 \right)$$

Substituting δ_H by the manipulation in equilibrium δ_H^{LRE} subject to equation (16) yields:

$$\lim_{\sigma^2 \to \infty} \left(-\frac{c_{An}}{\sigma^2 + 1} + c_{An} \right) < \lim_{\sigma^2 \to \infty} \left(p_H \frac{c_{Man}}{\sigma^2} \left(\frac{-b}{2a} + \sqrt{\frac{b^2}{4a^2} - \frac{c_2}{a} - \frac{c_1}{a} \sigma^2} \right)^2 \right)$$

Rearranging yields the following condition:

$$c_{An} < \frac{-p_H c_{Man} c_1}{a}$$

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