Hedge Accounting Incentives for Cash Flow Hedges of Forecasted Transactions

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Abstract

US-GAAP as well as IAS (IFRS) contain specific accounting regulations for hedging activities. Basically the hedge accounting rules ensure that an offsetting gain or loss from a hedging instrument affects earnings in the same period as the gain or loss from the hedged item. However, due to the way hedge accounting rules are set up, their application turns out to be an option rather than an obligation for firms. Recognizing this fact, the paper analyzes corporate incentives for hedge accounting in the presence of a moral hazard problem. We consider a two period LEN-type agency model with a risk averse agent and a risk neutral principal. The principal decides upon hedging and motivates effort through an incentive contract based on accounting income. We find that in such a setting the principal strictly prefers hedging as opposed to no hedging. Whether he prefers hedge accounting or not depends on how the firm’s overall risk exposure is allocated over periods. If risk exposures differ largely over periods the principal prefers hedge accounting. Otherwise no hedge accounting is preferred.

Keywords: Hedging, hedge accounting, performance measurement, agency theory, moral hazard, LEN-model

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1 Introduction

Since the 1980s a series of innovative financial instruments emerged in financial markets and has been used by companies for strategic corporate risk management. This trend forced accounting standard setters like the FASB and the IASB to come up with appropriate accounting standards for e.g. hedging activities and speculation. Related projects, however, proved to be demanding and actual standards are the outcome of an ongoing process of revisions and amendments.¹ One intermediate result from this process is that SFAS and IAS by now constitute very similar approaches for hedge accounting. As far as this paper is concerned, cash flow hedge accounting of forecasted transactions is identical. All remarks made below as well as the results obtained from the analysis in this paper are therefore valid according to either US-GAAP or IAS (IFRS).
A cash flow hedge is a hedge of the variability in cash flows that is attributable to a future transaction. Accordingly, the hedged item is not to be recorded in the financial statements at the inception of the hedge. To ensure that offsetting gains and losses from the hedging instrument and the hedged item affect profit in the same period, specific rules apply to the hedging instrument. These rules require offsetting gains or losses from the hedging instrument, also called the effective part of the hedge, to be recognized in equity in the first place. Once the future transaction takes place and affects earnings, these gains and losses are reclassified from equity to income as well.

To qualify for (cash flow) hedge accounting, however, standard setters specify several restrictive conditions. The most important ones refer to the nature of the hedged risk, the degree of hedging effectiveness, and to the documentation of the hedge. These conditions imply that application of hedge accounting rules in fact has to be regarded as an option rather than an obligation. E.g. a company can easily prevent to qualify for hedge accounting by not documenting the hedge performed in detailed fashion in the books.

Presuming that standard setting bodies generally intend like transactions to be accounted for in a like way, this standard design suggests that firms are expected to be very interested in applying hedge accounting rules, so that there is no need to force application. This notion is confirmed e.g. by Trombley (2003), who states: “Companies that engage in hedging activities would like very much to be allowed to use hedge accounting…” It rests upon the belief that hedge accounting produces superior information to be passed on to investors and thus benefits firms.

Consequently, most of the previous studies on hedge accounting investigated information effects. These studies, however, identified costs associated with hedge accounting, at least if specific rules are applied.
E.g. Melumad et al (1999) show that the information transmitted via hedge accounting affects the firm’s incentive to hedge. They find that all hedge accounting rules approved according to SFAS 133 lead to distortions from the optimal economic hedge.

Barnes (2001) considers distortions from optimal hedges as a consequence of hedge accounting within a signaling model. He finds that mark-to-market accounting might motivate bad firms to speculate to pool with good firms and to fool the market.

Finally, Hughes et al (2002) focus on the effect of additional disclosure requirements on forward contracting. In a duopoly model with a privately informed producer they identify a trade-off between a first mover advantage on the one hand and the revelation of private information to rivals on the other hand given the forward position has to be disclosed.

Contrary to these studies, Jorgensen (1997) analyzes hedge accounting within a moral hazard setting and therefore considers “control effects” rather than information effects. In his model the manager needs to collect costly information in the first place to be able to hedge. He compares the effect of alternative hedge accounting rules and finds that mark-to-market accounting causes distortions from the first best hedging strategy while deferral accounting does not.

In this paper we study incentives for hedging and hedge accounting in the presence of a moral hazard problem similar to Jorgensen (1997). Hence we also focus on control problems arising from hedging/hedge accounting. However, in our model hedging is assumed to be costless and publicly observable. Accordingly, the principal is in a position either to hedge himself or to force the agent to do so. The moral hazard problem in our setting arises from unobservable effort to be performed by the agent. Managerial compensation is based on accounting income and hence hedging/hedge accounting affects incentive contracting.

We show in a first step that hedging is generally favourable in our setting compared to no hedging. Given this result we compare hedge accounting to no hedge accounting, rather than
to consider alternative accounting rules. Our analysis shows that hedge accounting possibly aggravates the moral hazard problem and in turn increases agency costs. Thus we identify a possible motive for firms to choose not to apply hedge accounting rules and provide an (additional) argument to doubt conventional wisdom in favour of hedge accounting.

The paper proceeds as follows: In section 2 we characterize the model. Section 3 presents the principal’s optimization problems. Section 4 compares hedging to no hedging. In section 5 we study hedge accounting as opposed to no hedge accounting. Our results are summarized and discussed in section 6.

2 The Model

We assume a firm lives for two periods. It is owned by a principal but run by a professional manager. The manager privately performs an effort in each period that affects the firm’s income. Gross of hedging effects and management compensation, the firm produces the following income in each period:

\[
x_1 = a_1 + \theta_1 \quad \theta_1 \sim N(0, \sigma^2 k), \quad k > 0.
\]

\[
x_2 = a_2 + \theta_2 + \eta \quad \theta_2 \sim N(0, \sigma^2), \quad \eta \sim N(\mu_\eta, \sigma^2)
\]

First period income \(x_1\) is determined by the manager’s first period effort \(a_1\) and a shock \(\theta_1\). Second period income \(x_2\) is composed of second period effort \(a_2\) and two random shock terms, \(\theta_2\) and \(\eta\). \(\theta_1\) and \(\theta_2\) are related to the firm’s production process and can neither be hedged nor observed by the principal. \(\eta\) refers to a price shock that is publicly observable and can be hedged to some extent.

The production shocks \(\theta_1\) and \(\theta_2\) may differ with respect to variances as \(\text{Var}(\theta_1)\) is a multiple of \(\text{Var}(\theta_2)\). The parameter \(k\) measures the relative magnitude of production risk in
period 1 compared to period 2 as \( k = \frac{\text{Var}(\theta_1)}{\text{Var}(\theta_2)} \) and will turn out to be crucial for our results.

Alterations in \( k \) allow to capture settings in which production risk, and in turn overall income risk, prevails either in period 1 or period 2.\(^7\)

Furthermore we assume that \( \text{Var}(\theta_2) = \text{Var}(\eta) = \sigma^2 \) and that all shocks are mutually independent i.e. \( \text{Cov}(\theta_1, \theta_2) = \text{Cov}(\theta_i, \eta) = 0 \) for \( i = 1,2 \). This particular model design allows to keep the analysis as simple as possible but is still flexible enough to capture substantial effects.

The price shock \( \eta \) is realized in the first period but affects second period income. To be precise, we assume that the firm intends to sell some products in period 2. The product price is subject to change in period 1 but the change affects profit in period 2 when revenues are recorded. Part of the firm’s exposure to price risk can be hedged if the firm decides to enter into a cash flow hedge of the forecast transaction. In other words the firm has the opportunity to sell a given fraction \( y \in (0,1] \) of the products to be delivered in period 2 at a specified price in the forward market. \( y \) is restricted to positive numbers below (or equal to) one as we do not consider the possibility of speculation. The hedging opportunity and the price shock are observed by the principal.

Note that we restrict our analysis to a setting in which second period cash flow is hedged in period 1. In other words we do neither consider hedges of first period risk in period 1 nor hedges of second period risk in period 2. These alternative hedging strategies have been skipped. They cannot possibly add any insights to our study of accounting as, by construction, there is no difference between hedge accounting being used or not within a single period setting.
The market for derivatives is risk neutral and, for simplicity, we set the riskless interest rate to zero. In such a setting the fair price agreed upon in the forward contract equals the expected spot price at settlement date which is \( y \mu \).

When the forward contract is signed, its fair value of course is zero, \( f_0 = 0 \).

Once the price shock is realized, the forward value adapts to reflect the gain or loss from selling in the derivatives market rather than in the spot market. We get

\[
f_1 = y(\mu - \eta).
\]

The change in fair value that affects income equals \( f_1 - f_0 = f_1 \).

Including the derivatives market transaction, the firm’s lifetime income changes as follows:

\[
x_1 + x_2: \quad a_1 + a_2 + \theta_1 + \theta_2 + \eta \\
+ f_1: \quad y(\mu - \eta) \\
= \quad a_1 + a_2 + \theta_1 + \theta_2 + y\mu + (1 - y)\eta
\]

Taking a single period perspective, the effect of hedging on (accounting) income \( \pi_1 \) in period 1 and 2 depends on whether hedge accounting is used or not. If it is not used (NHA), the hedging instrument is recorded at fair value at \( t = 1 \) and the change in value \( f_1 \) is recognized in income. This results in the following expressions for period 1 and period 2 income:

\[
\pi_1^{NHA} = x_1 + f_1 = a_1 + \theta_1 + y(\mu - \eta) \\
\pi_2^{NHA} = x_2 = a_2 + \theta_2 + \eta
\]

If hedge accounting is used (HA), the change in fair value is shown in equity at \( t = 1 \) and affects income in \( t = 2 \). This follows, of course, from our construction of a perfect hedge that avoids any ineffectiveness. The change in fair value of the forward contract completely offsets the price change in the portion of products hedged. Accordingly the complete change
in forward value is recorded in equity rather than income in $t = 1$ and is reclassified to income in $t = 2$ when revenues from the hedged item are realized.

Income in each period becomes

$$\pi_1^{HA} = x_1 = a_1 + \theta_1$$

$$\pi_2^{HA} = x_2 + f_1 = a_2 + \theta_2 + y\mu_\eta + (1 - y)\eta.$$ 

We assume that both parties commit to a two-period contract. The principal is risk neutral and maximizes income net of management compensation. Assuming that the clean surplus relation holds and given a riskless interest rate of zero, the sum of net income is equivalent to residual firm value at $t = 2$.

The manager is risk averse and effort averse. His preferences are represented by a negative exponential utility function that is multiplicatively separable over periods:

$$U(\cdot) = -\exp[-r(\cdot)]; \ r > 0 \ \text{reflects the parameter of risk aversion.}$$

This type of utility function combined with our assumption of a riskless interest rate of zero ensures that only total compensation matters for the manager. Neither the timing of pay nor the timing of consumption affect his utility. Accordingly, consumption smoothing effects are not an issue, enabling us to work out the relative-period-risk effect we do focus on in an unobscured way.

Each effort performed causes a disutility of $\frac{a_i^2}{2}$, $i = 1, 2$. As the principal is unable to observe or to infer the manager’s effort in either period, a moral hazard problem is present. To motivate appropriate effort, the principal offers the agent an incentive contract $V$ based on accounting income in each period.

We restrict the incentive contract to be linear:

$$V = s_1\pi_1 + s_2\pi_2 + S.$$
Linearity is necessary to satisfy the properties of the so called LEN-model we are going to use in our analysis. The LEN framework is used in many contributions to the literature as it typically facilitates closed form solutions. Moreover, linear contracts are frequently observed empirically and therefore worth being analyzed.

$s_i, i = 1,2$ denote the share in period income while $S$ is a fixed compensation. As mentioned above the timing of payment is unimportant in our setting. A reasonable presumption, however, is to assume that first period performance pay $s_1\pi_1$ together with some fraction of $S$ is paid at the end of the first period while $s_2\pi_2$ and the other fraction of $S$ is paid after second period accounting income has been observed.

Using accounting income as performance measure is essential to be able to study the effect of hedge accounting rules on incentive contracting. This becomes clear from the following simple consideration: If the principal were free to adapt the performance measures used, he could e.g. apply hedge accounting rules but create performance measures that equal accounting income in each period as if hedge accounting is not used. The opposite of course would be equally feasible so that accounting becomes completely irrelevant for incentive contracting.

However, the principal’s discretion in performance measure choice is typically limited in some respects. One limitation is contracting costs involved with overly sophisticated contracts. Another one is that performance measures need to be contractible to be applicable, that is they need to be observable and verifiable by a third party, e.g. a court. Both limitations may well prevent adjustments of the kind described above. Accounting income, in contrast, is an audited measure and is one of the performance measures used most frequently by firms.
An adjustment that is reasonably assumed, however, is one that excludes hedging effects completely. It resembles the use of operating income rather than net income for performance measurement. In our simple model, such an adjustment is equivalent to a setting in which the firm decides not to hedge at all. We will consider this alternative in section 4.

The course of the game is depicted in figure 1.

*Insert figure 1 about here.*

The principal offers an incentive contract as described above that is either signed or rejected by the manager. The contract fixes the payment coefficients $s_t$, the fixed payment $S$, as well as the hedging choice and, if the firm decides to hedge, the hedge accounting method to be applied. As mentioned above, we assume that the principal is aware of the hedging opportunity and observes the price shock. Thus he is in a position to perform the hedge himself or to instruct the agent to do so. Both alternatives are equivalent if the principal can force the agent to behave in a certain way. For simplicity we assume throughout our analysis that the principal decides upon hedging. Once the contract is signed and the hedging decision is made, the agent performs his first effort. Price shock $\eta$ is realized and affects the value of the hedging instrument and, depending on the accounting choice, the first period income realization.

In the second period the agent performs another effort. In period 2 the products are sold and delivered either in the spot market or in the derivatives market. At $t = 2$ the second period income is realized, the firm is liquidated and the principal receives the residual firm value.
3 The principal’s decision problem

The principal decides upon a hedging strategy and fixes the coefficients of the manager’s compensation contract in order to maximize his objective function. The hedging decision contains two steps as illustrated in figure 2.

*Insert figure 2 about here.*

Given a hedging opportunity is available, the principal chooses in a first step to hedge or not to hedge. If he decides to hedge he may opt for or against hedge accounting.

In what follows we consider the principal’s contracting problem separately for each hedging strategy. Thus we determine the optimal compensation coefficients for a given hedging decision. The optimal hedging/compensation strategy is identified by comparing the results.

Alternative hedging strategies affect income variances but leave expected income unaffected. Accordingly, the principal’s optimization problems differ only in managerial compensation risk $Var(V^U)$. Thus we state the principal’s problems as follows:

$$\max_{s_1,a_1,a_2,S} a_1 + a_2 + \mu - s_1a_1 - s_2(a_2 + \mu) - S \quad s.t. \quad s_1a_1 + s_2(a_2 + \mu) + S - \frac{a_1^2}{2} - \frac{a_2^2}{2} - \frac{r}{2} Var(V^U) \geq 0$$  \hfill (PC)

$$a_1 = \arg \max_{a_1} s_1a_1 - \frac{a_1^2}{2} \quad \hfill (ICC1)$$

$$a_2 = \arg \max_{a_2} s_2a_2 - \frac{a_2^2}{2} \quad \hfill (ICC2)$$

$$Var(V^{NH}) = \sigma^2(s_1^2k + 2s_2^2)$$

$$Var(V^{NHA}) = \sigma^2[s_1^2k + s_2^2 + (s_2 - s_1y)^2]$$

$$Var(V^{HA}) = \sigma^2[s_1^2k + s_2^2 + (s_2 - s_2y)^2].$$
The principal maximizes his objective function subject to three constraints. The first one is the manager’s participation constraint (PC). In accordance with the LEN-model setup applied, we represent the manager’s preferences in terms of his certainty equivalent rather than expected utility.\textsuperscript{13} The participation constraint ensures that the manager receives his reservation utility. We normalize the certainty equivalent of reservation utility to zero without loss of generality.

The second and third constraint are the incentive compatibility constraints (ICC). Using a first order approach, they reflect the fact that in a second best setting the agent chooses the effort that maximizes his personal utility.\textsuperscript{14}

### 3.1 Solutions to the principal’s problems

To calculate explicit solutions and to ease the interpretation of our results, it is convenient to rephrase the optimization problems above. Evaluating the ICCs results in $s^*_1 = a^*_1$ and $s^*_2 = a^*_2$, which is a standard result in the LEN-Model. Moreover, the PCs are binding at the optimum.\textsuperscript{15} Accordingly, we obtain unconstrained problems from inserting into the principal’s objective functions. We define

\[
OF^{NH}(s_1, s_2) = s_1 + s_2 + \mu + S_1^2 - 2S_2^2 - \frac{1}{2} \sigma^2 [S_1^2k + 2S_2^2] \tag{1}
\]

\[
OF^{NHA}(s_1, s_2) = s_1 + s_2 + \mu + S_1^2 - 2S_2^2 - \frac{1}{2} \sigma^2 [S_1^2k + S_2^2 + (s_2 - s_1)^2] \tag{2}
\]

\[
OF^{HA}(s_1, s_2) = s_1 + s_2 + \mu + S_1^2 - 2S_2^2 - \frac{1}{2} \sigma^2 [S_1^2k + S_2^2 + (s_2 - s_2)^2]. \tag{3}
\]

Optimizing with respect to $s_1$ and $s_2$ we obtain the following solutions:

**Without hedging:**

\[
s^*_{1NH} = a^*_{1NH} = \frac{1}{1 + kr\sigma^2}, \quad s^*_{2NH} = a^*_{2NH} = \frac{1}{1 + 2r\sigma^2}.
\]
\[ OF_{NH^*} = \frac{S_1^{NH^*} + S_2^{NH^*}}{2} + \mu_\eta = \frac{2 + (2 + k)r\sigma^2}{2(1 + 2r\sigma^2)(1 + kr\sigma^2)} + \mu_\eta \]

Without hedge accounting:

\[ s_1^{NHA^*} = a_1^{NHA^*} = \frac{1 + r\sigma^2(2 + y)}{1 + r\sigma^2(2 + k + y^2) + r^2\sigma^4(2k + y^2)} \]

\[ s_2^{NHA^*} = a_2^{NHA^*} = \frac{1 + r\sigma^2(k + y + y^2)}{1 + r\sigma^2(2 + k + y^2) + r^2\sigma^4(2k + y^2)} \]

\[ OF_{NHA^*} = \frac{s_1^{NHA^*} + s_2^{NHA^*}}{2} + \mu_\eta = \frac{2 + r\sigma^2(2 + k + 2y + y^2)}{2 + 2r\sigma^2(2 + k + y^2) + 2r^2\sigma^4(2k + y^2)} + \mu_\eta \]

With hedge accounting:

\[ a_1^{HA^*} = s_1^{HA^*} = \frac{1}{1 + kr\sigma^2} \]

\[ a_2^{HA^*} = s_2^{HA^*} = \frac{1}{1 + r\sigma^2[(1 - y)^2 + 1]} \]

\[ OF_{HA^*} = \frac{s_1^{HA^*} + s_2^{HA^*}}{2} + \mu_\eta = \frac{2 + r\sigma^2(2 + k - 2y + y^2)}{2(1 + kr\sigma^2)[1 + r\sigma^2[(1 - y)^2 + 1]]} + \mu_\eta \]

4 Hedging versus no hedging

Starting with the first step of the principal’s decision problem as described above, we need to determine whether hedging is favourable compared to no hedging.

To prove that hedging is preferred, it is sufficient to show that hedging in combination with either hedge accounting or no hedge accounting is favourable. Accordingly the following inequality must be satisfied:

\[ \max\{OF_{NHA^*}, OF_{HA^*}\} > OF_{NH^*} \quad \forall \quad y \in (0,1], \quad r > 0, \quad \sigma > 0, \quad k > 0 \]

We prove that this is true in appendix B.

Proposition 1:

Hedging is strictly beneficial for the principal compared to no hedging.
We have demonstrated already in section 3 that alternative hedging strategies cause optimization problems that differ only with respect to managerial compensation risk. The manager’s compensation, however, is based on accounting income. Thus we examine the effect of hedging/no hedging on income variances to provide insights into the result from proposition 1. As in the proof of proposition 1, it suffices to consider no hedging as opposed to hedge accounting. Comparing the income variances in each period shows the following:

*Insert table 1 about here.*

First period income risk is identical in both settings. Second period income risk is lower with hedge accounting compared to no hedging as \([(l - y)^2 + 1] < 2\) for all \(y \in (0,1]\). For a given compensation contract, lower income variance translates into lower compensation risk. Lower compensation risk in turn reduces the risk premium required by the manager and allows to motivate effort at a lower cost. Thus optimal effort in period 2 is higher with hedge accounting than without hedging. This is readily observed from section 3.1 as \(a_{2}^{HA*} = s_{2}^{HA*} > a_{2}^{NH*} = s_{2}^{NH*}\). Within our model setup the principal captures all rents, thus it is him who benefits from hedging.

5 Hedge accounting versus no hedge accounting

Having identified hedging to be a favourable strategy, the next step is to compare alternative accounting treatments. We find, however, that the principal’s preferences are contingent on parameter values rather than to be unique. To analyze how the principal’s preferences relate to relative period risk exposure, we treat the parameter \(k\) as variable in what follows. Recall from section 2 that \(k\) is a measure of the relative magnitude of production risk in period 1 as
compared to period 2 defined \( k = \frac{\text{Var}(\theta_1)}{\text{Var}(\theta_2)} \). We determine whether hedge accounting or no hedge accounting is preferred as a function of \( k \) in proposition 2.

**Proposition 2:**

(i) Whether the principal prefers hedge accounting or no hedge accounting depends on parameter values \( r, \sigma, k \), and \( y \).

(ii) For some given \( r > 0, \sigma > 0 \), and \( y \in (0,1) \) a lower bound \( \bar{k}(r, \sigma, y) \) and an upper bound \( \underline{k}(r, \sigma, y) \) exist, \( \underline{k}(\cdot) < \bar{k}(\cdot) \), so that the principal strictly prefers no hedge accounting for \( k \in (\underline{k}(\cdot), \bar{k}(\cdot)) \); \( \underline{k}(\cdot) \geq 0 \) and \( \bar{k}(\cdot) < 2 \). Outside this range the principal prefers hedge accounting.

(iii) For \( y = 1 \) \( \bar{k}(r, \sigma, 1) = \bar{k}(r, \sigma, 1) = 1 \) \( \forall \ r, \sigma \). The principal prefers hedge accounting to no hedge accounting for \( k \neq 1 \) and is indifferent for \( k = 1 \).

We illustrate the results from proposition 2 in figure 3 and 4 below. Both plots assume parameter values of \( r = .5 \) and \( \sigma = 2 \). Thus they exemplify the results rather than to be exhaustive.

As in the proof of proposition 2 we examine the difference in (optimal) objective function values with and without hedge accounting.\(^{16} \) We define \( \Delta = \text{OF}^{\text{HHA}} - \text{OF}^{\text{NHA}} \). If \( \Delta > 0 \) the principal prefers no hedge accounting to hedge accounting and vice versa.

*Insert figure 3 about here.*

Figure 3 plots \( \Delta \) as a function of \( k \) for \( y = 0.1, 0.5, \) and 1. For \( y = 0.5 \) and 1 \( \Delta(k) \) is a bell shaped function. With \( y = 0.1 \) it is monotonically decreasing in \( k \).\(^{17} \) For larger \( y \)’s the range
of \( k \)'s that produce \( \Delta(k) > 0 \) decreases. At \( y = 1 \) the nulls coincide at \( k = 1 \) and the principal prefers hedge accounting for all \( k \neq 1 \). Negative values for \( \Delta(k) \) are obtained for \( k \) sufficiently large.

*Insert figure 4 about here.*

Figure 4 shows the nulls of \( \Delta(k) \) as a function of \( y \). Thus both curves depict points of indifference between hedge accounting and no hedge accounting. \( k^0_1 \) refers to the lower, \( k^0_2 \) to the upper null. At \( k^0_1 \) the principal’s preferences move from hedge accounting to no hedge accounting. At \( k^0_2 \) this switch of preferences reverses. Accordingly, the area within the two curves contains pairs of \((y, k)\) for which the principal prefers not to use hedge accounting. Outside this area hedge accounting is preferred.

The principal prefers hedge accounting if \( k \geq 2 \) for all \( y \). This result generalizes to all \( r, \sigma \) as shown in proposition 2. He also tends to prefer hedge accounting for high \( y \) and low \( k \). For \( k < 2 \) and very low \( y \) he almost certainly prefers no hedge accounting. If \( y = 1 \) the nulls coincide at \( k = 1 \) which, from proposition 2, is a general result as well.

To provide further insights and to develop the economic intuition for our results, it is a useful starting point again to compare income variances. We extend table 1 to include no hedge accounting in table 2.

*Insert table 2 about here.*

Compared to no hedging (NH), hedge accounting (HA) leaves first period income risk unaffected and reduces second period income risk. This has been shown in section 4. In
contrast, compared to no hedging (NH), no hedge accounting (NHA) increases first period income risk, leaves second period income risk unaffected and creates a negative inter-period covariance risk. Overall income risk is identical for HA and NHA as shown in the bottom line of table 2.

The agent’s compensation risk, however, is determined not only by income risk but by the payment coefficients $s_i^{(i)}$, $i=1,2$ fixed by the principal. Whether HA or NHA allows the principal to better trade off risk and return by choosing $s_i^{(i)}$ optimally, depends on the relative income risk exposure over periods, driven by $k$ and $y$.

To work out the details, we reformulate the principal’s objective function without hedge accounting (2) so that it equals the objective function with hedge accounting (3) plus an additional term:

$$OF^{NHA}(s_1, s_2) = s_1 + s_2 + \mu - \frac{s_1^2}{2} - \frac{s_2^2}{2} - \frac{r}{2} \sigma^2 [s_1^2 k + s_2^2 + (s_2 - s_1 y)^2] - \frac{r}{2} \sigma^2 y(s_1 - s_2) [(s_1 + s_2) y - 2s_2] =$$

$$= OF^{HA}(s_1, s_2) - \frac{r}{2} \sigma^2 y(s_1 - s_2) [(s_1 + s_2) y - 2s_2]$$

Evaluating the objective function value at $s_1^{HA*}$ and $s_2^{HA*}$ we obtain:

$$OF^{NHA}(s_1^{HA*}, s_2^{HA*}) = OF^{HA*} - \frac{r}{2} \sigma^2 y(s_1^{HA*} - s_2^{HA*}) [(s_1^{HA*} + s_2^{HA*}) y - 2s_2^{HA*}]$$

Obviously $OF^{NHA}(s_1^{HA*}, s_2^{HA*}) > OF^{HA*}$ if $\frac{r}{2} \sigma^2 y(s_1^{HA*} - s_2^{HA*}) [(s_1^{HA*} + s_2^{HA*}) y - 2s_2^{HA*}] < 0$.

At the optimum, however, we typically find $s_1^{NHA*} \neq s_1^{HA*}$ and/or $s_2^{NHA*} \neq s_2^{HA*}$ to get

$$OF^{NHA*} = OF^{HA*}(s_1^{NHA*}, s_2^{NHA*}) - \frac{r}{2} \sigma^2 y(s_1^{NHA*} - s_2^{NHA*}) [(s_1^{NHA*} + s_2^{NHA*}) y - 2s_2^{NHA*}]$$

with $OF^{HA*}(s_1^{NHA*}, s_2^{NHA*}) < OF^{HA*}$. 

It follows that for NHA to be favourable compared to HA the second expression in (4)
\[
\frac{r}{2} \sigma^2 y (s_1^{\text{NHA}^*} - s_2^{\text{NHA}^*}) [(s_1^{\text{NHA}^*} + s_2^{\text{NHA}^*})y - 2s_2^{\text{NHA}^*}] \tag{5}
\]

needs to be sufficiently negative to compensate for the reduction in the first part of (4).

Investigating necessary conditions for (5)\(\ll 0\) the role of \(k\) and \(y\) becomes apparent:

(5) becomes negative if and only if

\[s_1^{\text{NHA}^*} > s_2^{\text{NHA}^*} \quad \text{and} \quad (s_1^{\text{NHA}^*} + s_2^{\text{NHA}^*})y - 2s_2^{\text{NHA}^*} < 0.\tag{6}\]

Inserting the optimal solutions for \(s_1^{\text{NHA}^*}\) and \(s_2^{\text{NHA}^*}\) presented in section 3.1 into (6) and (7) and rearranging terms we get

\[k < 2 - y^2 \quad \text{and} \quad k > \frac{r\sigma^2_y^3 - 2(1 - y)}{r\sigma^2(2 - y)}. \tag{6'}\]

For both inequalities to be fulfilled, we require \(k\) to be neither too low nor too high and \(y\) not to be too high: (6’) is violated if \(k\) and \(y\) are sufficiently high. For \(k \geq 2\) (6’) is violated for all \(y \in (0,1)\) and HA is preferable. In addition, (7’) is violated for \(k\) sufficiently low and \(y\) sufficiently high. Note that the right hand side of (7’) is increasing in \(y\).\(\tag{7'}\)

Thus HA is also preferable for combinations of \(k\) low/\(y\) high. This is consistent with our findings in proposition 2 as well as with figure 4.

To conclude, moderate levels of \(k\) and \(y\) are required for the principal to be able to trade off risk and return in incentive contracting more efficiently without hedge accounting than with hedge accounting. Moderate levels of \(k\) and \(y\), however, go along with income risks that do not differ considerably over time. If the firm’s risk exposure stemming from non hedgable production risk and partly hedgable sales risks, as assumed in the model description in section
is smooth over both periods, no hedge accounting is efficient. Conversely, hedge accounting is efficient whenever risk exposure is unbalanced over periods.

6 Summary and extensions

US-GAAP as well as IAS (IFRS) contain specific accounting regulations for hedging activities. Basically hedge accounting rules ensure that an offsetting gain or loss from a hedging instrument affects earnings in the same period as the gain or loss from the hedged item.

As application of hedge accounting rules is in fact optional for companies, this paper analyzes incentives to apply these rules in the presence of a moral hazard problem.

In a first step we establish that hedging is generally favourable in our setting as opposed to no hedging. Comparing alternative accounting treatments, we find that hedge accounting is either favourable or detrimental depending on parameter values. Both alternatives differ in their effect on income risk and hence compensation risk. Whether the principal is able to trade off risk and return more efficiently with or without hedge accounting specifically depends on the relative magnitude of period risk exposure, reflected in the parameter \( k \). For almost all parameter values there exists some range of \( k \) for which no hedge accounting is favourable compared to hedge accounting.

Our results, however, have been obtained within a very simple setting. This allows to keep the analysis tractable and to capture first order effects but also involves a number of restrictive assumptions. Hence we discuss some straightforward extensions to the model in what follows. Throughout our analysis we have assumed that hedging as well as hedge accounting is costless. In the real world, however, either transaction costs or reporting costs, or both, are possibly involved with hedging. Transaction costs are related to hedging itself, and thus
independent of the accounting choice. They reduce net benefits from hedging. In terms of our model, the principal would prefer hedging if and only if benefits from reduced risk exposure exceed costs. Put another way, hedging remains beneficial in the presence of transaction costs if the manager’s risk aversion is sufficiently high.

Reporting costs certainly prevail if specific hedge accounting is used. As mentioned in the introduction, hedge accounting rules require firms to document a hedge in detail and to assess hedging effectiveness on an ongoing basis. This might be not only burdensome but also costly. Including reporting costs reduces benefits from hedge accounting as compared to no hedge accounting and thus adds to our result that hedge accounting is not favourable by all means.

Furthermore we presume in our model that the hedging opportunity \( y \) is exogenously given. This assumption is reasonable for a non-standardized bilateral forward contract. It is problematic if derivatives written on the product considered are traded in a regular market. In the latter case one would rather assume that the firm is free to choose the fraction to be hedged. Anyhow, modelling \( y \) as a choice variable combined with transaction costs depending on \( y \) yields results qualitatively similar to ours.

Finally, the model could be extended in at least two more directions that we leave to future research: First, the assumption of publicly observable hedging decisions could be relaxed to assume that the manager, rather than the principal, decides upon hedging/hedge accounting. In such a setting hedging would certainly continue to be favourable. To what extent the manager complies with the principal’s favoured accounting treatment is difficult to assess.

Second, the assumption that two-period contracts are feasible could be relaxed. If we allow the agent to leave after the first period, our results are likely to change. However, given the analysis carried out, our results provide a strong argument contrary to the prevalent assumption that hedge accounting is generally favourable.
From a firm’s perspective it suggests that companies should be aware of possible agency costs occurring from hedge accounting if they use accounting income as performance measure.

From a standard setter’s view our result is potentially meaningful as well. Standard setter’s prime objective is typically to provide investors with highly relevant information. If a standard setting body believes that the information contained in financial statements is more relevant with hedge accounting than without, they probably want to ensure that hedge accounting rules are indeed applied, even though this imposes additional costs on firms. Given this presumption our findings may call for a change in rules to force firm’s to use hedge accounting whenever applicable.
Appendix A

Our model setup ensures that accounting income is normally distributed and the agent’s compensation is linear in income. Combined with the exponential utility function of the manager it satisfies the properties of the LEN-model. Within a LEN-framework the certainty equivalent of expected utility turns out to be of the form

\[ CE = E(W) - \frac{1}{2} r \text{Var}(W) \]

with \( E(W) = E(V^{(i)} - \frac{a_{11}^2}{2} - \frac{a_{22}^2}{2}) = E(V^{(i)}) - \frac{a_{11}^2}{2} - \frac{a_{22}^2}{2} \)

and \( \text{Var}(W) = \text{Var}(V^{(i)}) \).

We obtain the following expressions for \( E(V^{(i)}) \) and \( \text{Var}(V^{(i)}) \):

(i) Without Hedging (NH):

\[ V^{NH} = s_1(a_1 + \theta_1) + s_2(a_2 + \theta_2 + \eta) + S \]

\[ E(V^{NH}) = s_1 a_1 + s_2 (a_2 + \mu_\eta) + S \]

\[ \text{Var}(V^{NH}) = s_1^2 \sigma_1^2 k + 2s_2^2 \sigma_2^2 = \sigma^2 (s_1^2 k + 2s_2^2) \]

(ii) Setting without hedge accounting:

\[ V^{NHA} = s_1[a_1 + \theta_1 + y(\mu_\eta - \eta)] + s_2 (a_2 + \theta_2 + \eta) + S \]

\[ E(V^{NHA}) = E(V^{NH}) \]

\[ \text{Var}(V^{NHA}) = s_1^2 \sigma_1^2 k + s_2^2 \sigma_2^2 + (s_2 - s_1 y)^2 \sigma^2 = \sigma^2 [s_1^2 k + s_2^2 + (s_2 - s_1 y)^2] \]

(iii) Setting with hedge accounting:

\[ V^{HA} = s_1(a_1 + \theta_1) + s_2[a_2 + \theta_2 + y\mu_\eta + (1-y)\eta] + S \]

\[ E(V^{HA}) = E(V^{NH}) \]

\[ \text{Var}(V^{HA}) = s_1^2 \sigma_1^2 k + s_2^2 \sigma_2^2 + s_2^2 (1-y)^2 \sigma^2 = \sigma^2 [s_1^2 + s_2^2 + (s_2 - s_2 y)^2] \]
Appendix B

Proof of proposition 1:

To show that hedging is favourable we compare the optimal solution without hedging to the one with hedge accounting.

\[ OF^{HA^*} - OF^{NH^*} = \frac{r\sigma^2(2-y)y}{2(1+2r\sigma^2)[1+r\sigma^2((1-y)^2+1)]} > 0 \ \ \forall \ \ y \in (0,1], \ r > 0, \ \sigma > 0 \]

\[ \square \]

Proof of proposition 2:

(i) We define \( \Delta \equiv OF^{NH^*} - OF^{HA^*} \). For \( \Delta > 0 \) the principal prefers no hedge accounting. For \( \Delta < 0 \) hedge accounting is preferred. Inserting and rearranging terms we get:

\[ \Delta = \frac{[r^2\sigma^4y[4+k^2r\sigma^2(y-2)-y[6-2y+r\sigma^2((1-y)^2+1)]+k[2(y-1)+r\sigma^2(4-3y+y^3)]]]}{2[1+k\rho\sigma^2][1+r\sigma^2((1-y)^2+1)][1+r\sigma^2(2+k+y^2)+r^2\sigma^4(2+k+y^2)]} \]

\( \Delta \) is a function of the parameters \( r, \sigma, k, y \) with \( r > 0, \sigma > 0, k > 0, y \in (0,1] \).

The denominator is positive in the feasible domain, thus the function is continuous.

In what follows we examine \( \Delta \) as a function of \( k \) holding the other parameters constant. To prove that the principal prefers hedge accounting in some settings and no hedge accounting in others, it suffices to show that \( \Delta(k) \) has at least one null within the feasible domain. Solving the numerator for \( k \) we identify two nulls:

\[ k_1^0 = \frac{r\sigma^2(4-3y+y^3)+(1-y)(-2-\sqrt{v})}{2r\sigma^2(2-y)} \]

\[ k_2^0 = \frac{r\sigma^2(4-3y+y^3)+(1-y)(-2+\sqrt{v})}{2r\sigma^2(2-y)} \]

with
\[ v = 4 + 4r\sigma^2(4 - y + y^2) + r^2\sigma^4[16 - 8y + y^2(1 + y)^2]. \]

As \( \sqrt{v} > 2 \) it follows that \( k_2^0 > 0 \), thus at least one null is in the feasible domain. The lower null, \( k_1^0 \), is either below or above zero.

(ii) To prove that the principal prefers no hedge accounting for some \( k \in (\underline{k}, \bar{k}) \), \( k < \bar{k} \) we show that a) \( k_1^0 < k_2^0 \) and b) \( \Delta(k) > 0 \) for \( k \in (k_1^0, k_2^0) \) given that \( y \in (0,1) \).

a) \( k_2^0 - k_1^0 = \frac{(1 - y)\sqrt{v}}{r\sigma^2(2 - y)} > 0 \quad \forall \ y \in (0,1), r > 0, \sigma > 0 \)

b) \( \Delta(k) \) has two extreme points:

\[ k_1^* = \frac{-2 + r\sigma^2[4 + y(1 + y + r\sigma^2y)]}{r\sigma^2[2 + r\sigma^2(4 + y)]} \]

\[ k_2^* = \frac{-1 + (1 + r\sigma^2)y}{r\sigma^2} \]

\( k_1^* < 0 \) and therefore outside the feasible domain.

\( k_2^* \) is either positive or negative. It is a local maximum as

\[ \Delta'(k_2^*) = -\frac{r^3\sigma^6}{(1 + r\sigma^2)^3y^6[1 + r\sigma^2(2 + y)]} < 0. \]

It is straightforward to show that

\( k_1^0 < k_2^* < k_2^0 \) for \( y \in (0,1), r > 0, \sigma > 0 \).

Thus \( \Delta(k) \) is a bell shaped function. This implies \( \Delta(k) > 0 \) for \( k \in (k_1^0, k_2^0) \).

We get \( \underline{k} = \max \{0, k_1^0\} \) and \( \bar{k} = k_2^0 \).

To show that \( \bar{k} = k_2^0 < 2 \) we insert \( k = 2 \) into \( \Delta(k) \) to get:
\[
\Delta(2) = \frac{r^2 \sigma^4 y^2 [2(y-1) + r \sigma^2 (-4 + 2y + y^2)]}{2(1 + 2r \sigma^2)[1 + r \sigma^2 ((1-y)^2 + 1)][1 + r \sigma^2 (1 + r \sigma^2)(4 + y^2)]} < 0
\]

While \( \Delta(2) < 0 \ \forall \ y \in (0,1) \), \( r > 0, \sigma > 0 \) and accordingly \( k_2^0 < 2 \) we obtain for arbitrary small values of \( y \)

\[
\lim_{y \to 0} \Delta(2) = 0
\]

and accordingly

\[
\lim_{y \to 0} k_2^0 = 2.
\]

Thus \( k_2^0 < 2 \) but approaches 2 for very low \( y \).

(iii) For \( y = 1 \) we get \( k_1^0 = k_2^* = k_2^0 = 1 \) for all \( r, \sigma \).

When \( y = 1 \) is inserted into \( \Delta(k) \) the expression simplifies to

\[
\Delta(k, y = 1) = -\frac{(k-1)^2 r^3 \sigma^6}{2(1 + r \sigma^2)(1 + kr \sigma^2)[1 + r \sigma^2 [3 + k + (1 + 2k)r \sigma^2]]}
\]

\( \Delta(k, y = 1) = 0 \) for \( k = 1 \) and \( \Delta(k, y = 1) < 0 \) for \( k \neq 1 \). \( \square \)
Notes

1. SFAS 133 has been published in 1998. It revised hedge accounting rules comprehensively superseding a number of previously issued standards. SFAS 138 and 149 contain some minor amendments w.r.t. very specific problems. The latest revision of IAS 32 and 39 has been published in December 2003. Since then some minor amendments have been integrated into IAS 39 throughout 2004 and 2005. Further Exposure Drafts are still subject to discussion.


4. Such intention is documented e.g. in the IASB preface P-4 (13).


7. Different risk exposures over periods possibly stem from different products or parts of products produced in both periods. Alternatively one might assume that production processes last two periods and that either early steps or final steps in the process are subject to higher risk.

8. Contrary to the principal we assume that the manager is not perfectly diversified. This is reasonable to assume as managers typically face compensation and future career risks that account for a large fraction of their overall risk exposure and are difficult to diversify.


11. Note that this contract design incorporates a contract that compensates the agent based on overall income, \( \pi_1 + \pi_2 \), as the principal is free to choose \( s_1 = s_2 = s \).

12. E.g. Murphy (1999) pp. 2500-2502 states that virtually all large US corporations use bonus plans as part of management compensation and that earnings are the most heavily used performance measure in these plans.

13. Details are given in appendix A.

14. The properties of the LEN-model ensure that first order conditions are sufficient to characterize the agent’s effort choice. See e.g. Datar et al (2000).

15. This is ensured by choosing the fixed payment \( S \) appropriately. The fixed payment, however, has no role in the rest of the analysis and we do not present explicit solutions in what follows.

16. See Appendix B.

17. In fact with \( y = .1 \) \( \Delta(k) \) is a bell shaped function, too. The maximum of this function, however, is reached for \( k < 0 \) and is therefore outside the feasible domain.

18. Note that the conditions developed in what follows are necessary but not sufficient for NHA to be preferred to HA. The point here is to convey the intuition of the results.

19. Whenever \( s_1^{NHA} < s_2^{NHA} \) we get \( (s_1^{NHA} + s_2^{NHA})y - 2s_2^{NHA} < 0 \) and therefore (5) is positive.

20. Within the analysis not much attention has been devoted to the role of \( r\sigma^2 \). The right hand side of (7'), however, is increasing in \( r\sigma^2 \) and thus higher \( r\sigma^2 \), other things equal work in favour of HA.

References

Figure 1: Timeline.

- **Hedging Strategy**
  - **Hedging**
  - **No Hedging (NH)**
  - **Hedge Accounting (HA)**
  - **No Hedge Accounting (NHA)**

Figure 2: Hedging decisions.

**Table 1: Income variances without hedging and with hedging and hedge accounting.**

<table>
<thead>
<tr>
<th></th>
<th>NH</th>
<th>HA</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Var(\pi_1)$</td>
<td>$k\sigma^2$</td>
<td>$k\sigma^2$</td>
</tr>
<tr>
<td>$Var(\pi_2)$</td>
<td>$2\sigma^2$</td>
<td>$[(1 - y)^2 + 1]\sigma^2$</td>
</tr>
</tbody>
</table>

**Table 2: Income variances without hedging, with hedge accounting, and without hedge accounting.**

<table>
<thead>
<tr>
<th></th>
<th>NH</th>
<th>HA</th>
<th>NHA</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Var(\pi_1)$</td>
<td>$k\sigma^2$</td>
<td>$k\sigma^2$</td>
<td>$(k + y^2)\sigma^2$</td>
</tr>
<tr>
<td>$Var(\pi_2)$</td>
<td>$2\sigma^2$</td>
<td>$[(1 - y)^2 + 1]\sigma^2$</td>
<td>$2\sigma^2$</td>
</tr>
<tr>
<td>$2 \cdot Cov(\pi_1, \pi_2)$</td>
<td>0</td>
<td>0</td>
<td>$-2y\sigma^2$</td>
</tr>
<tr>
<td>$Var(\pi_1 + \pi_2)$</td>
<td>$(2 + k)\sigma^2$</td>
<td>$[(1 - y)^2 + 1 + k]\sigma^2$</td>
<td>$[(1 - y)^2 + 1 + k]\sigma^2$</td>
</tr>
</tbody>
</table>
Figure 3: $\Delta(k)$ for parameter values $r = .5$, $\sigma = 2$.

Figure 4: Nulls as a function of $y$ with $r = .5$, $\sigma = 2$. 