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Three Forms of Accounting Conservatism as Informational Bias: Theory, System Design, and Behavioral Analysis

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Abstract

This paper develops a unified analytical framework that reconceptualizes accounting conservatism as a downward informational bias embedded in the accounting information system. We formally demonstrate that, under this conceptualization, only three internally consistent types of conservatism exist—unconditional, discretionary, and conditional—and provide a rigorous characterization of each. To capture these forms simultaneously, we design a generalized accounting information system that flexibly incorporates distinct bias parameters. Rather than focusing on deriving new results from contracting theory, our primary contribution lies in constructing and validating this system as a foundational modeling device. We embed the system into a canonical single-period principal-agent model to confirm its internal consistency and to examine how each form of conservatism influences reporting behavior and contract design under moral hazard. Our analysis reveals that unconditional conservatism always enhances informativeness and is optimal, discretionary conservatism uniformly reduces signal quality and is never chosen, and conditional conservatism is optimal only under high project risk and strong signal precision. Importantly, we show that conditional conservatism corresponds to real-world accounting rules such as impairment accounting and the lower-of-cost-or-market principle. By separating the structure of conservatism from the economic context, this paper contributes a tractable and extensible foundation for future theoretical analysis of conservative reporting practices.

Keywords: Accounting conservatism, Moral hazard

1. INTRODUCTION

Accounting conservatism is a foundational yet conceptually fragmented principle in financial reporting. While broadly understood as a tendency to recognize bad news more readily than good news, the term encompasses a wide array of reporting practices—ranging from the ex ante application of cautious assumptions to the ex post asymmetric recognition of losses. This diversity has led to inconsistent empirical interpretations and a lack of coherence in theoretical modeling (Watts 2003a, b; Ryan, 2006).

Prior literature has sought to classify conservatism into analytically meaningful categories. Basu (1997) introduced the concept of conditional conservatism as asymmetric timeliness. Ball and Shivakumar (2005) distinguished between contracting-based and valuation-based conservatism, and Beaver and Ryan (2005) further differentiated between news-based and standards-based forms. Givoly and Hayn (2000) also documented long-term trends in accruals-based conservatism. Despite these contributions, these classifications remain largely narrative or empirical and do not provide a unified analytical foundation that enables the joint modeling of multiple types. Although several analytical models address conservatism under asymmetric information, they typically focus on a single form—most often conditional—and do not provide a structure that nests multiple types within a common framework.

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This paper provides such a foundation by reinterpreting accounting conservatism as a systematic downward informational bias within the accounting information system. Under this conceptualization, we formally show that there are exactly three theoretically consistent forms of conservatism: (i) unconditional, (ii) discretionary, and (iii) conditional. Each form corresponds to a distinct configuration of signal bias, and together they exhaust the space of internally coherent conservative reporting structures.

To operationalize this classification, we design a generalized accounting information system that nests these three types as parameters in a binary signal environment. This system enables researchers to isolate and compare the economic effects of different conservative mechanisms under a common information-theoretic structure. We then embed this system into a standard single-period principal-agent model to verify its analytical behavior under moral hazard and contract design constraints. Although the contractual setting is stylized, it serves as a testbed for evaluating how each form of conservatism influences reporting quality and incentive alignment.

Our analysis shows that unconditional conservatism consistently enhances informativeness and is always adopted; discretionary conservatism uniformly degrades signal quality and is never used; and conditional conservatism is optimal only under specific combinations of high project risk and strong signal precision. Notably, this third form corresponds closely to real-world accounting rules such as impairment accounting and the lower-of-cost-or-market principle.

The primary contribution of this study lies in the design and validation of a tractable and extensible accounting information system that enables rigorous modeling of conservative reporting. By separating the informational architecture of accounting from its economic environment, this framework offers a foundation for future research on how conservatism affects decision-making, performance evaluation, and standard-setting.

2. DEVELOPMENT OF ACCOUNTING INFORMATION SYSTEM

2.1 Accounting Information Systems and the Usefulness of Accounting Information

In order to examine the consequences of introducing a downward bias into accounting information systems, it is essential to consider how such systems are modeled. To this end, it is appropriate to refer to the seminal work of Ball and Brown (1968), which laid the foundation for modern accounting research.

Ball and Brown (1968) is widely regarded as the starting point of modern accounting research because it empirically addressed a fundamental question: At a time when there were active normative debates in the United States regarding how accounting information systems should serve capital markets, they asked whether the existing accounting information system, as it stood, actually provided useful information to the stock market.

Basu (1997), which is considered the starting point of recent empirical research on accounting conservatism, also follows the same conceptual model of the accounting information system that was assumed in Ball and Brown (1968). Given that many subsequent empirical studies on accounting conservatism have adopted the empirical model proposed by Basu (1997), it is reasonable to base the following discussion on the accounting information system framework assumed by Ball and Brown (1968).

The accounting information system assumed by Ball and Brown (1968) can be depicted as a binary model, as illustrated in Figure 1. In this figure, and represent favorable and unfavorable outcomes from business operations, respectively. Naturally, what constitutes a "favorable" or "unfavorable" outcome can be subjective; however, in Ball and Brown (1968), outcomes were assessed based on whether they exceeded expected returns under the assumption of an efficient stock market.

Meanwhile, and represent "good news" (GN) and "bad news" (BN) conveyed to users by the accounting information system regarding these business outcomes. In other words, the accounting information system translates business outcomes into binary accounting information and communicates this to users. In Ball and Brown (1968), this translation was based on whether accounting earnings exceeded those of the previous year.

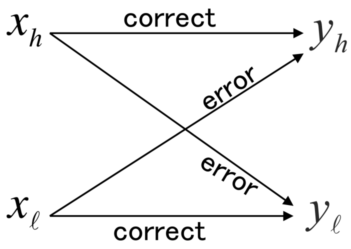

Figure 1: Binary Symmetric Communication Channel

However, the accounting information system does not always transmit perfect information. Instead, it is assumed that information errors occur probabilistically. Such a model of information transmission corresponds to what is known in information theory as the Binary Symmetric Channel (BSC). In this framework, the arrows in the figure represent probabilities, which satisfy the following conditions:

$$P(y_h \mid x_h) + P(y_\ell \mid x_h) = 1,$$
$$P(y_\ell \mid x_\ell) + P(y_h \mid x_\ell) = 1.$$

A typical example of information errors in real-world accounting information systems is the well-known delay with which value-enhancing investments are reflected in accounting earnings. Other sources of information errors include the inherent incompleteness of accounting standards and managerial discretion in the preparation of accounting information.

In essence, what Ball and Brown (1968) attempted to test by applying real-world stock price data and accounting earnings to this information system framework was whether the system satisfies the so-called Monotone Likelihood Ratio Property (MLRP), expressed as follows:

$$P(y_h \mid x_h) > P(y_h \mid x_\ell), \qquad P(y_\ell \mid x_\ell) > P(y_\ell \mid x_h). \tag{1}$$

In other words, they investigated whether receiving good (bad) news allows one to reasonably believe that a favorable (unfavorable) business outcome has occurred. This can be interpreted as a test of the accounting information system in light of the usefulness of accounting information.

Their empirical results confirmed that the MLRP holds. If this minimal requirement for an accounting information system had not been met, it would likely have posed a serious problem. Even though the traditional accounting framework for calculating distributable profits coexisted with newer frameworks such as depreciation-based accounting, had it turned out that profits computed under the traditional framework provided no useful information to capital markets, there would have been a fundamental need to reconsider the structure of accounting standards.

The results of Ball and Brown (1968) have not been overturned to this day, although they have been refined and reconfirmed in subsequent research. Moreover, even if an ideal accounting information system is developed in the future, it must still satisfy this essential property. Therefore, based on the above discussion, it is appropriate to examine the consequences of introducing a downward bias, such as conservatism, into the accounting information system by employing the BSC with MLRP assumed by Ball and Brown (1968). This approach enables consistent analysis of both current and future ideal accounting information systems.

2.2 The Good News Highlight Effect of Accounting Conservatism

What happens when a systematic downward bias is introduced into a Binary Symmetric Channel (BSC) that satisfies the Monotone Likelihood Ratio Property (MLRP). As illustrated in Figure 2, both positive and negative consequences emerge. Specifically, accounting conservatism simultaneously reduces Type II errors, $P(y_h \mid x_\ell)$, while increasing Type I errors, $P(y_\ell \mid x_h)$.

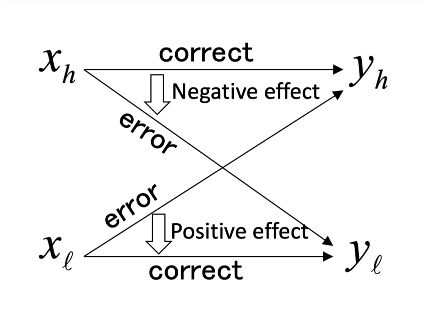

Figure 2: Two Types of Effects of Downward Bias

It is important to note that conservatism introduces this downward bias systematically into the accounting information system. That is, both the positive and negative effects are inherently brought about by conservatism. This is because conservatism fundamentally shapes the characteristics of the accounting information system and, as a higher-level concept within the accounting standard framework, governs the generation of accounting information. Moreover, as seen in the case of the immediate expensing of research and development (R&D) costs, while conservatism introduces information errors for successful R&D projects, it improves the usefulness of information for failed R&D projects. This dual nature reflects the complexity of conservatism's effects.

Thus, introducing a downward bias through conservatism does not necessarily have entirely negative implications for the accounting information system. Rather, the critical issue becomes the balance between its positive and negative effects. If the positive effects outweigh the negative effects, conservatism improves the accounting information system; conversely, the opposite holds true if the negative effects dominate.

To further examine this issue, let us consider the usefulness of the accounting information produced by the system, namely y_h and y_ℓ. We can rewrite the MLRP conditions as follows:

$$\frac{P(y_h \mid x_\ell)}{P(y_h \mid x_h)} < 1, \qquad \frac{P(y_\ell \mid x_h)}{P(y_\ell \mid x_\ell)} < 1. \tag{2}$$

These expressions indicate that the smaller these ratios are, the more useful the corresponding good news (y_h) and bad news (y_ℓ) become.

Under conservatism, the numerator and denominator in the first expression both decrease, while those in the second expression both increase. However, given that conservatism systematically introduces a downward bias, the first ratio either remains unchanged or decreases, while the second ratio either remains unchanged or increases. This is because, under the MLRP condition, the denominator is initially larger than the numerator in both expressions, meaning that proportional changes to both terms result in the overall change being determined primarily by the numerator. [1]

Consequently, conservatism generally enhances the usefulness of good news while diminishing the usefulness of bad news. This phenomenon may be termed the "Good News Highlight Effect" of conservatism. It is worth noting, however, that this result may appear counterintuitive. This is because conservatism is often associated with the notion of "recognizing bad news in a timely manner," leading to the belief that it enhances the usefulness of bad news.

It is crucial to distinguish here that an increase in the likelihood of bad news being reported when unfavorable outcomes occur—specifically, a higher $P(y_\ell \mid x_\ell)$—does not directly translate into improved usefulness of bad news. What determines information usefulness is not the absolute probability of correct reporting, but rather the ratio between the probability of correct reporting, $P(y_\ell \mid x_\ell)$, and the probability of incorrect reporting, $P(y_\ell \mid x_h)$.

[1] This can be easily illustrated with a simple numerical example. Consider the ratio $\frac{2}{3}$. Subtracting 1 from both the numerator and denominator yields $\frac{2-1}{3-1} = \frac{1}{2}$, which is smaller than the original ratio. Conversely, multiplying both terms by 0.5 yields $\frac{2\times0.5}{3\times0.5} = \frac{1}{1.5} = \frac{2}{3}$, leaving the ratio unchanged.

The "Good News Highlight Effect" of conservatism can be illustrated using the analogy proposed by Venugopalan (2004). Imagine two universities, A and B, where both have students of similar ability and provide comparable educational quality. However, their grading policies differ: University A has stricter grading standards, while University B is known for lenient grading.

Suppose employers are evaluating students from these two universities during the recruitment process, and both candidates present transcripts with straight-A grades across all subjects. If the goal is to hire the more capable student, which candidate should be preferred?

The rational choice would be the student from University A. This is because the grading information system at University A applies a stronger downward bias than University B's system, making good news (i.e., high grades) more informative in identifying truly capable students. On the other hand, when the objective is to identify and reject weaker students from a large applicant pool, the opposite holds true. In that case, ironically, poor grades from University B are more reliable indicators of poor ability than poor grades from University A.

The above discussion suggests that the usefulness of conservatism in accounting information systems depends on how the information is utilized. Given that conservatism highlights good news, it can enhance the usefulness of accounting information in situations where good news plays a critical role.

However, it is also possible that the systematic downward bias introduced by conservatism affects both the probability of correct and incorrect reporting to a similar extent, ultimately leaving the usefulness of the information unchanged. In the next section, we will refine the analysis of the informational effects of conservatism, taking this possibility into account.

2.3 Types and Modeling of Accounting Conservatism

We define the usefulness of good news and bad news in the accounting information system as follows:

$$u(y_h) \equiv \frac{P(y_h|x_\ell)}{P(y_h|x_h)}, \quad u(y_\ell) \equiv \frac{P(y_\ell|x_h)}{P(y_\ell|x_\ell)}.$$

These expressions correspond to the left-hand side of Equation 2. Since $u(\cdot)$ takes the error probability in the numerator, a smaller value indicates higher information usefulness.

As discussed in the previous section, a downward bias resulting from conservatism either leaves the usefulness unchanged or increases the usefulness of good news while decreasing the usefulness of bad news. We express this relationship as:

$$u(y_h)' \leq 0, \quad u(y_\ell)' \geq 0.$$

Here, we assume differentiation with respect to a parameter that increases as the degree of conservatism strengthens. Under this framework, there are four possible patterns for how a downward bias introduced by conservatism affects the accounting information system:

$$\begin{cases} \text{Type I} & : \quad u(y_h)' < 0, \quad u(y_\ell)' = 0, \\ \text{Type II} & : \quad u(y_h)' = 0, \quad u(y_\ell)' > 0, \\ \text{Type III} & : \quad u(y_h)' < 0, \quad u(y_\ell)' > 0, \\ \text{Type IV} & : \quad u(y_h)' = 0, \quad u(y_\ell)' = 0. \end{cases} \tag{3}$$

However, among these four patterns, Type IV conservatism cannot exist. It is impossible to introduce a downward bias into the accounting information system with having no effect on either good news or bad news.

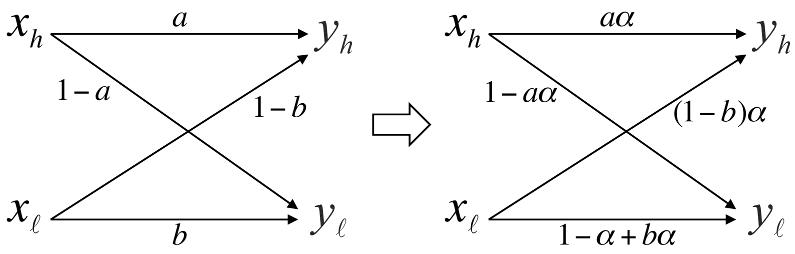

Figure 3: Nonexistence of Type IV Conservatism

To demonstrate this, consider the accounting information system shown on the left side of Figure 3. In this system, the probabilities of correct information being conveyed are denoted by a and b, where $1 > a > 0$ and $1 > b > 0$:

$$\begin{cases} P(y_h \mid x_h) = a, & P(y_\ell \mid x_h) = 1 - a, \\ P(y_\ell \mid x_\ell) = b, & P(y_h \mid x_\ell) = 1 - b. \end{cases}$$

Next, we apply a downward bias controlled by a conservatism parameter α to $P(y_h \mid x_h)$ and $P(y_h \mid x_\ell)$, transforming the system into the one shown on the right side of Figure 3. The smaller the value of α, the greater the downward bias introduced into the system. This transformation can be expressed as:

$$\begin{cases} \dfrac{dP(y_\ell \mid x_h)}{d\alpha} = \dfrac{d(1 - a\alpha)}{d\alpha} = -a < 0, \\ \dfrac{dP(y_\ell \mid x_\ell)}{d\alpha} = \dfrac{d(1 - \alpha + b\alpha)}{d\alpha} = b - 1 < 0. \end{cases}$$

For the accounting information system to be at least minimally useful, it must satisfy the MLRP condition. Substituting the above probabilities into Equation 1, the MLRP condition becomes:

$$a + b > 1. \tag{4}$$

It can also be shown that this system satisfies the first condition for Type IV conservatism in Equation 3:

$$u(y_h)' = \frac{d\left(\frac{P(y_h \mid x_\ell)}{P(y_h \mid x_h)}\right)}{d\alpha} = \frac{d\left(\frac{(1-b)\alpha}{a\alpha}\right)}{d\alpha} = 0.$$

However, considering the constraint that the sum of probabilities must be 1 and that the MLRP condition is given by Equation 4, it becomes clear that the second condition for Type IV conservatism in Equation 3 cannot be satisfied. [2]

The same logic applies in reverse. We can derive:

$$u(y_\ell)' = \frac{d\left(\frac{P(y_\ell \mid x_h)}{P(y_\ell \mid x_\ell)}\right)}{d\alpha} = \frac{d\left(\frac{1 - a\alpha}{1 - \alpha + b\alpha}\right)}{d\alpha} = -\frac{a + b - 1}{\left((b-1)\alpha + 1\right)^2} < 0.$$

Thus, Type IV conservatism does not exist. In the next section, we will use parameter-based formalization to examine the possible existence of the remaining three types of conservatism.

[2] Of course, this can also be demonstrated by proof by contradiction, showing that the conditions for Type IV conservatism are logically inconsistent.

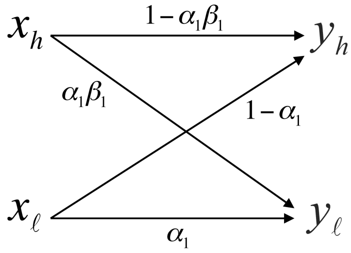

Figure 4: Type I Conservatism

2.4 Type I Conservatism

Type I conservatism can be illustrated as shown in Figure 4. By setting two parameters, α_1 and β_1, within the ranges $0 < \alpha_1 \leq 1$ and $0 \leq \beta_1 < 1$, all useful accounting information systems that can be represented by a Binary Symmetric Channel (BSC) are covered.[3] It should be noted that this system satisfies the MLRP condition expressed in Equation 1.

In this system, α_1 serves as a parameter for conservatism, as expressed by the following relationship:

$$\frac{dP(y_\ell|x_h)}{d\alpha_1} > 0, \frac{dP(y_\ell|x_\ell)}{d\alpha_1} > 0.$$

Thus, the degree of downward bias introduced by conservatism increases with α_1.

On the other hand, β_1 represents the accuracy of the accounting information system independent of conservatism. This is because, as shown below, a decrease in β_1 increases the usefulness of both good news and bad news, or at least improves the usefulness of bad news without affecting good news:

$$\frac{du(y_h)}{d\beta_1} = \frac{(1-\alpha_1)\alpha_1}{(1-\alpha_1\beta_1)^2} \geq 0, \frac{du(y_\ell)}{d\beta_1} = 1 > 0.$$

It can also be confirmed that the conditions specified in Equation 3 hold for Type I conservatism:

$$u(y_h)' = \frac{du(y_h)}{d\alpha_1} = \frac{\beta_1 - 1}{(\alpha_1\beta_1 - 1)^2} < 0, u(y_\ell)' = \frac{du(y_\ell)}{d\alpha_1} = 0.$$

As the above expressions clearly show, Type I conservatism increases the usefulness of accounting information as the downward bias intensifies. As discussed in Section 2.2, this corresponds to a situation where the positive effect of conservatism -reducing Type II errors for favorable outcomes-always outweighs the negative effect of increasing Type I errors.

If such a form of conservatism exists, it follows that the accounting standard framework should adopt it. Therefore, conservatism should not be immediately dismissed when exploring accounting standards that contribute to capital markets.

In fact, it can be argued that such conservatism is already embedded in existing accounting standards. This corresponds to the relative conservatism of accounting compared to the stock market, namely, the principle of nominal capital maintenance combined with realization-based revenue recognition.

Let us briefly reconsider the realization principle. The realization principle currently used is essentially a traditional revenue recognition standard that traces its origins to accounting practices of the Florentine era. This standard was chosen from the perspective of profit distribution. It was considered natural to define revenue as the actual inflow of distributable cash, rather than first defining the abstract concept of income.

[3] To satisfy the MLRP condition, it is necessary that $\beta_1 < 1$ and $\alpha_1 > 0$. When $\alpha_1 = 1$ and $\beta_1 = 0$, the system becomes a perfect information system.

In contrast, can the realization principle be derived inherently from the objective of estimating firm value? Likely not. If firm value estimation were the primary objective, it would be more effective to recognize as revenue the future cash inflows expected from current projects and then reflect subsequent changes in those expectations in profit and loss. This would enable internal information possessed by managers to be directly reflected in accounting information, contributing to more accurate firm value estimation.

However, incorporating unverifiable information such as expected future cash inflows into the accounting information system exposes it to managerial discretion, manipulation, or even outright deception, as well as inherent uncertainty, thereby undermining the reliability of accounting information. In other words, it increases the probability of information errors.

Therefore, if a downward bias introduced by conservatism can suppress the influence of information errors, such a rule should be adopted. From this perspective, it is understandable that the realization principle, inherited from Florentine accounting practices, continues to be applied in modern society, even as the objectives of financial reporting have evolved.

Nevertheless, this historical continuity reflects compatibility rather than superiority. It is important to recognize that the optimal degree of conservatism depends on external factors such as the degree of market development and technological advancements in financial reporting. Indeed, under the historical cost principle championed by Littleton, even marketable securities were evaluated at cost, and many countries maintained cost-based measurement for a long time. However, with the development of financial markets, revenue recognition standards have shifted toward fair value measurement. A similar logic applies to fair value measurement of financial derivatives, despite ongoing debates surrounding the issue.

2.5 Type II Conservatism

Next, Type II conservatism can be illustrated as shown in Figure 5. This figure is essentially an inverted version of the Type I diagram. As with Type I, by setting two parameters α_2 and β_2 within the ranges $0 < \alpha_2 \leq 1$ and $0 \leq \beta_2 < 1$, all useful accounting information systems representable by a Binary Symmetric Channel (BSC) that satisfy the MLRP condition can be covered.

Since this system is an inverted version of Type I, the conservatism parameter α_2 reflects the degree of conservatism through its decrease, as expressed by the following:

$$\frac{dP(y_\ell \mid x_h)}{d\alpha_2} < 0, \frac{dP(y_\ell \mid x_\ell)}{d\alpha_2} < 0.$$

Meanwhile, similar to Type I, β_2 represents the precision of the accounting information system, independent of conservatism. However, as shown below, when $\alpha_2 \neq 1$, a decrease in β_2 improves the usefulness of both good news and bad news, whereas when $\alpha_2 = 1$, only the usefulness of good news improves, with no effect on bad news:

$$\frac{du(y_h)}{d\beta_2} = 1 > 0, \frac{du(y_\ell)}{d\beta_2} = \frac{(1-\alpha_2)\alpha_2}{(1-\alpha_2\beta_2)^2} \geq 0.$$

It can also be confirmed that the conditions specified in Equation 3 hold for Type II conservatism. However, since in this system a decrease in α_2 indicates an increase in conservatism, a negative sign is added to the derivatives:

$$u(y_h)' = -\frac{du(y_h)}{d\alpha_2} = 0, u(y_\ell)' = -\frac{du(y_\ell)}{d\alpha_2} = -\frac{\beta_2 - 1}{(\alpha_2\beta_2 - 1)^2} > 0.$$

As these expressions make clear, Type II conservatism reduces the overall usefulness of accounting information as the downward bias increases. This reflects a situation where the negative effect of conservatism-namely, an increase in Type I errors - always outweighs the positive effect of reducing Type II errors for favorable outcomes, as discussed in Section 2.2.

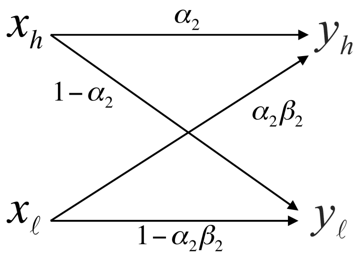

Figure 5: Type II Conservatism

If the objective is to improve the usefulness of accounting information, this type of conservatism is undesirable for accounting standards. However, from the perspective of firms that prepare accounting information, there may still be incentives to introduce a downward bias, even if it reduces information usefulness. For instance, in situations where accounting profits are directly linked to contractual or regulatory outcomes, such as under the principle of statutory financial reporting.

Alternatively, when accounting profits are tied to distributable profits, a downward bias in accounting information may serve as a signal to creditors.

In this sense, if conservatism is defined as a firm's discretionary application of downward bias, Type II conservatism can be viewed as representing this form of discretion. In some cases, this could even result from accounting fraud or manipulation that violates applicable accounting standards.

It should also be noted that the incentives behind such downward bias are not limited to firms themselves. Political costs arising from the standard-setting process, involving negotiations among various stakeholders, can also manifest as downward bias in accounting information. For example, prohibiting the use of pooling-of-interests accounting for corporate mergers for technical reasons, even when such accounting would otherwise apply, could introduce downward bias into reported profits.

Another case is the requirement for immediate expensing of research and development (R&D) costs to avoid excessive managerial discretion in allocating such costs, even though objectively linking revenues to R&D expenditures is inherently difficult. [4]

Furthermore, if national policies outside the scope of accounting, such as statutory financial reporting requirements, incentivize the introduction of downward bias into accounting information, this too can be seen as a political cost. In such cases, the cost of distorting accounting information must be weighed against the cost of abandoning statutory financial reporting and developing an entirely separate accounting framework for corporate income measurement.

2.6 Type III Conservatism

Finally, Type III conservatism can be illustrated as shown in Figure 6. As with the other two types, all useful accounting information systems that can be represented by a Binary Symmetric Channel (BSC) are covered using two parameters, α_3 and β_3. However, it is important to note that the range of these parameters differs slightly: while α_3 still satisfies $0 < \alpha_3 \leq 1, \beta_3$ is restricted to $0 < \beta_3 \leq \alpha_3$. The system satisfies the MLRP condition expressed in Equation 1.

As with Type II, this system is an inverted version of the Type I diagram. Thus, the degree of conservatism increases as α_3 decreases, as shown by the following relationships:

$$\frac{dP(y_\ell \mid x_h)}{d\alpha_3} < 0, \frac{dP(y_\ell \mid x_\ell)}{d\alpha_3} < 0.$$

[4] For details on the accounting treatment of R&D costs in the United States and its background, see FASB (1974).

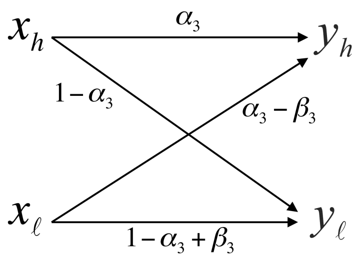

Figure 6: Type III Conservatism

Similar to the other two types, β_3 represents the precision of the accounting information system independent of conservatism. However, the direction of its effect is reversed. As β_3 increases, the usefulness of both good news and bad news improves. Furthermore, when $\alpha_3 = 1$, bad news becomes perfectly reliable, rendering its usefulness unaffected by β_3. These relationships are expressed as follows:

$$\frac{du(y_h)}{d\beta_3} = \frac{-1}{\alpha_3} < 0, \frac{du(y_\ell)}{d\beta_3} = -\frac{1-\alpha_3}{(-\alpha_3+\beta_3+1)^2} \leq 0.$$

Notably, when $\beta_3 = \alpha_3$, good news becomes perfectly reliable, meaning that the usefulness of good news is no longer influenced by changes in β_3. The conditions specified in Equation 3 also hold for this system. As in Type II, because the degree of conservatism increases as α_3 decreases, a negative sign is added to the derivatives:

$$u(y_h)' = -\frac{du(y_h)}{d\alpha_3} = -\frac{\beta_3}{\alpha_3^2} < 0, u(y_\ell)' = -\left(-\frac{\beta_3}{(-\alpha_3+\beta_3+1)^2}\right) > 0.$$

As these results clearly show, Type III conservatism exhibits the "Good News Highlight Effect" discussed in Section 2.2. Specifically, for good news, the positive effect of reducing Type II errors, $P(y_h \mid x_\ell)$, outweighs the negative effect of increasing Type I errors, $P(y_\ell \mid x_h)$, resulting in improved information usefulness. In contrast, for bad news, the negative effect of increasing Type II errors, $P(y_\ell \mid x_h)$, outweighs the positive effect of reducing Type I errors, $P(y_h \mid x_h)$, thereby reducing information usefulness.

A key characteristic of Type III conservatism is that it creates a trade-off between the usefulness of good news and bad news. As illustrated by the analogy in Section 2.2, when good news is more critical, applying conservatism is preferable, whereas when bad news carries greater importance, conservatism should be avoided.

Whether this form of conservatism should be incorporated into the accounting standard framework is subject to debate. As discussed in Section 2.1, the distinction between good news and bad news is inherently subjective. If such subjectivity is excluded in favor of purely objective accounting standards, Type III conservatism would likely be excluded from the framework. In other words, objective performance measurement that disregards the preferences of stakeholders would preclude this form of conservatism. This is consistent with the common rationale for rejecting conservatism within historical cost accounting.

Nonetheless, objective measurement has practical limitations, leaving room for stakeholder negotiations to influence accounting outcomes. Since accounting profits frequently serve as a basis for distribution decisions, and irreversibility of payments is a significant factor, it is reasonable to assume that good news tends to be emphasized.

This explains why conditionally conservative standards such as the lower-of-cost-or-market rule and impairment accounting, which embody conservatism, continue to be adopted in modern accounting practice.

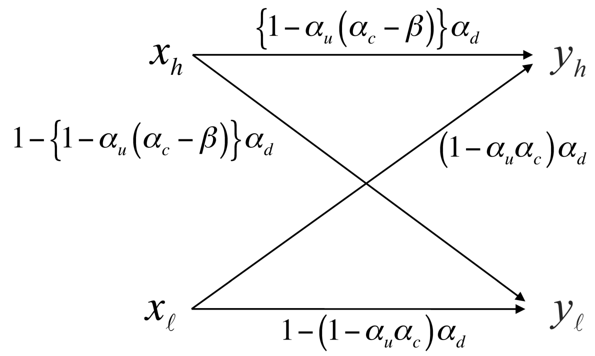

Figure 7: Model of Integrated Conservatism

2.7 Integration of the Accounting Information Systems

Thus far, this paper has demonstrated that the systematic downward bias introduced by conservatism into the accounting information system generates three distinct effects on accounting information. It was also confirmed that conservatism corresponding to each of these three types can indeed be observed in current accounting practices.

However, the discussions up to this point have modeled separate accounting information systems tailored to each type of conservatism. In reality, of course, there is only a single accounting information system. Therefore, as a final step, this section presents a unified accounting information system that incorporates all three types of conservatism, thereby reconfirming their coexistence and feasibility.

First, let the parameter for Type I conservatism be redefined as α_u, where the subscript " u " stands for "unconditional." As previously discussed, this represents a form of conservatism that the accounting information system should adopt unconditionally. It is important to note that "unconditional conservatism" as discussed by Beaver and Ryan (2005) refers to conservatism embedded unconditionally in current accounting standards, which, according to the earlier discussion, corresponds to practices such as the immediate expensing of R&D costs, categorized here as Type II conservatism.

Similarly, the parameter for Type II conservatism is redefined as α_d, with " d " representing "discretionary." As discussed earlier, this form of conservatism is not inherently part of the accounting information system, but arises from the exercise of discretion permitted by incomplete accounting standards. It should also be noted that discretionary conservatism may, in some cases, be explicitly adopted by standard setters themselves.

Finally, the parameter for Type III conservatism is redefined as α_c, with " c " representing "conditional." As discussed above, this form of conservatism introduces a trade-off between the usefulness of good news and bad news, implying that the accounting information system should adopt this type of conservatism conditionally. Although Beaver and Ryan (2005) also discusses conditional conservatism, it is framed in terms of the timely recognition of bad news. As clarified in this paper, however, Type III conservatism reduces the usefulness of bad news, an important point that must be acknowledged.

The unified accounting information system, characterized by the three conservatism parameters α_u, α_d, and α_c, along with β, representing the precision of the system independent of conservatism, is illustrated in Figure 7. The ranges of these parameters are given as:

$$0 < \alpha_u \leq 1, 0 < \alpha_d \leq 1, 0 < \beta < \alpha_c \leq 1.$$

First, it can be confirmed that the MLRP condition holds in this system:

$$P(y_h \mid x_h) - P(y_h \mid x_\ell) = P(y_\ell \mid x_\ell) - P(y_\ell \mid x_h) = \alpha_u\alpha_d\beta > 0.$$

The specific role of each conservatism parameter is expressed as follows:

$$\begin{cases} \text{Type I} & : \dfrac{dP(y_\ell \mid x_h)}{d\alpha_u} = (\alpha_c - \beta)\alpha_d > 0, \dfrac{dP(y_\ell \mid x_\ell)}{d\alpha_u} = \alpha_c\alpha_d > 0, \\ \text{Type II} & : \dfrac{dP(y_\ell \mid x_h)}{d\alpha_d} = (\alpha_c - \beta)\alpha_u - 1 < 0, \dfrac{dP(y_\ell \mid x_\ell)}{d\alpha_d} = \alpha_u\alpha_c - 1 < 0, \\ \text{Type III} & : \dfrac{dP(y_\ell \mid x_h)}{d\alpha_c} = \alpha_u\alpha_d > 0, \dfrac{dP(y_\ell \mid x_\ell)}{d\alpha_c} = \alpha_u\alpha_d > 0. \end{cases} \tag{5}$$

These results confirm that an increase in α_u and α_c, as well as a decrease in α_d, correspond to an increase in the degree of conservatism.

Next, consider whether the conditions specified in Equation 3 for each type of conservatism are satisfied. For Type I conservatism, the following holds:

$$\frac{du(y_h)}{d\alpha_u} = -\frac{\beta}{\{1 - \alpha_u(\alpha_c - \beta)\}^2} < 0, \frac{du(y_\ell)}{d\alpha_u} = -\frac{\beta\alpha_d(1 - \alpha_d)}{\{1 - \alpha_d(1 - \alpha_u\alpha_c)\}^2} \leq 0. \tag{6}$$

These results indicate that the condition in Equation 3 is satisfied for Type I conservatism when $\alpha_d = 1$. Even without this strict condition, the essential property of Type I conservatism-namely, its ability to improve the overall usefulness of accounting information-remains intact.

For Type II conservatism, the following condition holds. Since stronger conservatism corresponds to an increase in α_d, a negative sign is added to the derivatives:

$$\frac{du(y_h)}{d\alpha_d} = 0, \frac{du(y_\ell)}{d\alpha_d} = -\left(-\frac{\beta\alpha_u}{\{1 - \alpha_d(1 - \alpha_u\alpha_c)\}^2}\right) > 0.$$

Similarly, for Type III conservatism, the condition in Equation 3 is satisfied:

$$\frac{du(y_h)}{d\alpha_c} = -\frac{\beta\alpha_u^2}{\{1 - \alpha_u(\alpha_c - \beta)\}^2} < 0, \frac{du(y_\ell)}{d\alpha_c} = \frac{\beta\alpha_u^2\alpha_d^2}{\{1 - \alpha_d(1 - \alpha_u\alpha_c)\}^2} > 0.$$

Finally, it can be confirmed that β, which represents the precision of the accounting information system independent of conservatism, functions as expected:

$$\frac{du(y_h)}{d\beta} = -\frac{\alpha_u(1 - \alpha_u\alpha_c)}{\{1 - \alpha_u(\alpha_c - \beta)\}^2} < 0, \frac{du(y_\ell)}{d\beta} = -\frac{\alpha_u\alpha_d}{1 - \alpha_d(1 - \alpha_u\alpha_c)} < 0.$$

These results confirm that increases in β enhance the precision of the accounting information system.

In conclusion, the unified accounting information system illustrated in Figure 7 demonstrates that the three types of conservatism can coexist while preserving their individual characteristics. This significantly reinforces the feasibility of the three types of conservatism, thereby validating the preceding discussions. The model presented in Figure 7 can thus be regarded as a more realistic representation of how conservatism operates within an accounting information system.

2.8 Interrelationships Between Types of Conservatism

Thus far, we have examined each type of conservatism individually and presented a unified, realistic conservatism model in Figure 7. In this section, we further explore the interrelationships between these types of conservatism. This exercise not only enhances our understanding of how closely the model approximates real-world accounting systems, but also provides valuable insights for future discussions on conservatism.

A natural starting point is to consider the scope for applying discretionary conservatism, or Type II conservatism. Specifically, we examine how the strength of downward bias induced by α_d, as expressed in Equation 5, is influenced by other parameters. To do so, we differentiate the expressions in Equation 5 with respect to each parameter:

$$\frac{d^2P(y_\ell \mid x_h)}{d\alpha_d d\alpha_u} = \alpha_c - \beta > 0, \frac{d^2P(y_\ell \mid x_\ell)}{d\alpha_d d\alpha_u} = \alpha_c > 0.$$
$$\frac{d^2P(y_\ell \mid x_h)}{d\alpha_d d\alpha_c} = \alpha_u > 0, \frac{d^2P(y_\ell \mid x_\ell)}{d\alpha_d d\alpha_c} = \alpha_u > 0.$$

These results indicate that when the accounting standard framework already incorporates Type I or Type III conservatism, the scope for applying discretionary conservatism (Type II) is diminished. This outcome is also intuitively consistent with real-world accounting practices. It is important to recall from Equation 5 that, unlike the other types, an increase in α_d actually reduces the degree of conservatism.

Next, consider the relationship with β, which represents the ex-ante precision of the accounting information system independent of conservatism:

$$\frac{d^2P(y_\ell \mid x_h)}{d\alpha_d d\beta} = -\alpha_u < 0, \frac{d^2P(y_\ell \mid x_\ell)}{d\alpha_d d\beta} = 0.$$

These expressions show that the higher the value of β, the greater the effect of downward bias introduced by α_d. In other words, discretionary conservatism (Type II) exerts a stronger influence when the underlying accounting information is already reliable. Conversely, when information errors are substantial, additional bias has limited impact.

The same logic applies to the upward bias effect of α_u. As shown in Equation 6 and given that Figure 5 is an inverted version of Figure 4, a decrease in α_u implies the introduction of upward bias at the expense of information usefulness. This corresponds to the recognition of unrealized profits or highly subjective profit calculations. The following expressions illustrate this point:

$$\frac{d^2P(y_h \mid x_h)}{d\alpha_u d\beta} = \alpha_d > 0, \frac{d^2P(y_h \mid x_\ell)}{d\alpha_u d\beta} = 0.$$

Naturally, if detailed accounting standards or strict monitoring by accounting experts in principle-based regimes enhance the usefulness of accounting information, the practical scope for exercising discretion in financial reporting diminishes. In such circumstances, while the potential effect of bias remains high, opportunities to apply such bias, excluding outright fraud, are limited. [5]

Next, we examine the relationship between Type I and Type III conservatism. Although the classification differs somewhat, Beaver and Ryan (2005) highlights a trade-off in the practical application of these types. For instance, faster depreciation reduces opportunities to apply impairment accounting. In contrast, this paper demonstrates that Type I and Type III conservatism are complementary in nature, while their respective "Good News Highlight Effects," as discussed in Section 2.2, exhibit a trade-off relationship.

As noted earlier, Type II conservatism serves as a substitute for both Type I and Type III conservatism. In contrast, Type I and Type III conservatism are mutually complementary, as shown below:

$$\frac{d^2P(y_\ell \mid x_h)}{d\alpha_c d\alpha_u} = \frac{d^2P(y_\ell \mid x_\ell)}{d\alpha_c d\alpha_u} = \frac{d^2P(y_\ell \mid x_h)}{d\alpha_u d\alpha_c} = \frac{d^2P(y_\ell \mid x_\ell)}{d\alpha_u d\alpha_c} = \alpha_d > 0.$$

In other words, the stronger the downward bias applied by one type of conservatism, the greater the marginal downward bias that can be applied by the other. This suggests that employing both types together is more effective for achieving their shared "Good News Highlight Effect." Indeed, it is noteworthy that in the area of fixed asset accounting, both depreciation and impairment accounting are commonly applied together, despite ongoing debates.

[5] This has led to criticisms that international accounting standards, which aim to reduce discretion through principle-based approaches, may have backfired. It is argued that these approaches have merely increased discretion, resulting in reduced usefulness of accounting information due to excessive bias. See, for example, Ahmed et al. (2013).

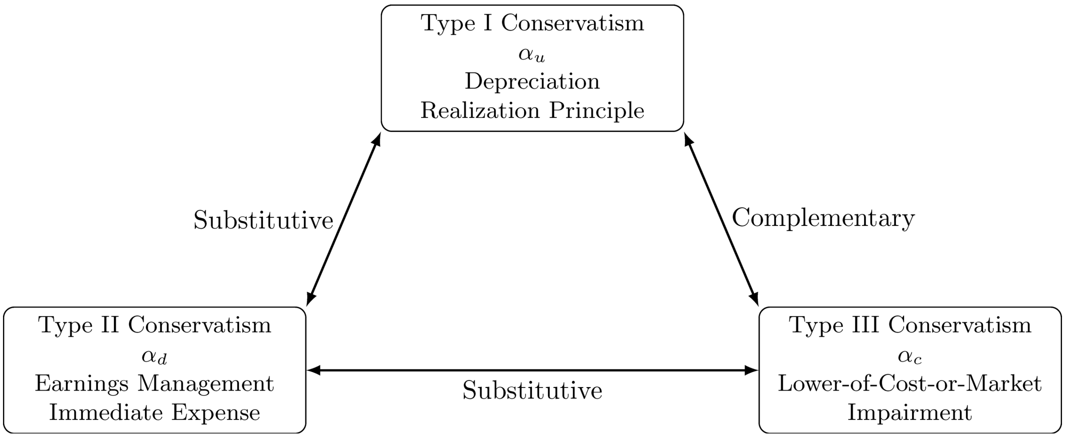

Figure 8: Interrelationships Between Types of Conservatism

However, this complementary effect exhibits diminishing marginal returns, as shown below:

$$\frac{d^2u(y_h)}{d\alpha_c d\alpha_u} = \frac{d^2u(y_h)}{d\alpha_u d\alpha_c} = -\frac{2\beta\alpha_u}{\{1-\alpha_u(\alpha_c-\beta)\}^3} < 0.$$

Furthermore, when Type I conservatism is embedded in the accounting standard framework, the negative effect of Type III conservatism on the usefulness of bad news increases at an accelerating rate:

$$\frac{d^2u(y_\ell)}{d\alpha_c d\alpha_u} = \frac{2\beta(1-\alpha_d)\alpha_d^2\alpha_u}{(1-\alpha_d+\alpha_u\alpha_c)^3} > 0.$$

These results indicate that even if Type III conservatism is adopted as part of accounting standards, it must be carefully designed to apply downward bias in a conditional, timely manner to appropriately realize the "Good News Highlight Effect." Indeed, current accounting standards, such as the lower-of-cost-or-market rule and impairment accounting, apply downward bias conditionally, reflecting this logic.

In summary, this section has demonstrated that Type II conservatism is substitutive to the other two types, while Type I and Type III conservatism are complementary (see Figure 8). However, the "Good News Highlight Effect" shared by Type I and Type III exhibits diminishing marginal returns, while the negative effect of Type III conservatism on the usefulness of bad news increases at an accelerating rate when Type I conservatism is present. Therefore, even if Type III conservatism is adopted as an accounting standard, appropriate conditionality is essential to mitigate its drawbacks.

3. MODEL

Consider a setting in which an owner (principal) hires a manager (agent) to implement a project for one period. The owner is assumed to be risk-neutral and the manager risk-averse. The manager's effort and a state of nature are combined to produce the following outcome:

$$e_i \in \{e_h, e_\ell\} \quad \text{(binary effort)},$$
$$x_i \in \{x_h, x_\ell\} \quad \text{(binary outcome)}.$$

Thus, the manager can choose one of the two effort levels (high or low) that would generate a high or low outcome ($x^h > x^\ell$). The high effort requires disutility, D, of the manager, while the low effort does not. In this paper, it is assumed that manager's high effort brings a high or low outcome, whereas his/her low effort never brings a high outcome:

$$P(x_h \mid e_h) = p, P(x_\ell \mid e_h) = 1-p \ (0 < p < 1),$$
$$P(x_h \mid e_\ell) = 0, P(x_\ell \mid e_\ell) = 1.$$

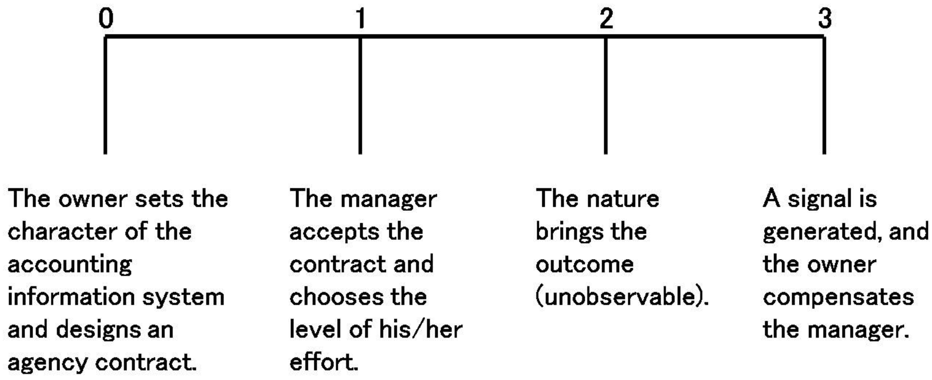

Figure 9: Timeline of Events

This assumption means that the project will always result in failure if the responsibility is shirked by the manager. The above assumptions are sufficient for resolving the optimal compensation schedule with ease, and such a binary setting is enough complicated for an analysis of conservatism as a bias.

Information asymmetry exists between the owner and the manager, and the level of effort exerted by the manager is unobservable to the owner. The outcome occurring after the manager's effort is assumed to be unobservable to both (or never identified until much later). Instead, an accounting information system exists that generates one of two signals, $y_i (i \in \{h, \ell\})$, informing the owner about the outcome. The agency contract between the owner and the manager is written according to these signals.

A timeline of events is shown in Figure 9. At time 0 , the owner sets the character of his/her accounting information system by deciding the numbers of α_u, α_c, α_d and β. At the same time, the owner designs and offers the agency contract to the manager based on signals generated by the information system. The key point is that the owner decides the combination of the design of the contract and the character of the accounting information system in order to maximize his/her payoff i.e., to minimize the agency cost. If the manager accepts the contract at time 1 , he decides the level of his/her effort, $e_i (i \in \{h, \ell\})$. At time 2, the nature brings the outcome, $x^i (i \in \{h, \ell\})$ according to the manager's effort. At time 3 , one of the signals, $y_i (i \in \{h, \ell\})$, is generated by the accounting information system and the owner compensates the manager based on the signal according to the agency contract. [6]

Denoting the manager's utility function as $U(s)$, the manager is assumed to be risk averse ($U'(s) > 0, U''(s) < 0$). The manager's reservation utility is denoted as $\underline{U}$. The owner is assumed to be risk-neutral and there exist the accounting regulations stated above. The compensations according to the accounting informations, y_h and y_ℓ, are denoted as s_h and s_ℓ respectively.

4. ANALYSIS

4.1 Under Information Symmetry

We now turn to the analysis of the model. The problem that the principal must solve in order to design the optimal contract can be stated as follows.

[6] In this paper, the maneger's capability for earnings management is not taken into account. Here, the manager is always supposed to have an incentive to manage the signal upwards. Under such conditions, the optimal character of the accounting information system that the owner chooses might be more conservative. See Chen et al. (2007) about the relation of the manager's earnings management and conservatism.

Program 1 (Moral Hazard Model).

$$\max_{\alpha_i,\beta,s_h,s\ell} P(x_h \mid e_h)\{x_h - P(y_h \mid x_h)s_h - P(y_\ell \mid x_h)s_\ell\}$$
$$+P(x_\ell \mid e_h)\{x_\ell - P(y_h \mid x_\ell)s_h - P(y_\ell \mid x_\ell)s_\ell\}$$

subject to

$$P(y_h \mid e_h)U(s_h) - D + P(y_\ell \mid e_h)U(s_\ell) \geq \underline{U} \qquad (PC)$$
$$P(y_h \mid e_h)U(s_h) - D + P(y_\ell \mid e_h)U(s_\ell) \qquad (PC)$$
$$\geq P(y_h \mid e_\ell)U(s_h) + P(y_\ell \mid e_\ell)U(s_\ell) \qquad (IC)$$
$$0 < \alpha_u \leq 1, 0 < \alpha_d \leq 1, 0 < \beta < \alpha_c \leq 1 \qquad (ARC1)$$
$$\underline{\beta} \leq \beta \leq \bar{\beta} \qquad (ARC2)$$

Constraint is divided into three types; the participation constraint (PC), the incentive compatibility constraint (IC), and the accounting regulation constraint (ARC). [7]

First, consider the benchmark situation. If the owner solves the basic model under information symmetry, that is, if the level of effort the manager chooses is verifiable, the owner finds $s_h = s_\ell$ by using of the PC and Jensen's inequality. Thus, s^*, the first-best compensation schedule for e_h, denoting the inverse function of $U(s)$ as $U^{-1}(s) \equiv \phi(s)$, is fixed as given below:

$$s^* = \phi(D + \underline{U}).$$

The optimal fixed compensation is determined only by the manager's disutility of exerting high effort and his/her reservation utility. The more they increase, the more the optimal compensation increases, because $\phi(s)$ is an increasing function under the assumption of $U' > 0$, that is, $\phi'(s) > 0$. The owner's expected utility is represented below:

$$px_h + (1-p)x_\ell - \phi(D + \underline{U}).$$

The expected utility of the owner is found not to vary with the character of the accounting information system, because the above expression does not involve either α or β.

4.2 Under Information Asymmetry

Now, let us consider a situation of information asymmetry in which the manager's choice is not verifiable. The basic model for the owner can be easily solved graphically for s_h and s_ℓ. In Figure 10, the PC and the IC are plotted. The shadow area is a set of the combination of s_h and s_ℓ that the owner can offer the manager under these two conditions. In this case, the optimal combination for the owner is point Q, the intersection of PC and IC, because the owner is motivated to minimize compensation. Therefore, the optimal combination is the solution to the simultaneous equations of PC and IC.

The optimal compensation is as follows:

$$s_h^* = \phi\left(\underline{U} + \frac{D[1-\alpha_d(1-\alpha_c\alpha_u)]}{p\alpha_d\alpha_u\beta}\right)$$
$$= \phi\left(\underline{U} - \frac{D(1-\alpha_c\alpha_u)}{p\alpha_u\beta} + \frac{D}{p\alpha_d\alpha_u\beta}\right),$$
$$s_\ell^* = \phi\left(\underline{U} - \frac{D(1-\alpha_c\alpha_u)}{p\alpha_u\beta}\right).$$

[7] If owners have the power to set accounting standards, the demand from inside the company will be reflected in them. In fact, accounting standards have been raised by social demands both from the inside and outside companies, which is why they are called generally accepted accounting principles (GAAP). Although nowadays, accounting standards have evolved to be set in terms of operating markets properly, there is a lack of solutions on how to set standards. They are often developed and applied by a political process, described by Zeff (1978) as "delicate balancing." Refer to Scott (2006) for more about the fundamental problem of financial accounting.

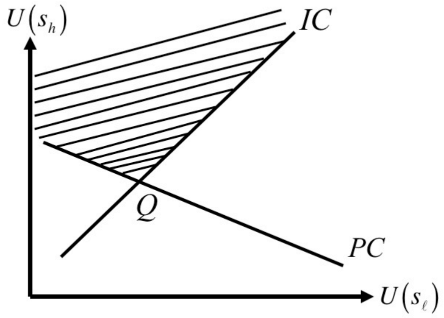

Figure 10: The feasible set of compensation schedules

We observe that $s_h^* > s_\ell^*$, where s_ℓ^* is lower than the reservation utility $\underline{U}$, while s_h^* exceeds it. The difference $D/(p\alpha_d\alpha_u\beta)$ represents the premium necessary to induce high effort. This premium decreases with respect to p, α_d, α_u, and β.

In particular, as β increases, the precision of the accounting information system improves, which means that the manager's effort is more accurately reflected in the accounting signals. Consequently, the required premium diminishes.

Similarly, α_u and α_d represent the degrees of conservatism: a larger α_u corresponds to stronger Type I conservatism, while a larger α_d implies weaker Type II conservatism. From the previous discussion, stronger Type I conservatism and weaker Type II conservatism enhance the usefulness of accounting reports in terms of information. Therefore, like β, they improve the contractibility of effort, leading to a reduction in the incentive premium.

The same reasoning applies to the probability of effort success p : as p increases, the mapping from effort to outcome becomes more reliable, thereby reducing the necessary premium. In contrast, a larger effort cost D raises the premium, as more substantial incentives are needed to compensate for the manager's burden.
Furthermore, the base component

$$\frac{D(1-\alpha_c\alpha_u)}{p\alpha_u\beta},$$

which determines the level of optimal compensation s_h^* and s_ℓ^*, also decreases with respect to $p, \alpha_c, \alpha_d, \alpha_u$, and β. This implies that the compensation amounts increase as the denominator becomes smaller.

Specifically, α_c captures the degree of Type III conservatism. A higher α_c (i.e., stronger conservatism) implies greater compensation. Even when the manager exerts high effort, there remains a possibility of low reported outcomes due to business risk represented by probability p. Type III conservatism enhances the informativeness of good news but limits the extent to which low outcomes can be rationalized as stemming from exogenous risk. As a result, to maintain the manager's incentive compatibility, compensation must be increased to offset this asymmetry.

4.3 Comparative Statics

Let the principal's total cost in equilibrium be C, which is given by:

$$C \equiv (s_h^* - s_\ell^*)[1-\alpha_u(\alpha_c - p\beta)]\alpha_d + s_\ell^*.$$

The principal determines the accounting information system parameters α_c, α_d, α_u, and β to minimize C and thereby maximize their utility. First, we examine whether the principal adopts Type II conservatism represented by α_d.

Proposition 1. *For any accounting information system parameters α_c, α_u, and β, Type II conservatism is not adopted: $\alpha_d = 1$.*

The result that Type II conservatism is not adopted can be understood intuitively. Type II conservatism impairs the usefulness of accounting information by introducing downward bias. Even when the manager exerts high effort, the high signal y_h becomes less likely to be observed, increasing the incentive cost for the manager. Therefore, the principal has no incentive to adopt Type II conservatism. In contrast, under the condition that Type II conservatism is not adopted, the principal always adopts Type I conservatism.

Proposition 2*. For any accounting information system parameters α_c and β, when Type II conservatism is not adopted ($\alpha_d = 1$), Type I conservatism is adopted: $\alpha_u = 1$.*

This result is also intuitively understandable. Although Type I conservatism introduces downward bias similar to Type II, it enhances the usefulness of accounting information. The downward bias increases the probability of observing the low signal y_ℓ, making the manager's effort less rewarded. However, when a high signal is observed, the probability that the manager has exerted considerable effort increases, enabling the principal to identify the manager's actions more accurately. This positive effect outweighs the negative effect, reducing the incentive cost for the manager. Therefore, the principal has an incentive to adopt Type I conservatism.

From these results, we find that the principal adopts Type I conservatism and does not adopt Type II conservatism, regardless of other accounting information system parameters. Next, assuming these results, we analyze α_c, representing Type III conservatism, and β, representing accounting information precision independent of conservatism.

Proposition 3. *When Type I conservatism is adopted and Type II conservatism is not adopted, for any accounting information system parameter α_c, the optimal accounting information precision independent of conservatism reaches its upper bound: $\beta = \bar{\beta}$.*

When the precision of the accounting information system (β) is high, the information usefulness of both good news and bad news improves. Consequently, it becomes easier to infer the manager's high effort from accounting information, reducing the manager's effort incentive cost. Similar to Type I conservatism, the principal always has an incentive to increase the precision of the accounting information system, thus adopting the highest possible β.

Owing to the tractability of our model, the parameters α_d, α_u, and β are all determined as corner solutions, invariant to other accounting system parameters.

Proposition 4. *When Type I conservatism is adopted and Type II conservatism is not, Type III conservatism is more likely to be adopted when business risk is sufficiently high and/or the optimal accounting information precision, independent of conservatism, is sufficiently high.*

High business risk means that the manager's efforts are unlikely to yield high outcomes. Consequently, the premium for inducing the manager's high effort must be increased. This simultaneously creates overpayment when high signals occur for low outcomes. The principal has an incentive to improve the information usefulness of good news to avoid this overpayment. Therefore, Type III conservatism may be adopted.

In Type III conservatism, the positive effect of reducing Type II error $P(y_h \mid x_\ell)$ for good news outweighs the negative effect of increasing Type I error $P(y_\ell \mid x_h)$, thereby improving the information usefulness of good news. Nevertheless, the negative effect of increasing Type I error $P(y_\ell \mid x_h)$ still exists. The precision of the accounting information system ($\bar{\beta}$) has the effect of reducing Type I error $P(y_\ell \mid x_h)$. Therefore, the higher the precision of the accounting information system $(\bar{\beta})$, the more effectively Type III conservatism can be exercised.

5. CONCLUSION

This paper proposes a unified analytical framework that reconceptualizes accounting conservatism as downward informational bias within the accounting information system. By rigorously modeling this bias structure, we formally demonstrate that only three internally consistent types of conservatism-unconditional, discretionary, and conditional - are theoretically possible. Building on this classification, we design a generalized information system that nests all three forms and enables comparative analysis under a common modeling environment.

Rather than attempting to derive novel insights into incentive design, the primary purpose of this study is to validate and demonstrate the analytical functionality of this information system. By embedding it into a standard principal-agent model with moral hazard, we examine how each form of conservatism affects reporting behavior and contract design. The results confirm that unconditional conservatism consistently enhances signal quality and is always optimal; discretionary conservatism uniformly degrades informativeness and is never selected; and conditional conservatism is optimal only in high-risk environments with precise signals.

Notably, our framework reveals that conditional conservatism, that is defined as downward bias contingent on unfavorable signals, naturally corresponds to real-world accounting rules such as accounting for impairment and the lower-of-cost-ormarket principle. This alignment suggests that these rules can be interpreted as rational institutional responses to incentive and information asymmetries.

The central contribution of this study lies in the construction and validation of a flexible, tractable accounting information system that isolates the informational content of conservatism. This system provides a theoretical foundation for future research on conservative reporting, enabling scholars to model diverse regulatory environments and incentive settings within a unified analytical framework.

Future research can extend this framework in several directions. For unconditional conservatism (α_u), introducing a social cost to adopting conservatism may allow researchers to analyze the informational delay between accounting earnings and market valuation, the trade-off between historical cost and fair value accounting, or the incremental role of cash flow disclosures in valuation. For discretionary conservatism (α_d), although it is never chosen in the current stylized setting, it may become rational when opportunistic managerial incentives are introduced. For instance, extending the model to incorporate corporate income taxes could provide a basis for analyzing discretionary conservatism as a tax-motivated reporting strategy, enabling researchers to investigate how managerial discretion in reporting interacts with regulatory arbitrage and tax minimization behavior.

By clarifying the theoretical structure of conservative reporting and providing a modular tool for its analysis, this paper lays the groundwork for future theoretical studies on accounting regulation, standard-setting, and contracting under asymmetric information.

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APPENDIX

The variables are defined as follows:

$$A_H \equiv \underline{U} + \frac{D[1-\alpha_d(1-\alpha_c\alpha_u)]}{p\alpha_d\alpha_u\beta}, \qquad A_L \equiv \underline{U} - \frac{D(1-\alpha_c\alpha_u)}{p\alpha_u\beta},$$
$$M \equiv \alpha_d[1-\alpha_u(\alpha_c - p\beta)], \qquad \Delta s \equiv s_h^* - s_\ell^*.$$

Proof of Proposition 1

Taking the partial derivative of the principal's cost C with respect to α_d :

$$\frac{\partial C}{\partial \alpha_d} = -\frac{D\phi'(A_H)M}{p\alpha_d^2\alpha_u\beta} + \frac{\Delta s M}{\alpha_d}$$
$$= \frac{M}{\alpha_d}\left[\Delta s - \frac{D\phi'(A_H)}{p\alpha_d\alpha_u\beta}\right].$$

By the mean value theorem, for some $t \in (A_L, A_H)$, we have:

$$\Delta s = \phi(A_H) - \phi(A_L) = \phi'(t)(A_H - A_L) < \phi'(A_H)(A_H - A_L) = \frac{D\phi'(A_H)}{p\alpha_d\alpha_u\beta}.$$

where the inequality holds due to the strict convexity of ϕ.

Therefore:

$$\frac{\partial C}{\partial \alpha_d} = \frac{M}{\alpha_d}\left[\Delta s - \frac{D\phi'(A_H)}{p\alpha_d\alpha_u\beta}\right] < 0.$$

The proof is thus complete.

Proof of Proposition 2

Taking the partial derivative of the principal's cost C with respect to α_u :

$$\left.\frac{\partial C}{\partial \alpha_u}\right|_{\alpha_d=1} = (\alpha_c - p\beta)\left[\frac{D\phi'(A_L)}{p\alpha_u\beta} - \Delta s\right].$$

Since $\alpha_c - p\beta > 0$ by assumption, the sign of the derivative depends on the comparison between $D\phi'(A_L)/(p\alpha_u\beta)$ and Δs. By the mean value theorem, for some $t \in (A_L, A_H)$, we have:

$$\Delta s = \phi(A_H) - \phi(A_L) = \phi'(t)(A_H - A_L) > \phi'(A_L)(A_H - A_L) = \frac{D\phi'(A_L)}{p\alpha_u\beta}.$$

Therefore:

$$\left.\frac{\partial C}{\partial \alpha_u}\right|_{\alpha_d=1} = (\alpha_c - p\beta)\left[\frac{D\phi'(A_L)}{p\alpha_u\beta} - \Delta s\right] < 0.$$

The proof is thus complete.

Proof of Proposition 3

Taking the partial derivative of the principal's cost C with respect to β :

$$\left.\frac{\partial C}{\partial \beta}\right|_{\{\alpha_d=1,\alpha_u=1\}} = \left[\phi'(A_H)A_H' - \phi'(A_L)A_L'\right][1 - (\alpha_c - p\beta)] + [\phi(A_H) - \phi(A_L)]p + \phi'(A_L)A_L'$$
$$= -\frac{D}{p\beta^2}\left[\phi'(A_H)\alpha_c - \phi'(A_L)(1 - \alpha_c)\right][1 - (\alpha_c - p\beta)]$$
$$+ [\phi(A_H) - \phi(A_L)]p + \phi'(A_L)A_L'.$$

Applying the mean value theorem and the strict convexity of ϕ, we obtain:

$$[\phi(A_H) - \phi(A_L)] \le (A_H - A_L)\phi'(A_H) = \frac{D}{p\beta}\phi'(A_H).$$

Therefore:

$$\left.\frac{\partial C}{\partial \beta}\right|_{\{\alpha_d=1,\alpha_u=1\}} \le -\frac{D}{p\beta^2}\alpha_c\phi'(A_H)(1 - \alpha_c + p\beta) + \frac{D}{\beta}\phi'(A_H) - \frac{D}{p\beta^2}(1 - \alpha_c)\phi'(A_L).$$

Comparing the coefficients of $\phi'(A_H)$ in the first and second terms, given the assumptions $0 < \alpha_c(1 - \alpha_c + p\beta) < 1$ and $0 < \beta < \alpha_c < 1$:

$$-\frac{D}{p\beta^2}\alpha_c(1-\alpha_c+p\beta)+\frac{D}{\beta}=-\frac{D}{p\beta^2}[\alpha_c(1-\alpha_c+p\beta)-p\beta]$$
$$=-\frac{D}{p\beta^2}[(1-\alpha_c)(\alpha_c-p\beta)]<0.$$

Thus:

$$\left.\frac{\partial C}{\partial \beta}\right|_{\{\alpha_d=1,\alpha_u=1\}}\leq -\frac{D}{p\beta^2}\alpha_c\phi'(A_H)(1-\alpha_c+p\beta)+\frac{D}{\beta}\phi'(A_H)-\frac{D}{p\beta^2}(1-\alpha_c)\phi'(A_L)$$
$$<0.$$

Hence, $\frac{\partial C}{\partial \beta}<0$ over the interior of the domain, and the principal's cost is decreasing in β. Therefore, the optimal value is attained at the upper bound $\beta=\bar{\beta}$. The proof is thus complete.

Proof of Proposition 4

Taking the partial derivative of the principal's cost C with respect to α_c :

$$\left.\frac{\partial C}{\partial \alpha_c}\right|_{\{\alpha_d=1,\alpha_u=1,\beta=\bar{\beta}\}}=(1-\alpha_c+p\bar{\beta})(A_H-A_L)\left[\phi'(A_H)-\phi'(A_L)\right]$$
$$+\left\{\phi'(A_L)(A_H-A_L)-[\phi(A_H)-\phi(A_L)]\right\}.$$

The term within the curly brackets, $\phi'(A_L)(A_H-A_L)-[\phi(A_H)-\phi(A_L)]$, is negative due to the strict convexity of ϕ, which implies that the secant line lies strictly below the tangent at A_L by the mean value theorem. Since $A_H-A_L>0$ and $\phi'(A_H)-\phi'(A_L)>0$ by the monotonicity of ϕ', the sign of the total derivative is positive if the weight ($1-\alpha_c+p\bar{\beta}$) is sufficiently large. Otherwise, the negative second term dominates.

From the assumptions, we have $0<1-\alpha_c+p\bar{\beta}<1$ and $\bar{\beta}<\alpha_c\leq 1$. Therefore:

$$1-\alpha_c+p\bar{\beta}<1-\bar{\beta}(1-p).$$

Hence, a smaller p and/or larger $\bar{\beta}$ makes the total derivative more likely to be negative, suggesting that the principal's cost decreases with α_c. This reinforces the incentive to adopt conservatism under such conditions. The proof is thus complete.