A Model of Principles-Based vs. Rules-Based Standards∗

Pingyang Gao  Haresh Sapra  Hao Xue
Chicago Booth  Chicago Booth  NYU Stern
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Abstract

We develop a model to investigate how a reporting standard should be designed to assess the economic substance of a transaction. By relying on quantifiable evidence, a rules-based standard induces evidence management whereas by relying on management’s professional judgement, a principles-based standard induces abuse of discretion. We show that the optimal standard takes a simple and intuitive form: for sufficiently positive evidence, it relies on the manager’s professional judgement; otherwise, a strict rule is applied. Stated differently, to get a favorable treatment, a transaction has to satisfy two hurdles: the evidence for the transaction must be sufficiently positive and the manager must also exercise professional judgement. We also examine how the optimal standard depends on several parameters of our environment such as the reliability of the evidence and the quality of enforcement of the standard.

Keywords: Principles-Based Standards, Rules-Based Standards, Professional Judgement, Optimal Standards.

JEL Classification: M41, M49, G28, G38

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1 Introduction

The extent to which reporting standards should be rules–based rather than principles–based is a fundamental question about the optimal design of standards. As standards around the world converge to International Financial Reporting Standards and therefore become arguably more principles–based, this question will only take on added significance. The revenue recognition standard entitled “Revenue from Contracts with Customers” issued jointly by the Financial Accounting Standards Board and the International Accounting Standards Board in May 2014 is a case in point. The standard is viewed as being largely principles–based because one would require significant judgement in implementing it (Katz (2014)). It supersedes the current revenue recognition standard that has been criticized for being overly rules–based in terms of providing detailed industry–specific bright line guidance that does a poor job at capturing the economics of complex transactions (McConnell (2014)). Moreover, rules–based standards have also been criticized as they ”often provide a vehicle for circumventing the intention of the standard” (SEC, 2003). However, practitioners do not necessarily view principles–based standards as a panacea. Some have argued that, by relying on professional judgement, principles–based standards allow too much discretion that could be exploited by management (Levin, 2014). Furthermore, principles–based standards “may present enforcement difficulties because they provide little guidance or structure for exercising professional judgment by preparers and auditors” (SEC, 2003). Despite its practical importance, theoretical guidance on the extent to which standards should rely on professional judgement is surprisingly sparse. Our objective in this paper is to provide a simple framework to weigh these issues. We develop an economic model that captures the above arguments and show that the trade–off between principles–based versus rules–based standards is indeed far from being one-sided. Given this trade-off, we ask several questions: (1) How should principles–based and rules–based elements be optimally combined to measure the economic substance of a transaction? (2) What form does the optimal standard take? (3) What are the properties of the optimal standard?

Our model consists of a standard setter and a firm’s insiders, i.e., the firm’s manager. The standard setter designs a reporting standard that accurately portrays the firm’s financial
condition to its outsiders. In particular, the standard setter designs a reporting standard that stipulates how quantifiable evidence and/or professional judgement should be used to assess the economic substance of a transaction. However, the standard setter and the manager have conflicting preferences: while the standard setter prefers the transaction to be faithfully represented, the manager prefers to paint a rosy picture of the transaction. For a given standard, the manager can improve the likelihood of receiving a favorable treatment for a transaction by tampering with the implementation of the standard in two ways. First, after receiving initial evidence about the transaction, she may engage in costly evidence management to boost the quantifiable evidence. Second, whenever the manager has the discretion to utilize her professional judgement to determine the appropriate accounting treatment for the transaction, she may abuse that discretion to misclassify the transaction. However, the ability of the manager to abuse her discretion depends on how well the standard is enforced. Enforcement ensures that the manager’s professional judgement is used appropriately in assessing the economic substance of a transaction. As the quality of the enforcement of the standard improves, the manager is less able to act opportunistically. The standard, the quality of enforcement, potential evidence management, and abuse of discretion jointly determine the report.

To motivate our model, consider the revenue recognition standard. The standard aims to measure whether a firm has transferred control of its products to its customers. To assess the transfer of control, various types of evidence may be collected. Certain types of evidence—such as product shipment—are relatively easy to quantify and can therefore be written in a rule. However, other types of evidence—such as the likelihood that the customer might return the products—are inherently subjective, consequently much harder to quantify and incorporate in a rule. Such non–quantifiable evidence may only be incorporated indirectly into the reporting process if the manager is allowed to exercise professional judgement. We refer to a standard that relies exclusively on quantifiable evidence as a (pure) rules–based standard. An example could be “revenue is recognized if products have been delivered to customers.” While such a rules–based standard can be easily enforced, it induces evidence management. By engaging in channel stuffing, the manager may prematurely recognize revenue even though
the firm may still retain control over the products. Conversely, we refer to a standard that leaves the recognition of the transaction entirely to the manager’s professional judgement as a (pure) principles–based standard. An example could be “revenue is recognized if, in management’s opinion, the majority of the risks and rewards associated with the products has been transferred to customers.” Such a principles–based standard now allows management to incorporate both quantifiable and non–quantifiable information in assessing the transfer of control. However, enforcement of the standard is no longer straightforward. If enforcement fails, the manager may exploit the discretion allowed by the standard by prematurely recognizing revenue even though she knows that the products are highly likely to be returned.

We study the design of the optimal standard under the frictions of evidence management and abuse of discretion. In principle, a standard could mix principles–based and rules–based elements in any arbitrary manner so that the space of possible standards could be very large. For example, a standard can prescribe favorable and unfavorable treatment for sufficiently good and bad evidence, respectively, but for intermediate evidence, leaves the treatment to management’s professional judgement. For another example, a standard can prescribe favorable treatment for intermediate evidence while for evidence that lies in the left and right tails, leave the recognition of the transaction to management’s professional judgement.

Our model generates several results. We first show that the optimal standard is fully characterized by a unique evidence threshold that combines rules–based and principles–based elements in a very specific way: below the evidence threshold, the standard adopts a rules–based element that prescribes the unfavorable treatment; above the evidence threshold, the standard uses a principles–based element that leaves the treatment to the manager’s professional judgement.

The broad intuition for the shape of the optimal standard is as follows. The standard setter designs the optimal standard in order to minimize two types of measurement errors: false alarm errors whereby an unfavorable report is issued even though the economic substance of the transaction is good and undue optimism errors whereby a favorable report is issued even though the economic substance of the transaction is bad. Consider an arbitrary standard that prescribes favorable or unfavorable treatments or defers to the manager’s professional
judgement for different intervals of quantifiable evidence. The optimal standard minimizes both types of errors via two modifications: (1) by moving all evidence intervals in which the unfavorable treatment is prescribed to the lower end of the evidence distribution, and (2) by simultaneously imposing professional judgement for the upper end of the evidence distribution. These two modifications reduce the measurement errors induced by the standard through two intertwined channels. First, the monotone likelihood ratio property (MLRP) of the evidence distribution suggests that it could be beneficial to move the intervals with unfavorable treatment to the lower end where the bad types are more likely to concentrate. Second, because the manager has incentives to issue a favorable report, it could be beneficial to impose professional judgement on the upper end of the evidence distribution where the good types are more likely to concentrate. By doing so, the standard not only directly reduces the likelihood of undue optimism errors but also indirectly dampens the manager’s incentives to engage in evidence management.

The result on the shape of the optimal standard has several implications for the debate on rules–based versus principles–based standards. First, in an environment plagued by potential evidence management and abuse of discretion, the optimal standard must necessarily contain both rules–based elements and principles–based elements. By relying on rules–based elements, the standard setter eliminates discretion and therefore the manager’s potential abuse of her professional judgement. In contrast, by relying on principles–based elements, the standard setter not only tackles the incidence of evidence management but also incorporates the manager’s non–quantifiable evidence to the extent that the standard can be effectively enforced. Second, and more interestingly, the shape of the optimal standard illustrates how rules–based elements and principles–based elements should be efficiently combined. Namely, the optimal standard prescribes principles–based elements only if the evidence is sufficiently favorable. Otherwise, the standard ignores the manager’s professional judgement and relies solely on quantifiable evidence in granting the unfavorable treatment. Stated differently, the optimal standard implies that, in order to get a favorable treatment, a transaction has to satisfy two hurdles: (1) the quantifiable evidence for the transaction must be sufficiently positive and (2) the manager must also exercise professional judgement to ensure that the favorable treatment
is indeed warranted.

We view the higher hurdle for favorable treatment relative to unfavorable treatment to be consistent with how current reporting standards are implemented in practice. The shape of the optimal standard implies that when faced with positive quantifiable evidence, the manager should not just view the rules as a check-list to get favorable treatment. Rather, the manager should also utilize her professional judgement to see if it concurs with the favorable evidence. Going back to our motivating example, the optimal standard implies that product delivery—a rules–based element—is only a necessary condition for revenue recognition. In practice, the manager must still exercise professional judgement about the likelihood that the products would be returned, a principles–based element, in order to recognize revenue. However, if product delivery has not occurred, it is quite unlikely that the manager would use her professional judgement to override the rule and prematurely recognize revenue.

We next characterize the unique evidence threshold that characterizes the optimal standard. The standard setter chooses the optimal threshold to minimize the expected cost of measurement errors associated with the report. A lower evidence threshold means that the standard incorporates more principles–based elements. While more reliance on professional judgement enables the manager to incorporate non–quantifiable information in the recognition, it also opens the door to managerial abuse of discretion, thereby altering the manager’s incentives to engage in evidence management. These factors jointly determine the optimal threshold.

Finally, we examine the equilibrium determinants of the optimal evidence threshold and investigate how it depends on several parameters of our model that capture various features of the transaction and/or the firm’s environment. We show that the optimal standard relies more on the manager’s professional judgement as (1) the quality of enforcement of the standard increases, (2) the reliability of quantifiable evidence increases, (3) the conflict of interest between the manager and the standard setter decreases, and (4) the cost of undue optimism errors decreases and/or the cost of false alarm errors increases.

The intuition for the above results are qualitatively similar so we only illustrate it for the result on enforcement. An increase in the quality of the enforcement of the standard has
two effects. First, it directly reduces the incidence of undue optimism errors by decreasing the likelihood that a manager who knows that the economic substance of the transaction is bad can abuse her discretion in order to get favorable treatment. Second, the anticipation of the reduced benefit of favorable evidence reduces managers’ ex-ante incentives to engage in evidence management that, in turn, increases the incidence of false alarm errors and simultaneously reduces the incidence of undue optimism errors. Both effects compel the standard setter to lower the threshold to restore the balance between false alarm and undue optimism errors. Better enforcement therefore allows the standard to rely more on the manager’s professional judgement. This confirms the argument made by practitioners that the quality of enforcement is an important ingredient for the proper implementation of principles-based standards.

2 Prior Literature

Our work is related to several strands of the literature. Dye (2002) is the first study that examines threshold design in reporting standards. Following Dye’s model, the subsequent literature (e.g., Fan and Zhang, 2012, Laux and Stocken, 2013, and Gao (2015)) has captured the rules-based element of reporting standard via thresholds. We also follow Dye’s model in the way we capture the rules-based element of a standard. However, unlike prior work, our model incorporates both principles-based and rules-based elements and we examine how they should be optimally combined. Cheng, Li, and Peng (2017) also investigate rules-based versus principles-based standards but the forces in their environment are different from ours. They model rules-based standard as a commitment to issuing a constant earnings ex-post and show that a principles-based standard has the advantage of allowing the manager to incorporate private information about the economic substance of a transaction. However, by committing to a constant report, rules-based standard has the benefit of deterring the manager from managing earnings.

Dye (1990) and Admati and Pfleiderer (2000) examine the informational externality of firm disclosures, Chen, Lewis, Schipper, and Zhang (2017) give conditions under which uni-
form standards on how firms report their information generate positive externality. Moreover, the externality of standards has also been studied from the political economy perspective. For example, Bertomeu and Cheynel (2013) compares the efficiency of different institutional designs for accounting standard setting, Bertomeu and Magee (2015b) and Friedman and Heinle (2016) explore the effects of political pressure and lobbying on standard setting, respectively. Using a voting mechanism among firms to choose accounting standards, Bertomeu and Magee (2011, 2015a) show how the properties of accounting standards are related to macroeconomic conditions and mandatory disclosure regulation, respectively. We take the existence of reporting standards as given and do not study the possible externality of accounting standards that justify the imposition of standards in the first place. In contrast, we focus on the optimal design of reporting standards to measure the economic substance of transactions.

Our paper is also related to the literature on optimal delegation (e.g., Holmstrom (1984), Melumad and Shibano (1991), Armstrong (1995), and Alonso and Matouschek (2008)). These studies show that—when contingent transfers are not feasible—giving discretion to biased but informed agents entails trading off the benefits of allowing such agents to utilize their private information to make efficient decisions against the costs of these agents acting opportunistically. This is similar to the principles–based element of our standard in that it allows managers full discretion to use their private information even though such discretion could also be used opportunistically. However, because our setting focuses on accounting standards, it also has features that are not present in the prior literature. For example, there is an observable signal (i.e., the quantifiable evidence) informative about the manager’s “type” in our model and the standard can depend directly on the signal. This, in turn, induces costly evidence management. Interestingly, the shape of our optimal standard is consistent with the main insight from this literature: the manager is given full discretion when she is less likely to behave opportunistically, i.e., when evidence is sufficiently favorable, the standard calls for professional judgement. Otherwise, the standard is rules–based so that the manager has no discretion.

Finally, the asymmetric feature of our optimal standard is reminiscent of the asymmetric monitoring result in some agency models and models studying conditional conservatism.
Early work such as Baiman and Demski (1980), Dye (1986), and Lambert (1985) investigate the value of acquiring additional information about the agent’s action above and beyond information about the agent’s output. The general insight from this work is that additional information about the agent’s action is more valuable after bad output is reported because it filters out the noise in the output and reduces the risk of the agent’s pay. The optimal reporting standard in our model requires a higher hurdle for favorable treatment relative to unfavorable treatment. This asymmetric feature shares some spirit with the conditional conservatism literature. In a similar spirit, Christensen and Demski (2004) study a setting in which the agent privately observes a noisy signal of output and can misreport it at no cost. Information about the agent’s action is now used to counteract the agent’s incentive to inflate the report and thus such information becomes more valuable after the agent reports favorable performance. Christensen and Demski (2004) relate the asymmetric feature to conservatism.

In our model, there are no explicit contracts but we model costly manipulation. However, by imposing professional judgement only for sufficiently favorable evidence, the standard setter not only directly reduces undue optimism errors but also indirectly dampens the manager’s incentives for evidence management.

There is also a growing empirical and experimental literature that measures the extent to which accounting standards are rules–based versus principles–based and the consequences of such standards on various outcomes of firms. For example, Folsom, Hribar, Mergenthaler, and Peterson (2015) show that while managers use the discretion inherent in principles–based standards to better communicate the economic substance of transactions, they may also abuse such discretion when their incentives are not aligned with those of outsiders and/or when the quality of enforcement of the standard is weak. Their empirical findings are consistent with our main results. Other empirical studies show rule–based standards affect firms’ reporting decisions (e.g., Agoglia, Doupnik, and Tsakumis, 2011; Nelson, Elliott, and Tarpley, 2002), firms’ litigation risk (e.g., Donelson, McInnis, and Mergenthaler, 2012), and the properties of firms’ earnings (e.g., Folsom, Hribar, Mergenthaler, and Peterson, 2015).

Section 3 presents the model. Section 4 analyzes the model and describes the results. Section 5 concludes by discussing some possible directions for future work. The Appendix
contains the proofs of the results.

3 The Model

Our model consists of four dates and two players: a firm’s insiders represented by its manager and a firm’s outsiders represented by a standard setter. The sequence of events is as follows:

1. At date 1, the standard setter designs a publicly observable reporting standard.

2. At date 2, Nature privately determines the economic substance \( \omega \) of a transaction. Before observing \( \omega \), the manager privately obtains initial evidence \( t \) about the transaction and decides whether to manipulate it at a cost. The quantifiable evidence \( t_m \) is realized after manipulation.

3. At date 3, the manager privately obtains additional (non-quantifiable) evidence about \( \omega \) and prepares the report according to the prevailing standard chosen at date 1.

4. At date 4, \( \omega \) becomes common knowledge and payoffs are realized.

The economic substance of the transaction, denoted as \( \omega \in \{G, B\} \) is either Good or Bad with probability \( q_G \) and \( q_B \equiv 1 - q_G \), respectively. The reporting process—which we elaborate on below—measures the economic substance of the transaction and produces a report \( r \in \{g, b\} \). We refer to \( r = g \) (b) as a favorable (unfavorable) report. The standard setter cares about the report’s informativeness and therefore seeks to minimize the following loss function:

\[
L = q_G L_G \Pr(r = b|\omega = G) + q_B L_B \Pr(r = g|\omega = B).
\] (1)

The objective function (1) is consistent with the goal of a standard setter such as the Financial Accounting Standard Board (FASB) of providing information useful for investors’ decision-making. \( L \) denotes the expected social cost of an inaccurate report, \( \Pr(r = b|\omega = G) \) is the probability of false alarm errors, and \( \Pr(r = g|\omega = B) \) is the probability of undue optimism errors. Both probabilities will be endogenously determined later. The false alarm errors result in decision loss of \( L_G \) while undue optimism errors lead to a loss of \( L_B \).
The manager’s preferences, however, are not necessarily aligned with those of the standard setter. While the latter prefers accurate reports, the former prefers to paint a rosy picture of the firm. In particular, the manager receives an incremental payoff of $\delta > 0$ from issuing a favorable report (relative to an unfavorable report). The parameter $\delta$ therefore captures the degree of the conflict of interest between the manager and the standard setter.

To focus exclusively on the design of standards, we model the misalignment of interests in reduced form. In particular, we take both the false alarm error $L_G$ and the undue optimism error $L_B$ as exogenously given. However, the misalignment can be endogenized in several ways. As one example, consider the external investors of a firm who rely on the firm’s report to make informed decisions about whether to invest in the firm’s project. $L_G$ is then the cost borne by investors who forgo a positive net present value (NPV) project upon receiving an unfavorable report, whereas $L_B$ is the cost borne by investors who invest in a negative NPV project upon receiving a favorable report. In contrast, regardless of the project’s profitability, the manager of the firm enjoys a private benefit $\delta$ as long as the external investors choose to invest in the project.

We now specify the standard design and the reporting process. The standard aims to measure a transaction’s economic substance $\omega$. To assess $\omega$, various types of evidence can be collected. Certain types of evidence are easier to quantify and can therefore be written in a rule. We refer to a standard that relies exclusively on such quantifiable evidence as a rules–based standard. However, other types of evidence are much harder to quantify because they are more qualitative in nature and hence cannot be directly incorporated in a rule. Such non-quantifiable evidence may only be incorporated indirectly into the reporting process if the manager is allowed to exercise professional judgement. We refer to a standard that leaves the recognition of a transaction entirely to the manager’s professional judgement as a principles–based standard.

More precisely, a standard is a mapping from quantifiable evidence, $t_m$, to a reporting treatment:

$$S(t_m) \rightarrow \{b, g, p\}.$$
As we explain next, the quantifiable evidence $t_m$ already incorporates the manager’s evidence management, if any. We refer to the mapping $S(t_m) = b$ (or $g$) as the rules–based element of a standard: a firm with quantifiable evidence $t_m$ receives the treatment $b$ (or $g$). Similarly, we refer to the mapping $S(t_m) = p$ as the principles–based element of the standard. It means that the treatment for the transaction with quantifiable evidence $t_m$ is left to management’s professional judgement. Stated differently, $S(t_m) = p$ implies that the manager whose quantifiable evidence is $t_m$ has the discretion to utilize her professional judgement to determine the appropriate treatment for the transaction.

For a given standard, the manager can influence the reporting process in two ways. First, she can engage in evidence management. More precisely, at date 2, before observing $\omega$, the manager privately observes the transaction’s initial quantifiable evidence $t$, which is drawn from a differentiable density $f^\omega(t)$ with cumulative density $F^\omega(t)$ over the real line $\mathbb{R}$. The density $f^\omega(t)$ satisfies the monotone likelihood ratio property (MLRP) so that if the manager gets sufficiently favorable evidence, i.e., observes a high value of $t$, she knows that the economic substance of the transaction is likely to be good. After observing the initial evidence $t$, the manager can boost the evidence by adding $m$ to the evidence $t$ at a cost of $C(m;c)$ where $C_m > 0$ for $m > 0$, and $C_c > 0$ so that a higher value of $c$ implies a higher cost of evidence management. The parameter $c$ can thus be viewed as a measure of the reliability of the quantifiable evidence, i.e., as $c$ increases, the evidence is harder to manage and hence becomes more reliable. The manipulated evidence $t_m \equiv t + m$ is the quantifiable evidence that is the input to the standard.

Second, the manager may also influence the reporting process if the manager’s professional judgement is called for by the reporting standard, i.e., $S(t_m) = p$. At date 3, the manager obtains additional evidence about $\omega$ above and beyond the quantifiable evidence $t_m$. For simplicity, we assume that all such evidence is non–quantifiable and allows the manager to perfectly learn $\omega$. While the manager may use her professional judgement to appropriately incorporate the non–quantifiable evidence, she may also be able to abuse it by acting opportunistically. An efficient enforcement system prevents managers from abusing their discretion by ensuring that managers appropriately use their professional judgement in recognizing a
transaction. In practice, the enforcement system consists of both internal and external governance mechanisms, such as the firm’s internal control system, its audit committee, its external auditor, whistle blowers, and regulators. These mechanisms together discipline the manager’s exercise of professional judgement. Instead of modeling any specific component of this complicated system explicitly, we capture it with a simple structure. When the manager abuses the professional judgment, she faces either no penalty (when the enforcement system is ineffective) or faces a penalty larger than $\delta$ (when the enforcement system is effective). We denote the effectiveness of the enforcement system by the parameter $\theta \in \{0, 1\}$ where $\theta = 1$ indicates that the enforcement system is effective and $\Pr(\theta = 1) = \tau$. At date 3, the manager observes the realization of $\theta$ before she decides how to exercise professional judgement.\(^1\) The parameter $\tau$ thus captures the quality of the enforcement system.\(^2\)

The equilibrium solution concept of our model is subgame perfect. An equilibrium consists of the manager’s evidence management and reporting strategies, and the standard setter’s choice of the standard such that both players’ decisions are optimal and consistent with each other in the sense of rational expectations.

To fix ideas, we return to our motivating example. Consider a firm that engages in a sales transaction in which it transfers goods to a buyer. The transaction’s economic substance $\omega$ is whether the firm has transferred control of the products to the customer. To measure $\omega$, a revenue recognition standard could incorporate quantifiable accounting evidence $t_m$ such as product delivery and/or allow the manager to use her professional judgement to assess whether the risks and rewards associated with the goods have been transferred to the buyer. The manager who knows that she will receive an order from a customer, i.e., privately observes $t$, may prematurely recognize revenue by either engaging in costly channel stuffing $m$ and/or by abusing the discretion allowed by the standard even though she knows that the products are highly likely to be returned.

\(^1\)Our results are robust to the alternative assumption that the manager exercises her professional judgement before the realization of $\theta$.

\(^2\)Note that, unlike principles-based standards, rules-based standards offer less discretion to managers and are therefore relatively easy to enforce. To ensure that rules are not violated, an enforcement system only needs to ensure that the rules have been followed. Otherwise, the penalties are large and would deter any violations. We therefore do not model the enforcement of rules-based standards and simply assume that they are self-enforcing. See Donelson, McInnis, and Mergenthaler (2012) for supporting evidence.
4  Analysis

4.1  Shape of the Optimal Standard

We first identify the optimal standard and then characterize its properties. We start by formalizing the standard space over which we search for the optimal one. Recall that a standard is a mapping from (potentially manipulated) evidence \( t_m \) to one of the three possible treatments (\( b, g \) or \( p \)). Since \( t_m \) is a scalar, it is convenient to characterize the standard as a partition over \( t_m \). For a given standard \( S \), the support of \( t_m \) can be partitioned into \( N \) consecutive intervals, denoted as \( I_n \), where \( n = 1, 2, \ldots N \), such that the standard assigns the same treatment (\( b, g \) or \( p \)) for evidence in the same interval but assigns different treatments for evidence in adjacent intervals. Mathematically, we have (i) \( S(t_m) = S(t'_m) \forall t_m, t'_m \in I_n \) and (ii) \( S(t_m) \neq S(t'_m) \forall t_m \in I_n, t'_m \in I_{n+1} \).

We next illustrate the characterization of a standard using three examples. One of the simplest possible rules-based standard is a rules-based standard that has a binary structure such that

\[
S(t_m) = \begin{cases} 
  g & \text{if } t_m \in I_2 \equiv [T, \infty), \\
  b & \text{if } t_m \in I_1 \equiv (-\infty, T). 
\end{cases}
\]

It is a pure rules-based standard because it specifies a treatment for any possible evidence, leaving no room for the manager to exercise professional judgement. A more complicated pure rules-based standard can take the following form:

\[
S(t_m) = \begin{cases} 
  g & \text{if } t_m \in I_3 \equiv [T_2, \infty), \\
  b & \text{if } t_m \in I_2 \equiv [T_1, T_2), \\
  g & \text{if } t_m \in I_1 \equiv (-\infty, T_1). 
\end{cases}
\]

An even more complicated standard can combine both the rules-based element and the
principles-based element in an arbitrary manner. One such example is

\[
S(t_m) = \begin{cases} 
    g & \text{if } t_m \in I_3 \equiv [T_2, \infty), \\
    p & \text{if } t_m \in I_2 \equiv [T_1, T_2), \\
    b & \text{if } t_m \in I_1 \equiv (-\infty, T_1).
\end{cases}
\]

This hybrid standard prescribes favorable and unfavorable reports for sufficiently good and bad evidence, respectively. But, for intermediate evidence, it allows the manager to exercise professional judgement.

The search for the optimal standard is complicated by two factors. First, the standard space is infinitely large. This is clear from the above definition because one can partition the support of the evidence \(t_m\) arbitrarily. Moreover, the presence of evidence management further complicates the standard design. We use the following example to demonstrate this layer of difficulty.

Consider two standards \(S\) and \(S'\) shown in Figure 1.

![Figure 1: The “global” effect of standard design on evidence management](image)

Both standards give the same treatment to all evidence \(t_m\) except for those in the interval \(I_N\). To be concrete, the example assumes that if the evidence \(t_m\) lies in \(I_N\), \(S\) prescribes the favorable treatment \(r = g\) for sure while \(S'\) requires that the manager also exercises professional judgement to ensure that \(r = g\) is indeed warranted. In the absence of evidence management, comparing the efficiency of these two standards is straightforward because the comparison can be restricted to comparing the measurement errors in interval \(I_N\) alone. In this particular example, standard \(S'\) strictly dominates standard \(S\): given that the manager has perfect information, there are no false alarm errors over the interval \(I_N\) under both \(S'\)
and $S$. Furthermore, as long as the enforcement of the standard is effective, the likelihood that $\omega = B$ and $r = g$ is strictly lower over the interval $I_N$ under $S'$ than under $S$.

However, once one takes into account evidence management, comparing the efficiency of $S$ and $S'$ is no longer trivial. The comparison is now complicated because it cannot be restricted by simply comparing the measurement errors over the interval $I_N$. Replacing $S(I_N) = g$ with $S'(I_N) = p$, i.e., change the treatment of the transaction in only one interval, alters the incentives of evidence management for all managers whose (un-manipulated) initial evidence $t$ lies below the interval $I_N$. Managers with initial evidence $t \in \bigcup_{n=1}^{N-1} I_n$ may now choose not to manipulate evidence $t$ to the interval $I_N$ even though they would have done it had the standard been $S$. Therefore, in order to compare the efficiency of the two standards $S$ and $S'$, one needs to keep track of the manager’s evidence management activity for all evidence $t \in \bigcup_{n=1}^{N-1} I_n$ even if the standard only changes its treatment over the interval $I_N$. Stated differently, a local change of the standard has a global effect on the manager’s evidence management. It is this global nature of induced changes in evidence management that complicates the comparison of any two standards and therefore the search for the optimal standard.

Despite the difficulties discussed above, the proposition below shows that, without loss, we can confine our attention to a particular type of standard that takes a surprisingly simple form.

**Proposition 1** The optimal standard is fully characterized by a unique threshold $T$ such that

$$S(t_m) = \begin{cases} p & \text{if } t_m \geq T \\ b & \text{if } t_m < T. \end{cases}$$

Under the optimal standard, a favorable treatment is granted only when the evidence is sufficiently positive and the manager uses her professional judgement to ensure that the favorable treatment is indeed warranted. Otherwise, the transaction receives an unfavorable treatment. In other words, when the evidence is weak, a strict rule is applied but when the evidence is strong, the manager can exercise professional judgement. The proof of the
Proposition is by construction and is therefore somewhat abstract given the level of generality it deals with. However, the basic idea behind the proof can be summarized as follows. For any given standard $S$, we can always construct a new standard $S'$ in the form described in Proposition 1, and, by judiciously choosing the threshold $T$ of the new standard $S'$, we show that the newly constructed standard (at least weakly) lowers the social loss $L$ from the level under the original standard $S$. To do so, we first calculate the implied false alarm errors and undue optimism errors for any given standard $S$, taking into account the manager’s evidence management. Second, we construct a new standard $S'$ that takes the form described in Proposition 1. Because the false alarm and undue optimism errors under the new standard $S'$ depend on the threshold $T$, we can choose $T$ so that the false alarm errors under the two standards ($S$ and $S'$) are the same. Finally, using the MLRP property of the evidence distribution, we show that undue optimism errors are weakly lower under our constructed standard $S'$ than under $S$.

4.1.1 Implications of the Optimal Standard

Proposition 1 implies that the optimal standard incorporates both rules–based elements and principles–based elements. This result is not surprising. Recall that, in designing the optimal standard, the standard setter tackles two frictions: the incidence of evidence management and the abuse of discretion. By incorporating rules–based elements, the standard setter eliminates discretion and therefore the manager’s misuse of her professional judgement. In contrast, by incorporating principles–based elements, the standard setter not only tackles the incidence of evidence management–but as long as the standard can be effectively enforced–the standard also incorporates the manager’s non–quantifiable evidence by utilizing the manager’s professional judgement.

Perhaps more interestingly, Proposition 1 illustrates how rules–based elements and principles–based elements should be efficiently combined. Namely, to get favorable treatment, the transaction must satisfy two hurdles: the quantifiable evidence for the transaction should be sufficiently positive and the manager must exercise professional judgement to ensure that the favorable treatment is indeed warranted. However, if the quantifiable evidence for the
transaction is not sufficiently positive, then the manager cannot exercise her professional
judgement to override the rule; instead the transaction automatically gets the unfavorable
treatment.

We believe that the higher hurdle for favorable treatment relative to unfavorable treatment
is consistent with how current accounting standards are implemented in practice. When faced
with favorable evidence, the optimal standard implies that the manager should not use rules
as a check-list to get favorable treatment. Rather, the manager should also utilize her
professional judgement to ensure that it does indeed concur with the favorable evidence. In
addition to our motivating example on revenue recognition, we now provide two additional
examples. First, consider a firm that seeks to obtain off–balance sheet financing through
operating lease treatment (a favorable treatment) for a leasing transaction. Under current
US reporting standards for leases, the manager uses four rules–based criteria to determine
whether the firm (lessee) bears most of the risks and rewards of owning the leased asset.
However, structuring the transaction so that it does not satisfy any one of the four leasing
criteria is unlikely to be sufficient for classification as an operating lease. The firm’s manager
should still use her professional judgement to ensure that the firm does not indeed bear most
of the risks and rewards of owning the asset. But if the transaction satisfies even one of the
criteria for capital lease treatment (i.e., there is unfavorable evidence), then it is less likely
that the manager would use her professional judgement to override the rule and recognize
the transaction as an operating lease. Consolidation accounting provides another example.
Consider a firm that owns the majority (50% or more) of the voting rights in a subsidiary.
Under current accounting standards, the firm would most likely consolidate the subsidiary’s
accounts in its financial statements (an unfavorable treatment). However, structuring the
firm’s ownership stake such that it owns less than 50% of the voting rights in the subsidiary
(favorable evidence) does not necessarily preclude consolidation. The firm’s management
should still utilize all other evidence to ensure that it is not the primary beneficiary of the
subsidiary’s risks and rewards.

Having established in Proposition 1 that the optimal standard is fully specified by a
unique threshold $T$, we next characterize the equilibrium threshold.
4.2 Equilibrium

At \( t = 3 \), the manager learns the transaction’s economic substance \( \omega \). Under the optimal standard, regardless of \( \omega \), the unfavorable report \( b \) is issued if the quantifiable evidence falls below the threshold, i.e., \( t_m < T \). Otherwise, the manager exercises professional judgement. In particular, given \( t_m \geq T \), the manager who observes \( \omega = G \) recognizes \( r = g \); the manager who observes \( \omega = B \) issues a favorable report if the enforcement system fails (\( \theta = 0 \)) and an unfavorable report otherwise. In summary, the manager’s reporting decisions depend on the observable evidence \( t_m \), the transaction’s economic substance \( \omega \), and the enforcement system \( \theta \) as follows:

\[
\begin{align*}
   r^*(t_m < T) &= r^*(t_m \geq T, \omega = B, \theta = 1) = b, \\
   r^*(t_m \geq T, \omega = G) &= r^*(t_m \geq T, \omega = B, \theta = 0) = g.
\end{align*}
\]  

At \( t = 2 \), the manager decides whether to manage evidence after observing the initial evidence \( t \) (but before observing \( \omega \)). Because the optimal standard is binary in nature, evidence management that doesn’t boost evidence \( t_m \) up to the threshold \( T \) or that pushes evidence \( t_m \) above \( T \) is wasteful. Therefore the manager prefers either \( t_m = t \) or \( t_m = T \). If the initial evidence already exceeds the threshold (\( t \geq T \)), the manager does not engage in evidence management, i.e., \( t_m = t \). Otherwise, the manager compares the expected payoffs from choosing between \( t_m = t \) and \( t_m = T \). If the manager chooses \( t_m = t < T \), or \( m = 0 \), she receives a payoff of 0. If she chooses \( t_m = T \) or \( m = T - t > 0 \), she incurs a cost of \( C(T - t) \) in return for an expected benefit of

\[
\Delta(t) = \Pr(\omega = G|t)\delta + \Pr(\omega = B|t)\delta(1 - \tau).
\]

The expected benefit \( \Delta(t) \) depends on the realization of the economic substance \( \omega \) at \( t = 3 \). If \( \omega \) is good, which occurs with probability \( \Pr(\omega = G|t) \), the manager receives the favorable treatment and enjoys benefit of \( \delta \). But if \( \omega \) is bad, the manager gets the payoff \( \delta \) only if she is able to abuse her discretion, resulting in a net expected payoff of \( \delta(1 - \tau) \). In all
other cases, the manager gets the unfavorable treatment and a net benefit of 0. This yields
the expression for $\Delta(t)$.

For a given standard with threshold $T$ and initial evidence $t < T$, the expected benefit
of evidence management $\Delta(t)$ is strictly increasing in $t$. To see this, note that $\Delta_t \equiv \frac{\partial \Delta}{\partial t} = \frac{\partial \Pr(\omega=G|t)}{\partial t} \delta(1-\tau) > 0$ where $\frac{\partial \Pr(\omega=G|t)}{\partial t} > 0$ is due to the MLRP property of the initial
evidence distribution. Intuitively, the manager who observes more favorable initial evidence
is more confident that the economic substance of the transaction will be good at $t = 3$ and
thus the expected benefit of meeting the threshold $T$ at $t = 2$ is larger. On the other hand,
the cost of evidence management $C(T-t)$ is strictly decreasing in $t$. A manager who observes
a higher $t$ needs to manipulate less in order to satisfy the threshold. Combining these two
observations, the manager’s net incentives to engage in evidence management is increasing
monotonically in her initial evidence $t$. Therefore, the optimal evidence management strategy
is characterized by a unique evidence threshold, say $\hat{T}$ at which the manager is indifferent
between manipulating or not manipulating. That is, evidence management threshold $\hat{T}$ as a
function of the threshold $T$ is defined implicitly by the equation

$$\Delta(\hat{T}(T)) - C(T - \hat{T}(T)) = 0. \quad (3)$$

Having determined the marginal type of the manager who engages in evidence manage-
ment, we can characterize the manager’s optimal evidence management strategy at $t = 2$:

$$m^*(t; T) = \begin{cases} T - t & \text{if } t \in (\hat{T}(T), T) \\ 0 & \text{otherwise} \end{cases} \quad (4)$$

Both functions $\hat{T}(T)$ and $m^*(t; T)$ capture certain aspect of evidence management. For
any given $T$, $\hat{T}(T)$ determines the marginal type of manager who manipulates evidence and
$m^*(t; T)$ measures the magnitude of evidence management by each manager with initial
evidence $t$.

The determination of the manager’s evidence management strategy at date 2 and the
manager’s reporting strategy at date 3 allows us to specify the ex–ante false alarm and
undue optimism errors as follows:

\[
\begin{align*}
\Pr(r = b | \omega = G) &= \int_{-\infty}^{\hat{T}(T)} f^G(x)dx \\
\Pr(r = g | \omega = B) &= (1 - \tau) \int_{\hat{T}(T)}^{\infty} f^B(x)dx.
\end{align*}
\]

Finally, at date 1, rationally anticipating the manager’s evidence management strategy at \( t = 2 \) and the manager’s reporting strategy at \( t = 3 \), the standard setter chooses the threshold \( T \) to minimize the social loss function, i.e.,

\[
\min_T L = q_G L_G \int_{-\infty}^{\hat{T}(T)} f^G(x)dx + q_B L_B (1 - \tau) \int_{\hat{T}(T)}^{\infty} f^B(x)dx
\]

subject to equation (3). (5)

The optimal threshold \( T^* \) is then determined by the first-order condition

\[
L_{T|T=T^*} = \left( q_G L_G f^G(\hat{T}(T)) - q_B L_B (1 - \tau) f^B(\hat{T}(T)) \right) \frac{\partial \hat{T}(T)}{\partial T} = 0. \quad (6)
\]

The intuition behind equation (6) that determines the optimal threshold is as follows. The threshold \( T \) affects the loss function through two channels. First, \( T \) affects the manager’s incentives to engage in evidence management. A standard with threshold \( T \) induces all managers with initial evidence exceeding \( \hat{T}(T) \) but lower than \( T \) to engage in evidence management. The relationship between \( T \) and \( \hat{T}(T) \) is implicitly defined by equation (3). Differentiating equation (3) with respect to \( T \), we obtain

\[
\frac{\partial \hat{T}}{\partial T} = \frac{C_m}{C_m + C_p} > 0.
\]

Thus, a higher threshold \( T \) makes it more difficult for managers to manipulate the evidence to satisfy the standard and thus shifts upwards the marginal type of manager who engages in evidence management.

Second, the induced evidence management affects the trade-off between the false alarm and undue optimism errors. An increase in \( \hat{T} \) increases the false alarm error at the rate of \( q_G f^G(\hat{T}) \) but simultaneously reduces the undue optimism error at the rate of \( q_B (1 - \tau) f^B(\hat{T}) \). Each error costs \( L_G \) and \( L_B \), respectively. Thus, the marginal effect of raising \( \hat{T} \) on the loss
function is

\[ H(\hat{T}) \equiv q_G L_G f^G(\hat{T}(T)) - q_B L_B (1 - \tau) f^B(\hat{T}(T)). \]  

(7)

Therefore, the optimal standard \( T^\ast \) is chosen so as to induce a \( \hat{T}^\ast \) that balance these two errors weighted by their respective costs to the investors, that is, \( H(\hat{T}(T^\ast)) = 0 \). This explains the first-order condition of equation (6).

Note that the first-order condition is necessary but may not be sufficient for \( T^\ast \) to be a maximizer. Given the general form of the distribution of evidence, the objective function \( L \) may not be globally concave and thus the second order condition may not be globally positive. Since we are interested only in the properties of the optimal threshold, we focus on the case when the second order condition is satisfied, that is, when \( \frac{\partial H(\hat{T}(T))}{\partial \hat{T}} \big|_{T=\hat{T}^\ast} > 0 \). Moreover, there could be multiple optimal solutions that satisfy the first-order condition and generate the same value. In this case, the standard setter can chooses any one of them and all subsequent results (comparative statics) are the same across the standard setter’s choices.

In summary, we have solved the model and the next result characterizes the equilibrium.

**Proposition 2** The standard setter’s choice of threshold \( T^\ast \) is characterized by the first-order condition (6). The manager’s evidence management strategy \( \hat{T}(T^\ast) \) and \( m^\ast(t; T^\ast) \) are characterized by equations (3) and (4). The manager’s reporting strategy \( r^\ast(t_m, \omega, \theta) \) is summarized in equation (2). The equilibrium is fully characterized by \( T^\ast \), \( m^\ast(t; T^\ast) \), \( \hat{T}(T^\ast) \), and \( r^\ast(t_m, \omega, \theta) \).

### 4.3 Properties of the Optimal Standard

Having characterized the optimal standard, we can now examine its properties. Note that as the threshold \( T^\ast \) decreases, the standard incorporates more principles–based elements. We next investigate how various features of the firm and/or the transaction affect the level of \( T^\ast \) and therefore the standard’s reliance on principles–based elements.

**Proposition 3** The optimal standard relies more on the manager’s professional judgement, i.e., \( T^\ast \) decreases, as
1. the quality of the standard enforcement increases (i.e., $\frac{dT^*}{d\tau} < 0$); or

2. the reliability of quantifiable evidence increases (i.e., $\frac{dT^*}{dc} < 0$); or

3. the conflict of interest between the manager and outsiders decreases (i.e., $\frac{dT^*}{d\delta} > 0$); or

4. the cost of undue optimism error (false alarm error) decreases (increases) (i.e., $\frac{dT^*}{dL_B} > 0$ and $\frac{dT^*}{dL_G} < 0$).

To understand the preceding comparative statics, recall that a standard with threshold $T$ induces the marginal evidence management level $\hat{T}$ that, in turn, balances the two types of measurement errors. Therefore, a change in any parameter in our environment affects the optimal standard in potentially two ways: it either directly affects the expected cost of the measurement errors and/or does so indirectly by changing the manager’s incentives to engage in evidence management.

We first illustrate the effect of the quality of standard enforcement $\tau$ on the optimal standard. An effective enforcement regime ensures that the manager exercises her professional judgement by appropriately utilizing her non–quantifiable evidence in preparing the report. Making it more difficult (by increasing $\tau$) for the manager to abuse her discretion has two effects. First, it directly reduces the probability of undue optimism errors by ensuring that the manager utilizes her knowledge about $\omega$ appropriately in recognizing the transaction. This, in turn, allows the standard setter to lower the threshold in order to reduce the false alarm errors. Second, because the favorable treatment requires both favorable evidence and the exercise of professional judgement, an effective enforcement regime also has an indirect effect of reducing evidence management. For better standard enforcement (i.e., a higher $\tau$), the manager anticipates that the favorable evidence obtained through evidence management is less likely to yield the favorable treatment. This effect, in turn, dampens her incentives to engage in evidence management, which means that the marginal evidence management level $\hat{T}$ is moving up and towards the nominal threshold $T$ specified in the standard. Since a higher marginal evidence management $\hat{T}$ would upsets the balance of the measurement errors by increasing the false alarm errors, the standard setting would set less restrictive standard in terms of a lower $T$ to restore the optimal balance of the measurement errors. In summary, a
more effective enforcement regime allows the standard setter to incorporate more professional judgement in the optimal standard.

We now turn to the cost of evidence management $c$. Part 2 of Proposition 3 implies that the optimal standard uses a lower threshold to trigger the principle-based element as it becomes more costly for the manager to manipulate evidence. At the first sight, this result may appear counter-intuitive: as the reliability of accounting evidence increases, the optimal standard relies less on the rule-based element of the standard. However, note that as the accounting evidence becomes more reliable, the manager manipulates less. The evidence is therefore “discounted” less, resulting in a lower optimal threshold. Stated differently, as the evidence becomes more reliable, the optimal threshold declines so that standard calls for professional judgement for less favorable evidence.

An alternative way to understand the inverse relationship between evidence management cost and threshold is as follows. As $c$ increases, it does not directly affect the trade-off between the two types of measurement errors. However, it increases the manager’s evidence management threshold. The higher evidence management threshold $\hat{T}$ induced by a higher cost of evidence management makes the false alarm errors more costly so that the standard setter lowers the optimal threshold in order to reduce the false alarm error. Thus, as the cost of evidence management increases, the optimal threshold is lower and the optimal standard relies more on the manager’s professional judgement.

Similarly, while the manager’s preference for a favorable treatment captured by the parameter $\delta$ doesn’t directly affect the trade-off between the two types of measurement errors, a higher $\delta$ increases the incentive for evidence management that, in turn, constrains the standard setter from lowering the threshold. Therefore, the standard relies more on the manager’s professional judgement as the preferences between insiders and outsiders are more aligned.

Finally, while the cost of the measurement errors, i.e., $L_G$ and $L_B$ does not affect the incentive for evidence management, it affects the trade-off between the types of measurement errors. As the cost of false alarms increases relative to the cost of undue optimism, (i.e., as $L_G$ increases relative to $L_B$), the standard setter lowers the threshold in order to reduce the cost of false alarms so that the standard relies more on principles-based elements.
5 Conclusions and Discussions

We developed a theoretical framework to study the trade-offs between principles-based vs. rules-based standards. We have shown that, in a second-best environment plagued with potential evidence management and abuse of discretion, the optimal standard incorporates both rules-based and principles-based elements. In particular, the optimal standard takes a simple and intuitive form that seems consistent with how standards are applied in practice: for sufficiently positive evidence, it relies on management’s professional judgement; otherwise, a strict rule is applied. Stated differently, to get a favorable treatment, our optimal standard implies that a transaction has to satisfy two hurdles: the evidence for the transaction must be sufficiently positive and the manager must also exercise professional judgement to ensure that the favorable treatment is indeed warranted.

Our model can be used as a springboard to enrich our analysis and provide additional insights into the optimality of rules-based vs. principles-based standards. We made some simplifying but important assumptions that could be relaxed in future work. For example—whenever called upon to make a professional judgement—we assumed that management’s non-quantifiable information about the economic substance of a transaction is perfect. This assumption, in turn, rules out any false alarm errors whenever the standard incorporates any principles-based element. Incorporating imperfect information in a principles-based setting would enrich the current analysis by capturing the drawback of relying management’s professional judgement. Another simplification of our study is that—whenever the standard incorporated a rules-based element—we assumed that the evidence manipulation technology is deterministic so that, in equilibrium, the standard-setter could perfectly anticipate and correct for the manager’s evidence manipulation. This, in turn, implies that evidence manipulation cannot affect the informativeness of the optimal standard. While this technology is commonly used in the prior literature (e.g., Stein (1989), Dye (2002) and Laux and Stocken (2013)), in general, evidence management could be stochastic in nature thereby impairing the informativeness of standards and reducing the desirability of rules-based standards. Finally, we captured the role of the external auditor in reduced form via an exogenous enforcement
mechanism. In practice, given an accounting standard, both the manager and the auditor use professional judgement to negotiate the appropriate treatment of a transaction. Auditor professional judgement, in turn, relies on both auditor independence and competence. Endogenizing the role of the auditor could yield additional insights into the desirability of principles-based standards.
6 Appendix

Proof of Proposition 1. The proof is by construction in three steps. First, for an arbitrary standard $S$, we identify its false alarm error and undue optimism error. Second, we construct a new standard $S'$ that takes the form claimed in Proposition 1. The false alarm and undue optimism error of the new standard $S'$ are characterized by a threshold $T$. We choose the threshold $T$ such that the false alarm error under the two standards are same. Finally, we show that the undue optimism error is at least weakly lower under the new standard $S'$ than under the original standard $S$, which completes the proof.

Consider a simple standard $S$ that does not prescribe $r = b$ to any interval of reported evidence, i.e., $S(t_m) \neq b$ for any $t_m$. Now construct a new standard $S'$ that takes the form of Proposition 1 and set $T = -\infty$. It is easy to see that constructed (pure principle-based) standard is weakly better than the original standard $S$ because there is no false alarm error under either standard, and the undue optimism error is at least lower under the new standard.

Now consider a more general standard $S$ that prescribes $r = b$ to some non-trivial interval(s) of reported evidence. Denote by $I_b(S)$ the set of reported evidence for which the standard $S$ prescribes $b$, that is:

$$I_b(S) \doteq \{t_m | S(t_m) = b\}. \quad (8)$$

Because the manger can manipulate evidence, the reported evidence $t_m$ can be different from the un-manipulated evidence $t$, which is governed by the exogenous distribution $f^G(\cdot)$ or $f^B(\cdot)$. Because the manager’s incentive of manipulating evidence is standard-dependent, we write the reported evidence $t_m = t_m(t,S)$ to emphasizes its dependence on the un-manipulated evidence $t$ and the standard $S$. Denote by $\hat{I}_b(S)$ the set of un-manipulated evidence $t$ that, after manager’s manipulation, lies in the set $I_b(S)$ defined in (8).

$$\hat{I}_b(S) \doteq \{t | t_m(t,S) \in I_b(S)\}. \quad (9)$$

In words, $\hat{I}_b(S)$ is the set of evidence that the manager chooses to accept $r = b$ by default
without even trying to engage in evidence management. Therefore, we can calculate the ex ante probability for a “good” type manager to receive \( r = b \) (i.e., false alarm) under the standard \( S \) as follows:

\[
m_{False}(S) = q_G \int_{\hat{I}_b(S)} f^G(t) \, dt,
\]

(10)

Similarly, denote by \( m_{Undue}(S) \) the ex ante probability that a “bad” type manager receives \( r = g \) (i.e., undue optimism) under \( S \). Note that \( m_{Undue}(S) \) satisfies the following:

\[
m_{Undue}(S) \geq q_B \left[ 1 - \int_{\hat{I}_b(S)} f^B(t) \, dt \right] (1 - \tau),
\]

(11)

where the inequality holds as a strict one except when all reported evidence \( t_m \) outside the set \( I_b(S) \) are subject to professional judgement (as opposed to receiving \( r = g \) by default).

Having calculated the measurement errors under the original standard \( S \), we turn to the second step: we construct a new standard \( S' \) that takes the form described in the proposition. Given a new standard \( S' \) that is characterized by a threshold \( T \), we show in Proposition 2 that there exists a unique threshold \( \hat{T} \) (with \( \hat{T} < T \)) such that the manager manipulates evidence upwards if and only if \( t \in [\hat{T}, T] \). In the language of (9), the set of evidence that the manager accepts \( r = b \) without even even trying to manipulate evidence is

\[
\hat{I}_b(S') = \{ t \mid t < \hat{T} \}.
\]

One can therefore calculate the ex-ante false alarm error under the new standard \( S' \) as

\[
m_{False}(S') = q_G \int_{t < \hat{T}} f^G(t) \, dt,
\]

and the ex-ante undue optimism probability as

\[
m_{Undue}(S') = q_B \left[ 1 - \int_{t < \hat{T}} f^B(t) \, dt \right] (1 - \tau).
\]

(12)

Note that, in designing the new standard \( S' \), we can pick the cut-off \( T \) so that false alarm error \( m_{False}(S') \) equals the false alarm error in the original standard \( S \) (calculated in (10).)
That is, we pick $T$ such that

$$
\int_{t<\hat{T}} f^G(t) \, dt = \int_{\hat{I}_b(S)} f^G(t) \, dt. \tag{13}
$$

We can do so because $m^{False}(S')$ is strictly monotonic in $\hat{T}$ and that there is a one-to-one relation between $\hat{T}$ and $T$ (proved in Proposition 2).

In the last step, we show that

$$
\int_{t<\hat{T}} f^B(t) \, dt \geq \int_{\hat{I}_b(S)} f^B(t) \, dt. \tag{14}
$$

That is, the “low” type manager is more likely to accept $r = b$ without even trying to manipulate evidence under the new standard $S'$ constructed above than under the original standard $S$. Note that, once we prove the inequality (14), we can show the following:

$$
m^{Undue}(S') = q_B[1 - \int_{t<\hat{T}} f^B(t) \, dt](1 - \tau) \leq q_B[1 - \int_{\hat{I}_b(S)} f^B(t) \, dt](1 - \tau) \leq m^{Undue}(S),
$$

where the first inequality is by (14) and the second inequality is by (11), which then completes the proof the proposition because the false alarm errors satisfy $m^{False}(S) = m^{False}(S')$ by construction (recall 13). Therefore, the remaining of the proof aims to prove (14).

More notation is required to prove (14) because, in order to calculate the right hand side of the of the inequality, we need to keep track of each of the interval(s) over which the original standard $S$ prescribes $S(t_m) = b$. Consider the general case in which $r = b$ is prescribed to $N$ intervals, denoted as $[b^n, B^n]$ for $n = 1, 2, 3, ..., N$. As we argued above, there exists a de-facto threshold $\hat{T}^n \in [b^n, B^n]$ in each of these interval such that the manager will choose to manipulate evidence if and only if $t \in [\hat{T}^n, B^n]$. Therefore, we can express (8) and (9) as $I_b(S) \equiv \cup_{n=1}^N [b^n, B^n]$ and $\hat{I}_b(S) \equiv \cup_{n=1}^N [b^n, \hat{T}^n]$, respectively. We construct a sequence of $N + 1$ points $-s_0, s_1, ..., s_N$ – to divide the interval $(-\infty, \hat{T})$ of the new standard $S'$ into $N$
subintervals. The sequence of points $s_n$ is chosen to satisfy the following properties:

$$\int_{s_{n-1}}^{s_n} f^G(t) \, dt = \int_{b^n}^{\hat{T}_n} f^G(t) \, dt, \quad \forall n = 1, 2, \ldots, N, \tag{15}$$

with $s_{n-1} < s_n$ and the boundary condition that $s_0 = -\infty$, and $s_N = \hat{T}$. The sequence of $s_n$ exists and is unique because we choose $\hat{T}$ to match the false alarm errors between the two standards, i.e., $\sum_{n=1}^{N} \int_{s_{n-1}}^{s_n} f^G(t) \, dt = \sum_{n=1}^{N} \int_{b^n}^{\hat{T}_n} f^G(t) \, dt$.

Having divided the interval $(-\infty, \hat{T})$ in the new standard $S'$ into $N$ subintervals, we prove the inequality (14) by showing that the claim holds for each subinterval as follows:

$$\int_{s_{n-1}}^{s_n} f^B(t) \, dt \geq \int_{b^n}^{\hat{T}_n} f^B(t) \, dt, \text{ for any } n. \tag{16}$$

Condition (16) follows from MLRP, which requires $\frac{f^G(t)}{f^B(t)}$ increase in $t$. Note that we can write the MLRP requirement equivalently as following

$$f^G(t) = f^B(t)a(t),$$

where $a(t)$ is a strictly increasing function of $t$.\(^3\) Suppose by contradiction that condition (16) fails, that is $\int_{s_{n-1}}^{s_n} f^B(t) \, dt < \int_{b^n}^{\hat{T}_n} f^B(t) \, dt$. Then we can show that, for any $n = 1, \ldots, N$,

$$\int_{b^n}^{\hat{T}_n} f^G(t) \, dt = \int_{b^n}^{\hat{T}_n} a(t) f^B(t) \, dt$$
$$> a(b^n) \int_{b^n}^{\hat{T}_n} f^B(t) \, dt$$
$$\geq a(s^n) \int_{b^n}^{\hat{T}_n} f^B(t) \, dt$$
$$> a(s^n) \int_{s_{n-1}}^{s_n} f^B(t) \, dt$$
$$> \int_{s_{n-1}}^{s_n} a(t) f^B(t) \, dt = \int_{s_{n-1}}^{s_n} f^G(t) \, dt,$$

\(^3\)It is without loss of generality to consider the case where $s^n \leq b^n$ for all $n$. If otherwise, we can take out the overlapping interval $[b^n, s^n]$ as it does not affect the ranking of the two standard $S$ and $S'$.  

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which contradicts condition (15). Hence, condition (16) holds. The second from the last inequality makes use of the (contradiction) assumption, and the first and the last inequality makes use of the fact $a(t)$ is strictly increasing. This completes the proof.

**Proof of Proposition 2.** The proof follows the arguments in the text.

**Proof of Proposition 3.** We consider a generic parameter $x \in \{\tau, c, \delta, L_G, L_B\}$. By applying the implicit function theorem to the standard setter’s first order condition (equation 6), we have

\[
\frac{dT^*}{dx} = -\frac{1}{SOC} \left( \frac{\partial H(\hat{T};x)}{\partial \hat{T}} \frac{\partial T^*(x)}{\partial x} + \frac{\partial H(\hat{T};x)}{\partial x} \right).
\]

Parameter $x$ affects the optimal threshold through two channels. First, $x$ affects the relationship between the optimal threshold $T^*$ and the manipulation threshold $\hat{T}$, $\frac{\partial H(\hat{T};x)}{\partial \hat{T}} \frac{\partial T^*(x)}{\partial x}$. Second, $x$ also affects the marginal effect of the manipulation threshold $\hat{T}$ on the regulator’s loss function, $\frac{\partial H(\hat{T};x)}{\partial x}$. The denominator $SOC$ is the second order condition of the standard setter’s minimization problem and thus $SOC > 0$. Moreover, $\frac{\partial H(\hat{T};x)}{\partial \hat{T}} > 0$ because $\frac{\partial H(\hat{T};x)}{\partial \hat{T}} = \frac{SOC}{\partial T^*(x)}$ and $\frac{\partial T^*(x)}{\partial \hat{T}} > 0$. Thus, the sign of $\frac{dT^*}{dx}$ is determined by that of $\frac{\partial T^*(x)}{\partial x}$ and $\frac{\partial H(\hat{T};x)}{\partial x}$.

For any given $T^*$, we differentiate equation 3 with respect to the parameters and obtain

\[
\frac{\partial \hat{T}(T^*; \tau)}{\partial \tau} = \frac{-\Delta_l}{\Delta_l + C_m} \frac{Pr(\omega = B|t)\delta}{\Delta_l + C_m} > 0,
\]
\[
\frac{\partial \hat{T}(T^*; \delta)}{\partial \delta} = \frac{-\Delta_l}{\Delta_l + C_m} \frac{Pr(\omega = G|t) + Pr(\omega = B|t)(1 - \tau)}{\Delta_l + C_m} < 0,
\]
\[
\frac{\partial \hat{T}(T^*; c)}{\partial c} = \frac{C_c}{\Delta_l + C_m} > 0,
\]
\[
\frac{\partial \hat{T}(T^*; L_G)}{\partial L_G} = \frac{\partial \hat{T}(T^*; L_B)}{\partial L_B} = 0.
\]

Similarly, for any given $\hat{T}$, we differentiate equation 7 with respect to the parameters and
obtain

\[
\frac{\partial H(\hat{T}; \tau)}{\partial \tau} = -q_B L_B f^B(\hat{T})(1 - \tau) > 0,
\]
\[
\frac{\partial H(\hat{T}; \delta)}{\partial \delta} = 0,
\]
\[
\frac{\partial H(\hat{T}; c)}{\partial c} = 0,
\]
\[
\frac{\partial H(\hat{T}; L_G)}{\partial L_G} = q_G f^G(\hat{T}) > 0,
\]
\[
\frac{\partial H(\hat{T}; L_B)}{\partial L_B} = -q_B f^B(\hat{T})(1 - \tau) < 0.
\]

Combining the signs of \( \frac{\partial H(\hat{T}; x)}{\partial \hat{T}} \) and \( \frac{\partial H(\hat{T}; x)}{\partial x} \), we obtain the sign of \( \frac{dT^*}{dx} \) and prove Proposition 3. \( \blacksquare \)
References


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