THE EARNINGS MANAGEMENT STRATEGY TO MEET OR BEAT THRESHOLDS

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ABSTRACT

Public firms are under pressure to repeatedly report earnings that meet or beat thresholds numbers. We study the impact of this pressure on the firm's menu of reporting strategies in a two-period principal-agent game with two types of firms: some are mainly concerned with meeting the first-period threshold; some prefer to do so in the second period. We confirm that without thresholds, the earnings management strategy is smoothing — overstating (understating) low (high) outcomes. With thresholds, the menu of reporting strategies is richer. Besides smoothing, firms take a bath, create "a cookie jar reserve," meet the threshold, beat the threshold by a very small margin, and beat it with larger margins. For some profiles of the thresholds, the average firm reports more conservatively than firms that smooth, while a few poorly-performing firms report so aggressively that they become compelled to restate in the following period. Hence, this study explains both the rich menu of reporting strategies besides smoothing, and the seeming paradox that some of the largest accounting scandals occur in the United States, which is renowned for having the lowest level of managed earnings.

Key words: Meeting or Beating a threshold, Earnings management, Repeated principal-agent contract, smoothing, "taking a bath," "cookie-jar reserve."

> Executives focus on thresholds for earnings because the parties concerned with the firm's performance do. [DeGeorge, Patel, and Zeckhauser, 1999, p.5]

1. Introduction

Empirical research has found that the pressure to meet or beat thresholds is a crucial determinant of reported earnings (for example, 85% of the 336 S&P 500 firms that reported second-quarter earnings by July 30 2010 met or beat analysts' expectations). [1] In this study, we examine the impact of the pressure to meet or beat thresholds repeatedly to explain (1) why the menu of reporting strategies is de facto so rich, given the consensus that the optimal strategy is smoothing: the report overstates low outcomes and understates high ones (Ronen and Sadan [1981], Dye [1988], Fudenberg and Tirole [1995], Demski [1998], Sankar and Subramanyam [2001], and others) and (2) why do the largest accounting scandals occur in the United States, which is renowned for having the lowest level of managed earnings (Dechow and Schrand, 2004; Leuz, Nanda, and Wysocki 2003).

We model the firm as a two-period contract between the board of directors and the manager. There are two types of firms: short-run- and long-run meet or beat (MBT) firms. The short-run MBT firms are firms whose survival depends on meeting short-run expectations, such as new firms that need to access the capital market to finance their growth. For them, meeting or beating the first period threshold is more important than doing so in the second period. The long-run MBT firms represent firms that may be forgiven for a temporary failure to meet a

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[1] Through July 30, 336 companies in the S&P 500 Index have reported earnings for Q2 2010, according to an analysis done by earnings tracking firm Thomson Reuters. Of these, 75% have reported earnings above expectations, 10% have reported earnings in line with expectations and 15% have reported earnings below expectations, says Thomson Reuters analyst John Butters.

Over the past four quarters, 76% of S&P 500 companies have beaten consensus estimates, 8% have matched expectations and 17% have missed estimates, says the Thomson Reuters report.

http://www.indiainfoline.com/Markets/News/US-earnings...75-percent-SandP-500-Cos-beat-estimates/4896795827.

threshold, such as value firms with a solid history of profitability and maximizing shareholders' value, or firms that change their business strategy. For them, meeting or beating thresholds in the second period is more important.

We confirm that firms that are not pressured to meet or beat thresholds smooth their earnings and they continue doing so when facing thresholds only when the smoothed report does not jeopardize beating the threshold in each period; otherwise they beat the thresholds. When the first-period's outcome is insufficient to meet or beat thresholds in both periods, the short-run MBT firm meets the first-period threshold at the lowest level of outcome and beats it marginally for higher outcomes. The long-run MBT firm hoards reported earnings to meet the threshold in the second period while minimizing the gap between the first-period- report and the first-period threshold. Specifically, it takes a bath when the first-period outcome is low, creates a cookie-jar reserve for higher outcomes, and meets the first-period threshold when the first-period outcome suffices to meet both periods' thresholds.

The equilibrium reporting strategies are such that short-run MBT firms report aggressively only when the first-period outcome is lower than the first-period threshold. For higher outcomes they report conservatively, and the long-run MBT firms always report conservatively. Hence, for some profiles of first- and second-period thresholds, an economy in which firms meet or beat thresholds ("MBT economy") may be more conservative than an economy of smoothers, while at the same time a few poorly-performing scandal firms report aggressively in the first period.

In addition to explaining why one observes a rich menu of reporting strategies and a coincidence of accounting scandals with conservative reporting, our study also refutes the popular claim that the pressure to meet or beat a threshold induces aggressive reporting (Levitt [1998], Graham et al. [2005], and Reed [2005]). We find that because firms also wish to hoard reported earnings to meet or beat future thresholds, they may on the average be conservative. We also show that the reporting strategies induced by thresholds are costly to investors as they induce the manager to exert more costly effort, resulting in wealth transfer from shareholders to managers.

Moreover, our study sheds light on why a substantial portion of public companies followed by analysts beat the consensus forecast by a penny rather than just meet it (Ronen and Yaari, 2008, p. 208, Durtschi and Easton, 2005, Figure 7, Koh, Matsumoto, and Rajgopal, 2008). We show that threshold beating may convey value-relevant information because the difference between the threshold and the report reveals the true outcome.

The paper proceeds as follows: Section 2 presents the model. Section 3 analyzes the benchmark cases of firms that neither meet or beat thresholds nor are restricted by GAAP. Section 4 presents the optimal reporting strategy and the likelihood of a restatement by firms that are under pressure to meet or beat thresholds. Section 5 discusses the demand for thresholds, and Section 6 examines whether the demand for thresholds is motivated by their impact on the effort exerted by the managers. A summary and conclusions are provided in Section 7. The optimization programs and proofs are relegated to Appendices A and B.

2. The Model

2.1 The Firm is a contract between the board of directors and management

The firm is a two-period, non-renegotiable, risk-sharing contract between the board of directors who represent shareholders, and the manager.[2] It generates earnings, x, $\underline{x} \leq x \leq \overline{x}$,

[2] Renegotiation affects the principal-agent contract (Demski and Frimor 1999; Christensen, Demski, and Frimor 2002, Gigler and Hemmer 2004; Feltham and Hofmann 2007; and others). In general, renegotiation reduces the welfare of the principal, which thus provides him with incentives to commit to not renegotiate (Aghion, Dewatripont, and Rey (1994).

that depend on a firm's period-specific parameter, a, a>0, and nature.[3] In what follows, we interchangeably refer to earnings as outcome.

The sequence of events is as follows: At the beginning of the first-period, the board of directors designs the manager's contract, S. The contract is based on reported earnings in periods 1 and 2, m_1 and m_2; i.e., $S \in \{S_1(m_1), S_2(m_1,m_2)\}$. By the end of each period, the firm generates earnings, x_t, t=1,2, that are observed by the manager alone. Afterwards, the manager reports an earnings number, m_t, t=1,2 and is reimbursed in accordance with the contract. Lastly, shareholders collect the residual value of the firm, $x_1+x_2- S_1(m_1)- S_2(m_1,m_2)$, net of additional costs, as described below.

2.2 The Reporting Flexibility

The total actual and reported earnings must be equal, $x_1+x_2=m_1+m_2$. We focus on the first-period report, m_1, $\underline{x}_1 \le m_1 \le \bar{x}_1$, because it determines the second-period report, m_2

$$\forall x_1,x_2,m_1, \quad m_2 \equiv x_2 + (x_1 - m_1). \qquad (1)$$

The firm may inflate earnings without violating Generally Accepted Accounting Principles (GAAP) if $m_1 \le x_1 + d$, d >0. If the firm violates GAAP in period 1 and an investigation at the end of period 2 reveals the violation, the firm must restate earnings at a cost C, C > 0.[4] An investigation is initiated only when the second-period report falls below the second-period minimum outcome, $m_2 < \underline{x}_2$. Thus the firm may violate GAAP in the first period

[3] In section 6, we let a be the unobservable effort exerted by the risk-averse, work-averse manager.

[4] Our characterization of C entails no loss of generality. Analyzing the cases where C is stochastic or C varies with the difference between the first-period report and GAAP earnings has no qualitative effect on the results because at the time of the decision on m_1, only the expected C matters, and the preferences of MBT firms are lexicographic: between two reporting strategies they are otherwise indifferent to, they choose the one that minimizes the chance of a restatement.

without detection when the second-period actual earnings, x_2, are sufficiently large to offset the deficit, $m_1–x_1$, in the first-period reported earnings.

2.3 The Importance of Meeting or Beating Thresholds

Several types of thresholds have been documented empirically: analysts' consensus forecasts (Bartov et al. 2002; Durtschi and Easton 2005), earnings of the same quarter of the previous year with/without growth (DeGeorge et al. 1999; Graham et al. 2005, DeAngelo et al. 1996; Barth et al. 1999, Kim 2002), zero income that separates profits from losses, or no decrease in earnings (Burgstahler and Dichev 1997; DeGeorge et al. 1999), and minimum earnings required by debt holders (Smith and Warner 1979).

We assume that thresholds exist because boundedly rational investors (see e.g., Abreu and Brunnermeir, 2003) use the threshold as a rule of thumb to evaluate performance. Earnings that meet or beat the threshold indicate strong performance and earnings that miss threshold are disappointing. The role of these investors in ensuring that the stock is traded in a liquid market prompts the firm to meet or beat thresholds. [See further discussion in section 5.]

Generally, when management is about to announce earnings, the manager knows the current period's and can anticipate next period's threshold. This is self evident in case the threshold is zero earnings or zero earnings change, and contractual covenants. In the case of the threshold being a consensus analysts forecast, the firm becomes aware of the thresholds through interaction with analysts who issue forecasts, and guiding the analysts' expectations through their own disclosures (Ronen and Yaari, 2008, Chapter 5).

In what follows, we denote the threshold in period t by T_t, $T_t \in [\underline{T}_t, \overline{T}_t]$. We assume that thresholds are nontrivial, $\underline{x}_i < T_t$, and achievable, i.e., $\underline{x}_t < \underline{T}_t \leq T_t \leq \overline{T}_t < \overline{x}_t$, t=1,2.[5]

2.4. The payoffs

the risk-averse manager maximizes his expected Von Neumann utility function over the stream of future incomes, E[U(S)].[6] We assume that the manager's utility over income is additively separable over time. That is, $E[U(S)] = E[U(S_1)] + E[U(S_2)]$, t=1, 2, where $U' > 0$, and $U'' < 0$. The manager is willing to participate in the contract if it guarantees him his reservation utility denoted by *u*. The objective function of the risk-averse board that does not attempt to meet or beat thresholds is to maximize expected utility, $E[V(x_1 + x_2 - S_1 - S_2)]$, $V' > 0$, $V'' < 0$.

MBT firms are of two types: short-run- and long-run. When earnings are not sufficient to meet or beat both periods' thresholds, the short run (long-run) MBT firms prefer to meet or beat thresholds in the first (second) period over meeting or beating the second (first) period. Short-run MBT firms include growth companies that raise capital, or firms owned by mostly transient institutional shareholders. Bushee (2001) finds that this group of shareholders tends to put more weight on short-run performance. To the extent that these investors rely on input from analysts (Reingold and Reingold, 2006), missing the threshold in the short run turns these investors away.

Long-run MBT firms include those that change their strategy, and value firms. Disappointing performance in the short run by a firm that is changing its strategy is forgiven in the hope that the new strategy will turn things around. If the threshold is missed after the change

[5] Our analysis also accommodates the case where T_2 is revised at the end of period 1 after m_1 is reported provided the relationship between the first-period report and second-period revised threshold is common knowledge.

[6] Prime as in U' and double prime as in U'' denote the first and second-order derivative, respectively.

in strategy, however, the firm is no longer considered a desirable investment prospect (consider, for example, Starbucks' plan to expand to China and the subsequent closing of thousands of coffee shops in the United States). Value firms are firms that have acquired a reputation for solid performance**.** Hence, missing a threshold just once would not threaten their survival. Repeatedly disappointed analysts, however, may stop coverage, chase away investors, and cause stock prices to plummet. This, in turn, increases the cost of capital, strains relations with customers and suppliers, and may induce investors to sue the firm for recovery under the Securities Acts (Ronen and Yaari, 2002; Evans, Kim, and Nagarajan, 2006; Li, 2009). Such firms can afford to miss a threshold in the short run, but not in the long run.[7]

Denoting by g the loss from failing to meet or beat a threshold in the period that is more important to the firm, and by *G*, the loss function from failing to meet or beat a threshold in the period that is less important to the firm,[8] and designating the fraction of long-run MBT firms in the economy by δ, the realized payoffs of short- and long-run MBT firms, denoted by $V_{1-\delta}$ and V_{δ} are, respectively

$$\forall x_1, x_2, T_1, T_2,$$

$$V_{1-\delta} = \begin{cases} -g, & \text{if } m_1 < T_1 \\ V(x_1 + x_2 - S_1(m_1) - S_2(m_1, m_2)) - G(T_2 - m_2) - \mathbf{1}_C C & \text{if } m_1 \geq T_1, \end{cases} \quad (2a)$$

$$V_{\delta} = \begin{cases} -g & \text{if } m_2 < T_2 \\ V(x_1 + x_2 - S_1(m_1) - S_2(m_1, m_2)) - G(T_1 - m_1) - \mathbf{1}_C C & \text{if } m_2 \geq T_2, \end{cases} \quad (2b)$$

[7] The stylized designation of period 1 as the "short run" and period 2 as the "long run" is meant to reflect what in reality are early and late stretches of quarters or years in the horizon of a company. The length of such stretches may vary across industries and firms.

[8] *g* is a scalar while *G* is a function indicating that the cost of missing the threshold in the more important period is independent of how far the report is from the threshold. In other words, the cost is arbitrarily large even if the threshold is missed by a very small amount.

where $\mathbf{1}_c$ is an indicator function that takes the value of 1 if the firm restates earnings and zero if not.

The conditions on G and g are:

(a) $G(.)$ is a piecewise positive, strictly increasing, strictly convex, function, if $T_t - m_t > 0$, $G>0$, $G'>0$, and $G''>0$. If $T_t - m_t \le 0$, $G = G' = G'' = 0$.[9]

(b) (i) $g > G(\overline{T}_2 - \underline{x}_1 - \underline{x}_2 + \overline{T}_1) + C$. (ii) $\forall T_s, x_t, x_s,\ gf(x_t | a_t) > G'(T_s - \underline{x}_s)$, $s,t = 1,2,\ s \neq t$. where $f(x|a)$ denotes the density function of earnings conditional on a. Condition (i) implies that a short-run MBT firm is better off meeting or beating the first-period threshold, even when it involves both violating GAAP and costly restatement and incurring the maximum possible loss for missing the threshold in the second period. Condition (ii) implies that long-run MBT firm is better off shifting a dollar report to m_2 to reduce the chance of missing the second-period threshold even if as a result, it incurs the cost of missing the threshold in the first period with certainty.[10]

2.4 Technicalities

We assume that all functions are twice continuously differentiable, and that all programs satisfy the Kuhn-Tucker conditions, and hence, the optimization programs have a unique optimum. Our assumptions on the density function of earnings conditional on the period's firm-

[9] Assuming the same loss function for both types when missing a threshold entails no loss of generality.
[10] Since the expected loss of missing the second-period threshold by a long-run MBT firm is $E(g) = \int_{\underline{x}_2}^{T_2+m_1-x_1} g f(x_2 | a_2) dx_2$, the marginal increase in expected second-period loss with respect to the first-period report, m_1, is $gf(x_2 | a_2)|_{x_2 = T_2 + m_1 - x_1}$.

specific parameter, $f(x|a)$, are: (a) its support, $[\underline{x}, \overline{x}]$, is compact and convex[11], and (b) $f(x_1|a_1)$ and $f(x_2|a_2)$ are independent.

3. A Benchmark: The board does not induce the manager to meet or beat thresholds

The board designs the manager's compensation by solving the following program:

$$\underset{M(x_1),S}{\text{Max}} \quad E[V(x_1+x_2-S_1(m_1)-S_2(m_1,m_2))]$$

s.t. $\quad E[U(S_1(m_1),S_2(m_1,m_2))] \geq u.$ (PC)

$$\forall x_1,\ m_1 \in \underset{\underline{x}_1 \leq m_1 \leq \overline{x}_1}{\text{argmax}}\ E[U(S_1(m_1), S_2(m_1, m_2))]. \qquad \text{(IC.}m\text{)}$$

(PC) states that the manager is willing to sign the contract if it guarantees him at least his reservation utility level, u. The (IC.m) constraint formalizes the manager's self-interested choice of the first-period report, m_1.

Definition 1:

(a) A "truth-telling" report: the first-period report equals the first-period outcome, $m_1=x_1$.

(b) A "smoothing" strategy: the first-period reports overstate low first-period outcomes and understate high first-period outcomes. That is, there is a critical value of x_1, x_1^c, such that $\forall x_1 < x_1^c$, $m_1(x_1|x_1< x_1^c) > x_1$, $\forall x_1 > x_1^c$, $m_1(x_1|x_1> x_1^c) < x_1$.

(c) A "threshold meeting" report: the first-period report equals the first-period threshold, $m_1=T_1$.

(d) A "threshold beating" report: the first-period report exceeds the first-period threshold, $m_1>T_1$.

[11] A convex support is defined by the condition that any two points in the support are connected by a line that lies within the support.

(e) An “aggressive report”: the first-period report overstates the first-period outcome, $m_1 > x_1$.

(f) A “conservative report”: the first-period report understates the first-period outcome, $m_1 < x_1$.

(g) A “taking a bath” report: a conservative strategy where the first-period report equals the minimum first-period outcome, $m_1=\underline{x}$.

(h) A “cookie jar reserves” report: a conservative strategy where the first-period report equals the true outcome minus a reserve, Q', $m_1=x_1- Q'$, $Q'>0$.

Definition 1 is consistent with the commonly used definitions of earnings management strategies (Scott 1997; Ronen and Yaari 2008). Smoothing has been defined in the literature in different ways. In this paper the variability of the first-period report is dampened because the report overstates (understates) low (high) outcomes. To the best of our knowledge, we are the first to offer a formal definition for the “cookie jar reserves:” a conservative strategy wherein the true outcome is understated by a pre-specified reserve amount.

Proposition 1 characterizes the firm’s reporting strategy in the benchmark case with no restrictions on reporting flexibility and with no attempt to meet or beat thresholds.

Lemma 1

Denote by M^* the equilibrium reporting strategy, M^*: $[\underline{x}_1, \overline{x}_1] \to [\underline{x}_1, \overline{x}_1]$. The equilibrium strategy is a monotone increasing function of the first-period outcome that is flatter than the truth-telling strategy, $0 < \dfrac{dM^*}{dx_1} < 1$, and at the minimum outcome, $x_1=\underline{x}_i$, the report overstates the truth, $m_1(x_1) > \underline{x}_{i.}$

Proposition 1: In equilibrium,

(a) The firm smoothes the report.

(b) The report reveals the true outcome, $M^{*-1}(m_1) = x_1$.

Lemma 1 shows that the equilibrium report increases in the outcome but at a lower rate. Thus, the first-period report allocates the first-period performance to both periods. Proposition 1 identifies this strategy as smoothing.[12] A flatter, monotone reporting strategy implies that the report coincides with the true outcome at one point only. To the left (right) of this point, it overstates (understates) outcomes.[13] Because the reporting strategy assigns one report for each outcome, the smoothed report reveals the truth.

Figure 1 contrasts the smoothing strategy with truth-telling. It is constructed based on the following assumptions: the minimal (maximal) outcome is zero (380). Smoothing is reflected in the linear equation m_1=80+0.33x_1.[14] At x_1=120, truth-telling and smoothing yield the same report.

Insert Figure 1 about here.

In our setting, smoothing is derived from the demand for consumption smoothing by the manager. The smoothing result has already been established in the earnings-management literature in other settings as well (e.g., Dye 1988; Fudenberg and Tirole 1995; Demski 1998; Kirschenheiter and Melumad 2000; Sankar and Subramanyam 2001). The prevalence of this

[12] Under the regularity conditions we imposed to guarantee a mathematical solution, the market needs not be imperfect to obtain smoothing. In other words, for a solution to exist, the utility (from compensation) function should be concave in the first-period report. More generally, it is indeed realistic to posit an imperfect boring and lending market: individuals do not have as easy an access to loans as corporations do (Stiglitz, 1969).

[13] The region to the left exists because at the minimum outcome, the report overstates the truth.
[14] For a justification of the linear strategy, see the proof of Lemma 1.

result raises the question of why other reporting strategies are observed. We answer this question in the next section.

4. The equilibrium with thresholds

4.1. The Reporting Strategy of the Threshold-Beating Firm

In this section, we analyze the reporting strategy of a threshold-meeting or beating firm. We adopt the following notation: m_1^R (m_1^L) is the first-period report of the short-run (long-run) MBT firm, and $M^R(x_1)$ and $M^L(x_1)$ denote the reporting strategy of a short- and long-run MBT firm, M^k: $[\underline{x}_1, \overline{x}_1] \rightarrow [\underline{x}_1, \overline{x}_1]$, k=R,L. A smoothed report in this scenario is denoted by m_1^{**}; it may or it may be not the same as the smoothed message, m_1^*, in the scenario studied in section 3.

Because the manager anticipates T_2 before publicizing the first-period report, he knows how much of the first-period earnings ought to be hoarded, $x_1 - m_1 = Q$, $Q = T_2 - \underline{x}_2$, to ensure that the firm meets its second period threshold even when the second-period outcome is at its minimum. In what follows, we refer to Q as the Reserve.[15]

Definition 2:

The smoothed report is *strictly adequate* if it suffices to both beat the first-period threshold and meet the second-period threshold: $m_1 \in (T_1, x_1 - Q]$.

Definition 3*:*

A *Truth-revealing threshold-beating* strategy is a strategy where:

(i) the report beats the threshold, $m_1 > T_1$, and

[15] Under Definition 1, the reserve is the first-period earnings set aside for the second-period report. Here, Q is the *minimum* reserve required to ensure meeting or beating the threshold in the second period.

(ii) the difference between the report and the first-period threshold is such that the report reveals the true outcome, $M^{-1}(m_1) = x_1$.

A *Marginal truth-revealing threshold-beating strategy* is a *truth-revealing threshold-beating* strategy wherein the excess of the report over the first-period threshold is very small, $m_1(x_1) = T_1 + e(x_1)$, $e(x_1) \rightarrow 0$.

We distinguish between two types of threshold beating. One where the difference between the report and the threshold needs not be small, and the other where the difference is very small. Both are truth-revealing, because the difference between the report and the threshold varies with the first-period outcome.

Proposition 2:

(a) The strategy of a short-run MBT firm is as follows:

Region	**First-Period Outcomes**	**Reporting Strategy**
I^R	$x_1 = \underline{x}_1$.	Threshold meeting, $M^R(\underline{x}_1) = T_1$.
II^R	$\underline{x}_1 < x_1 \leq T_1 + Q + e(x_1)$.	Marginal truth-revealing threshold beating, $M^R(x_1) = T_1 + e(x_1)$, $e(x_1) \rightarrow 0$, $\frac{\partial e(x_1)}{\partial x_1} > 0$.
III^R	$x_1 > T_1 + Q + e(x_1)$. but the smoothed report is not strictly adequate, $m_1^{**} \notin (T_1, x_1 - Q]$.	Truth-revealing threshold beating, $M^R(x_1) = T_1 + h(x_1) > T_1$, $\frac{\partial h(x_1)}{\partial x_1} > 0$, that: (i) is conservative, $m_1^R < x_1$, (ii) builds the reserve, $x_1 - m_1^R > Q$, and (iii) $h(x_1, x_1 = T_1 + Q + e(x_1)) = e(x_1, x_1 = T_1 + Q\ e(x_1))$
IV^R	$x_1 > T_1 + Q + e(x_1)$, and a smoothed message is strictly adequate, $m_1^{**} \in (T_1, x_1 - Q]$.	Smoothing, $M^R(x_1) = m_1^{**}(x_1)$ and $M^{R-1}(m_1^{**}) = x_1$.

(b) The reporting strategy reveals the first-period outcome, and the manager earns the smoothed-report's compensation. That is, denoting by S^{R} the contract designed by the board of a short-run MBT firm, $S^{R}(M^{R}(x_1)) = S(M_1^{**}(x_1))$.

Proposition 2 shows that the short-run MBT firm smoothes the report only when the smoothed report is strictly adequate. Otherwise, it meets the threshold when outcome is at the minimum and beats the threshold for all higher outcomes When the first-period outcome is too low to afford meeting the thresholds in both periods with certainty under threshold beating, the firm beats the threshold marginally; by doing so it increases the chance of meeting the second-period outcome. When the outcome suffices to beat both periods' thresholds under marginal threshold beating, the firm moves from marginal threshold beating to the more aggressive threshold beating strategy with no discontinuity. These findings indicate that thresholds-beating encompasses a rich menu of strategies.

At first glance, the finding that the board prefers marginal threshold beating, $m_1^{R} > T_1$, over threshold meeting, $m_1^{R} = T_1$, is not intuitive: after all, just meeting the first-period threshold increases the chance of meeting or beating the threshold in the second period and it also may reduce the chance of a costly restatement. The intuition for preferring threshold beating is as follows: if the manager meets the threshold for some subset of outcomes, A, $A \subseteq (\underline{x}_1, T_1+Q)$, then within this subset $\forall x_1 \in A$, , his report is not informative. In the Appendix, we prove that such a contract is less efficient than a contract that varies with the actual first-period outcome. That is, threshold beating increases the residual share of the principal, $\mathrm{E}(x_1+x_2-S(m_1,m_2))$. The board can decrease the margin, $e(x_1)$, until the benefits from beating a threshold exceed the benefits of designing a threshold-meeting contract.[16] Furthermore, a truth-revealing contract requires that the threshold be met for only one realization of the first-period outcome. The principal chooses this realization to be at the minimal x_1 since, by the convexity of G, the loss from failing to beat the second-period threshold at this level is the largest if the second-period outcome is too low to meet or beat the second-period threshold; that is, choosing x_1 as the threshold-meeting outcome maximizes the benefits.

Proposition 2 has interesting empirical implications. Realistically, firms cannot reduce $e(x_1)$ indefinitely because income increments are measured in discrete cents. [17] The proposition predicts two types of short-run MBT firms in the market: firms that beat the threshold by no more than a penny to reap the informational benefit of inverting the report to learn the underlying outcome, while others will just meet it because the cost of missing the threshold in period 2 exceeds the benefit of designing an efficient contract.

Observe that the manager plays the 'number games' rather than tells the truth or smooth even though his report reveals the true outcome because only then he receives the optimal payments stream that supports his consumption smoothing.

Figure 2 depicts the reporting strategy of a short-run MBT firm when the first-period

[16] Consider a numerical example to illustrate this point: Suppose that $e(x_1)=0.001x_1$. The expected cost of failing to meet or beat the threshold in the second period (including a possible eventual restatement) is assumed to be 500 for each dollar of over-reporting in the first period. (All numbers are in millions of dollars). Suppose x_1=T_1=100 and that the residual value to shareholders increases by 60 if the reporting strategy reveals the outcome. The incremental benefit of threshold beating is:

1	The expected incremental costs of failing to meet or beat thresholds in the second period and possible eventual restatements (50=500*0.001*100)…………………………	-50
2	The incremental value of the firm if a more efficient contract is designed…..	60
3=(2)-(1)	The incremental expected net benefit (cost)……………………………………	10 ==

[17] Since we solve for the case where $e(x_1)$ is unbounded from below, the infimum, of ($e(x_1)$), but not the minimum, equals zero. That is, this game does not have Nash equilibrium. For a valuable discussion of this issue in the Game Theory literature, consult Dasgupta and Maskin (1986a, 1986b) and the citations therein. This issue is easily resolved by bounding $e(x_1)$ from below, which implies that Proposition 2 holds for the limit case in which the lower bound of $e(x_1)$ equals zero.

threshold is 60 and the second is 100. The firm reports 60 only at the minimal outcome of zero. It marginally beats the threshold, $M^R(x_1)$=60+0.025x_1, which implies that Region II^R ends at x_1=164.1. Beyond x_1=164.1, it beats the threshold by gradually converging to $M^R(x_1)$=56+0.9636*(x_1-160) until the outcome is 260 and $M^R(x_1)$=20+1.3636*(x_1-160) between 260 to 270. At x_1=270 the firm shifts to smooth ($M_1^{**}(x_1)$=80+1/3x_1). It does not smooth for lower outcomes because the smoothed report is too high to enable it to meet or beat the threshold in the second period. For example, when x_1=210, the smoothed report is 150 (=80+1/3*210), leaving an inadequate reserve of unreported earnings of 60 (=210-150), while the threshold-beating report is 108.18 (=56+0.9636*(210-160)), leaving a reserve of 101.82. >100.[18]

Insert Figure 2 about here

Figure 2 presents both Regions III^R and IV^R. If the smoothed message is strictly (not strictly) adequate for all outcomes that are sufficient to meet or beat thresholds in both periods, $x_1>T_1+Q$, Region III^R (IV^R) vanishes.

We next present the reporting strategy of a long-run MBT firm.

Proposition 3:

(a) The reporting strategy of a long-run MBT firm is as follows:

Region	First-Period Outcomes	Reporting Strategy
I^L	$\underline{x}_1 \le x_1 \le Q+\underline{x}_1$.[19]	"Taking a bath," $M^L(\underline{x}_1) = \underline{x}_1$.
II^L	$Q+\underline{x}_1 < x_1 < T_1 + Q$.	A "Cookie jar reserves" policy, $M^L(x_1) = x_1 - Q'$ such that: (i) the "Cookie jar reserve" equals

[18] Except for the smoothing strategy depicted in Figures 1 and 2, the policies in Figure 2 are independent of the utility functions and the technology.

[19] When $x_1=Q+\underline{x}_1$, a "cookie jar reserve" report coincides with "taking a bath," and when $x_1=T_1+Q$, the "cookie jar reserve" report coincides with a threshold-meeting report.

Region	First-Period Outcomes	Reporting Strategy
		the Reserve, $Q' = Q = T_2 - \underline{x}_2$., and (ii) reveals the truth, $M^{L-1}(m_1) = x_1$.
III^L	$x_1 = T_1 + Q$.	Threshold meeting, $M^L(T_1+Q) = T_1$.
IV^L	$x_1 > T_1 + Q$, but the smoothed report is not strictly adequate, $m_1^{**} \notin (T_1, x_1 - Q]$.	Truth-revealing threshold beating, $M^L(x_1) = T_1 + h(x_1) > T_1$, that: (i) builds the reserve, $h(x_1) \in (0, x_1 - Q - T_1)$, and (ii) is conservative, $m_1 < x_1$.
V^L	$x_1 > T_1 + Q$, and the smoothed message is strictly adequate, $m_1^{**} \in (T_1, x_1 - Q]$..	Smoothing, $M^L(x_1) = m_1^{**}(x_1)$, that reveals the truth.

(b) The manager is paid the same had the board designed a smoothing-based contract with a flat payment for $\underline{x}_1 \leq x_1 \leq Q + \underline{x}_1$. That is, denoting by S^L the compensation schedule designed in a long-run MBT firm,

$$S_1^L(M^L(x_1, x_1 \leq Q + \underline{x}_1)) = S^L(\underline{x}_1),$$

$$S_1^L(M^L(x_1, x_1 > Q + \underline{x}_1)) = S_1(M^{**}(x_1, x_1 > Q + \underline{x}_1) | S_1^L(m_1(x_1, x_1 \leq Q + \underline{x}_1)) = S^L(\underline{x}_1)),$$

$$S_2^L = S_2(M^{**}(x_2) | S_1^L(m_1(x_1, x_1 \leq Q + \underline{x}_1)) = S^L(\underline{x}_1).$$

The manager is penalized if the first-period report exceeds the one prescribed by "taking a bath" and the firm fails to meet or beat the second-period threshold.

Part (a) of Proposition 3 characterizes the reporting strategy as a function of the first-period outcome and the second-period threshold, T_2, and Figure 3 presents it graphically (for T_1=60, T_2=100, where the slope of the smoothed report is 0.333). This figure divides the set of outcomes into five regions. Up to a first-period outcome of 100 (Region I^L), the reserve would be insufficient because the first-period outcome is too low. The firm then "takes a bath" by reporting the minimum outcome of zero, hoarding all first-period earnings for the second-period report. In Region II^L, between 100 and 160 (=reserve of 100+first-period threshold of 60), the firm creates a “cookie jar reserve” of 100. That is, when the outcome is 110, 120, or 130, the firm reports 10, 20, or 30, respectively, hoarding the remaining 100 for reporting in the second period. Region III^L is a single point at an outcome of 160: the firm meets the first-period threshold by reporting 60, thus hoarding the 100 required to ensure that it does not miss the threshold in the second period. Region IV^L contains those higher outcomes, up to 270, for which the smoothed message is too high; here, similar to region III^R, the firm replaces smoothing with beating the threshold. In the figure, $M^L(x_1) = 55 + 0.9636(x_1 - 160) + k$, k is scalar that ranges from -0.5 at x_1=170 to 9 at x_1=270, and because the difference between the outcome and first-period threshold is proportional to the first-period outcome, it reveals the true outcome. In Region V^L, where the smoothed message is strictly *adequate* (it starts at x_1=270 wherein the smoothed report is 170), the firm smoothes just as the short-run MBT firm does.[20]

Insert Figure 3 about here

Part (b) derives the implications for the manager's contract. In Region I^L, the contract is a flat wage, but in the remaining regions, the report reveals the true outcome, and the manager is paid the same amount that he would have been paid had the board designed a smoothing-based contract with a flat region for low outcomes. To ensure that the manager is not tempted to earn higher compensation by deviating from “taking a bath” when the first-period outcome falls in Region I^L, the contract specifies a penalty if the second-period report fails to meet the second-period threshold and the manager failed to “take a bath” in the first period.[21]

[20] The same reporting strategy is employed by short- and long-run MBT firms beyond a first-period outcome that is sufficient to meet or beat thresholds in both periods.

[21] The same intuition for the need to meet or beat the thresholds despite truth revelation in the case of a short run MBT firm (Proposition 2) applies here.

Definition 4:

(a) An MBT firm is more *aggressive* (*conservative*) than another if it publicizes a higher (lower) first-period report for the same realized first-period outcome.

(b) Designate an economy where all firms are smoothers as a smoothing economy, and an economy where all firms meet or beat thresholds as an MBT economy. Then, an MBT economy is more *conservative* (*aggressive*) than a smoothing economy if the expected reported outcome of the average firm (for the same distribution of earnings) is lower (higher) than that of a smoothing economy, $(1-\delta)\,\mathrm{E}_{x_1}[M^{\mathrm{R}}(x_1)] + \delta\,\mathrm{E}_{x_1}[M^{\mathrm{L}}(x_1)] < (>)$ $\mathrm{E}[M^{**}(x_1)]$.

The next Proposition specifies the conditions for an MBT economy to be more conservative than a smoothing economy.

Proposition 4: There is a set, *H*, of critical levels of thresholds, T_1, T_2, and minimal fraction of long-run MBT firms, δ, for which:

(i) an MBT economy and a smoothing economy report the same in expectation. That is,

$$\forall (T_1, T_2, \delta) \in H,\ (1-\delta)\mathrm{E}[M^R(x_1 | T_1, T_2)] + \delta \mathrm{E}[M^L(x_1 | T_1, T_2)] = \mathrm{E}[M^{**}(x_1)].$$

(ii) an MBT economy is more conservative than a smoothing economy for all lower T_1, higher T_2, and higher δ than the critical thresholds in H. That is,

$$\forall (-T_1, T_2, \delta) > (-\hat{T}_1, \hat{T}_2, \hat{\delta}) \in H,\ (1-\delta)\,\mathrm{E}[M^{\mathrm{R}}(x_1 | T_1, T_2)] + \delta \mathrm{E}[M^{\mathrm{L}}(x_1 | T_1, T_2)] < \mathrm{E}[M^{**}(x_1)].$$

(b) Fix T_2 and δ. Denote the maximum first-period T_1 for which $(T_1, T_2, \delta) \in H$ by $T_1^{\max}(T_2, \delta)$ and the largest first-period threshold for whi**c**h meeting the first-period threshold at $x_1 = \underline{x}_1$ does not violate GAAP by $T_1^{\min}$, $T_1^{\min} = \underline{x}_1 + d$. Then, the MBT economy is characterized by conservative reporting and a positive probability of restatements $\forall\, T_1^{\min} < T_1 < T_1^{\max}(T_2, \delta)$.

Part (a) establishes the existence of profiles of first- and second-period thresholds and the fraction of long-run MBT firms for which an MBT economy is more conservative. Furthermore, the MBT economy is more conservative than a smoothing economy at all lower first-period thresholds, higher second-period thresholds, and higher fractions of long-run MBT firms than the parameters for which both economies are equally aggressive. The intuition of this result is that the firms are more (less) conservative the higher the second (first)-period threshold, because they opt to transfer first period earnings to the second (first) -period report. Since long-run MBT firms are more conservative than short-run MBT firms, the higher their proportion, the more conservative the MBT economy.

Part (b) establishes that when threshold meeting by a short-run MBT firm entails the violation of GAAP, the equilibrium may be characterized by conservative reporting on the part of the average firm, concurrently with some positive likelihood of restatements.[22]

We conclude with the following comment: This is the first analytical paper to consider the accounting policies that arise from the repeated pressure to beat or meet thresholds. Beyer (2008), for example, examines the impact of the pressure to beat thresholds set by analysts' forecasts in a one-shot game. She proves that firms report the true outcome when it exceeds the forecast and inflate earnings when it is not. Analyzing a two-period model yields a richer menu of strategies.

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[22] , Demski (2000) offers that a few "bad apples" caused the avalanche of accounting scandals. Our result that the average firm is conservative supports his view if T_1 and the percentage of short-run MBT firm is sufficiently low so that only a few short-run MBT firms have to restate their earnings at the end of the second period.

5. The demand for thresholds

The reporting strategy in response to the pressure to meet or beat thresholds reveals the truth unless the long-run MBT firm "takes a bath. Hence, meeting or beating thresholds may reduce the quality of accounting information. Another unsavory aspect of the threshold beating game is provided in Proposition 5.

Proposition 5:

Each firm may miss the threshold with some positive probability: Short-run MBT firm may miss the threshold in period 2 and the long-run MBT firm may miss both periods' thresholds.

The proof is immediate from Propositions 2 and 3. In regions I^R and II^R, the short-term MBT fails to build the reserve that guarantees threshold beating in period 2, and in regions I^L, the long-run MBT firm may fail to meet the threshold in period 2 and in regions I^L and II^L it misses the first-period threshold. Proposition 5 indicates that the threshold-beating game is costly in the sense that it cannot be won with certainty.

It may be asked why thresholds exist in equilibrium? We motivate the demand for thresholds by invoking the irrationality of a subset of investors.[23] In their seminal paper on thresholds beating, DeGoerge, Patel, and Zeckhouser (1999), for example, motivate the demand

[23] Kent, Hirschleifer, and Teoh (1998) state:

> It has long been recognized that a source of judgment and decision biases is that cognitive resources such as time, memory, and attention are limited (P. 143).
>
> We argue that limited attention and processing capacity creates a general problem of investor credulity. …There is evidence that investors in many contexts do go beyond superficial appearances and make some adjustment for systematic biases in measures of value such as accounting earnings. However, cognitive limitations make it hard to make the appropriate adjustments uniformly and consistently. ((p.142)

for thresholds by appealing to findings of cognitive psychology.[24] Many investors are households that do not have the resources required to understand what firms do (Sunder 1997). Lyn Turner, 2001, p. 1, for example, cites a 2000 study that finds that "stockholders come from all walks of life, young and old, rich and not so rich. … And interestingly, half of those stockholders have income of less than $57,000 and only 18 percent have family incomes that exceed $100,000."

To sum up so far, thresholds-meeting-or-beating are found to obfuscate reports on average but do not necessarily give rise to aggressive reporting. In addition, we invoked bounded rationality of a subset of investors to explain why thresholds exist. In the following section, we examine the effect, if any, of meeting or beating thresholds on management's effort.

6. Endogenous effort

To model the impact of thresholds on effort, we extend the setting by modeling the firm as a principal-agent game with moral hazard. That is, the firm-specific parameter, a_t, t=1, 2, is the unobservable effort exerted by the risk-averse, work-averse manager-at a cost (disutility) of a_t. The manager chooses a_1 at the beginning of period 1 and a_2 simultaneously with the first-period report after the first-period earnings are realized. The manager's preferences are assumed to be separable in utility over monetary compensation, U, and effort; W, i.e.,

$E[U(S \mid a_1,a_2)]= E[U(S_1|a_1)] + E[U(S_2|a_1,a_2)] - ½\sum_t W(a_t)$, t=1, 2, $U'>0$, $U''<0$, $W'>0$, and $W''>0$.[25]

[24] They offer three mutually exclusive explanations:: (i) people think discreetly on continuous variables, so they pay attention to dividing lines created by beating the thresholds or not. (ii) Reference points are an important ingredient for making decision and thresholds thus serve as a reference point: firms that exceed the thresholds are successful while firms that fail to do so are not. (iii) Boundedly rational people rely on rules-of-thumb to reduce transaction costs, and having a threshold allows for a rule based on whether the firm beat it or not.

[25] $U'(V')$ and $U''(V'')$ are the first and second-order derivatives of U (V) with respect to compensation and effort, respectively.

We extend the regularity conditions by adopting the standard assumption that effort shifts the distribution function of outcomes to the right in a first-order stochastic dominance sense, i.e., $F_a(x_t|a_t) < 0$, t=1,2, where F is the cumulative distribution function of earnings and F_a is the first order derivative of F with respect to effort, a. The implication of this assumption is that higher effort decreases the likelihood of low outcomes and increases the likelihood of high outcomes.

The revised program of the board – the principal--, who designs the incentives of the manager is:

$$\max_{S_1,S_2,a_1,a_2,M} \mathrm{E}\left[\mathrm{V}(x_1+x_2-S_1(M(x_1))-S_2(M(x_1),x_1+x_2-M(x_1)))\,\middle|\,a_1,a_2\right]$$

s.t.

$$\mathrm{EU}[S,a_1,a_2\,|a_1,a_2\,]=\int \mathrm{U}(S_1(M(x_1)))f(x_1|a_1)\,dx_1\ +$$

$$\iint \mathrm{U}(S_2(M(x_1),x_1+x_2-M(x_1)))f(x_1|a_1)\ f(x_2|a_2)dx_1dx_2-\sum_{\mathrm{i}}\mathrm{W}(a_{\mathrm{i}})\geq u.. \qquad \text{(PC)}$$

$$a_1=\underset{a_1\ >\ 0}{\arg\max}\ \mathrm{EU}[S,a_1,a_2\,|a_1,a_2\,]. \qquad \text{(IC. 1)}$$

$$\forall\ x_1,\ (a_2^*,m_1^*)=\underset{\substack{a_2\ >\ 0\\ \underline{x}_1\ \leq\ m_1\ \leq\ \overline{x}_1}}{\arg\max}\ \mathrm{EU}[S,a_1,a_2\,|a_1,a_2\,,x_1].. \qquad \text{(IC.2)}$$

(IC) lists now three types of constraints. (IC.1) is the incentive-compatibility constraint with respect to effort in period 1, which is chosen after the contracting phase; (IC.2) are incentive-compatibility constraints with respect to effort exerted in period 2 and the first-period report, respectively, conditional on the realized first-period outcome, x_1.

When we compare this scenario with the one studied in sections 3 and 4, we refer to it as the moral-hazard scenario. The first question we address concerns the reporting strategy of the firm.

Proposition 6:

(a) Let the utility of the manager be strictly concave in each component of his compensation. Then, a firm that does not pursue the threshold meeting/beating game adopts truth-revealing smoothing as its reporting strategy.

(b) The reporting strategy of an MBT firm is unaffected by moral hazard. That is, the results in Propositions 2-4 extend to this section as well.

Part (a) is concerned with generalizing Proposition 1 to the moral-hazard setting. Without moral hazard, the manager smoothes to achieve consumption smoothing and the board encourages it because it reduces the cost of the manager's contract. When the contract also provides incentives to exert effort, however, the first-period compensation also affects the incentives to exert effort in period 2 (Lambert, 1983). Smoothing is still optimal if allocating across reports inter-temporally increases the wealth of the manager (Dye, 1988; Demski, 1998; and others). Part (b) shows that the results of section 4 generalize to the moral hazard setting.

Proposition 7: In comparison with the board of a firm that does not meet or beat thresholds, the board of a firm that meets or beats thresholds induces higher levels of effort, a_1 and a_2, but leaves a smaller residual value, $\sum_{t=1}^{2} x_t - S_t$, to shareholders.

Proposition 7 shows that boards of MBT firms are willing to decrease the probability of missing a threshold by paying for a higher level of effort than a board with no such concerns.

The result is that the manager exerts higher effort and the output (value) of the firm is higher (lower); but shareholders would not pay for the additional effort in the absence of a threshold. The pressure to meet or beat thresholds reduces the value of the firm to shareholders.[26]

6. Summary

We examine the impact of the pressure to report earnings that meet or beat a threshold number on the reporting strategy of the firm. We model firms as a two-period principal-agent contract between the board of directors and the manager. Without thresholds and GAAP restrictions, firms smooth: they overstate (understate) low (high) earnings. With thresholds, we consider an MBT economy with two types of firms: short-run and long-run threshold meet-ers or beaters. The former (latter) *must* meet or beat the first-period (second-period) threshold.

Table 1 summarizes the reporting strategies.

Insert Table 1 about here.

The short-run MBT firm reports the threshold when the outcome is lowest and attempts to hoard reported earnings for the next period by marginally beating the threshold as long as the economic earnings fall short of the first-period threshold plus the reserve required for meeting the second-period threshold. At higher outcomes the firm smoothes if the smoothed message allows it to meet or beat the thresholds in both periods, and beats the first-period threshold otherwise (so that the report is either lower or higher than the smoothed report).

The long-run MBT may "take a bath" to increase the chance of meeting or beating a threshold in the second period, and for higher outcomes, it adopts a "cookie jar reserves" policy,

[26] Harvey et al. (2005), for example, report that CFOs may delay capital expenditures to meet or beat thresholds.

where the reserve is the required first-period earnings that need to be hoarded to guarantee that it does not miss the second-period threshold. It meets the threshold only when the first-period economic earnings are just sufficient to meet or beat the thresholds in both periods. For higher outcomes, it adopts the same strategy as a short-run MBT firm: smoothing if the smoothed message allows it to meet or beat the thresholds in both periods and beating the threshold otherwise.

Our results address two issues. One is that in reality, firms adopt a variety of reporting strategies, and do not restrict their strategy to smoothing. The other is that on average, US firms report conservatively while a few "bad apples" are embroiled in restatements and accounting scandals. For some profiles of thresholds, the average firm is conservative while poorly performing short-run MBT firms may be too aggressive and will have to restate earnings when future performance does not cover the shortfall caused by prior aggressive reporting.

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APPENDIX

Proof of Lemma 1:

Step 1:

At the end of the first period, the manager solves the following program:

$$\forall x_1, \max_{m_1} \; \mathrm{U}(S_1(m_1)) + \int \mathrm{U}(S_2(m_1, m_2)))\, f(x_2 | a_2) dx_2 \quad s.t. \;\; \underline{x}_1 \le m_1 \le \overline{x}_1.$$

Denote by $\underline{\rho}^{\mathrm{M}}$ and $\overline{\rho}^{\mathrm{M}}$ the Lagrange multiplier of the requirement that m_1 is neither lower than $\underline{x}_1$ nor higher than $\overline{x}_1$, respectively. The Lagrangian, Λ^{M}, is

$$\forall x_1,\; \Lambda^{\mathrm{M}}(x_1) = \mathrm{U}(S_1(m_1)) + \int \mathrm{U}(S_2(m_1, m_2))\, f(x_2 | a_2) dx_2 \;+ \underline{\rho}^{\mathrm{M}}[m_1 - \underline{x}_1] + \overline{\rho}^{\mathrm{M}}[\overline{x}_1 - m_1].$$

Upon denoting by $\mathrm{U}_i' = \dfrac{\partial \mathrm{U}(S_i(.))}{\partial S_i(.)}$; and $S_i' = \dfrac{\partial S_i(.)}{\partial m_1}, i = 1, 2,$ the first-order-condition with respect to m_1 is:

$$\forall x_1,\; \mathrm{U}_1' S_1' - \int \mathrm{U}_2' S_2' f(x_2 | a_2) dx_2 \;+ \underline{\rho}^{\mathrm{M}} - \overline{\rho}^{\mathrm{M}} = 0. \qquad \text{(IC.}m\text{)}$$

Step 2:

We solve the board's program when (IC.*m*) is not binding and then show that the solution satisfies it. Upon denoting by λ the Lagrange multiple of (PC) in the board's program as outlined in section 3, the Euler equations of the board's program yield the following equilibrium conditions:

$$\forall x_1, \quad \int \mathrm{V}'(x_1 + x_2 - S_1(m_1) - S_2(x_1, x_2, m_1))\, f(x_2 | a_2) dx_2 = \lambda \mathrm{U}_1'(S_1(m_1)). \qquad \text{(E1)}$$

$$\forall x_1, x_2, \mathrm{V}'(x_1 + x_2 - S_1(m_1) - S_2(x_1, x_2, m_1))) = \lambda \mathrm{U}_2'(S_2(x_1, x_2, m_1)). \qquad \text{(E2)}$$

Taking expectations over x_2 of (E2) and substituting in (E1) yields:

$$\forall x_1,\ U_1'(S_1(m_1)) = \int U_2'(S_2(x_1,x_2,m_1))f(x_2|a_2)dx_2. \tag{A1}$$

(A1) implies that (IC.*m*) holds because the contract includes resettling, i.e., $S_2(x_1,x_2,m_1)=S_2(x_1,x_2)\ -S_1(m_1)$.

By the mean value theorem, there is one x_2, denoted by $\hat{x}_2(x_1)$, that is the certainty equivalent of marginal second-period utility in (A1), $U_1'(S_1(m_1)) = U_2'(S_2(x_1,\hat{x}_2(x_1)) - S_1(m_1))$, which implies that the manager choose to report so that:

$$\forall x_1,\quad S_1(m_1) = S_2(x_1,\hat{x}_2(x_1)) - S_1(m_1). \tag{A2}$$

The first-period report allocates the first-period outcome between the two periods. Upon denoting the reporting strategy by *M*, if, by contradiction, either $dM/dx_1 > 1$ or $dM/dx_1 <0$, an increase in x_1 would affect the left-hand-side and the right-hand side of (A2) in opposite directions, which establishes the required contradiction.

Since the report allocates the second-period outcome to period 1 and 2 as well, at $\underline{x}_1$, the report overstates the truth. If, by contradiction, the first-period message at $\underline{x}_1$ were truthful,[27] the report then would have allocated total outcome to period 2 instead of allocating it between both periods. This yields the required contradiction.

Observe that if preferences of the board and the manager are CARA utility functions, a combination of linear contract and linear smoothing strategy is an equilibrium, because the preferences over second-period variables are multiplicatively separable then from the preferences over the first-period variables. Q.E.D.

[27] Reminder: The report cannot be lower than $\underline{x}_1$.

Proof of Proposition 1:

To prove smoothing requires showing that there is a critical value of x_1, x_1^C, where the smoothed report and the truth coincides, because if such a critical outcome exists, the reports for smaller outcome overstate the truth and the reports for higher outcomes understate it. The proof that such an outcome exists is immediate from the fixed-point theorem, which establishes that there is at least one outcome for which $m_1(x_1) = x_1$.[28] Smoothing reveals the truth because the reporting strategy is a monotone increasing function of x_1. Q.E.D.

Lemma A1: Let the contract of the manager include a flat region (where he is paid a fixed salary for different outcomes). Then,

(a) Outside the flat region, the manager smoothes and the first-period compensation is an increasing function of m_1.

(b) A contract that is a strictly increasing function of the report for all *outcomes* dominates a contract with a flat region, i.e., E $(x–S)$ is higher under the strictly increasing contract.

Proof: Since (E1), (E2), (A1) and (A2), are pointwise conditions, the proof of part (a) is similar to the proof of Proposition 1, and since (E1) implies that $\frac{dS_1}{dx_1} > 0$ and by the chain rule, $\frac{dS_1}{dx_1} = \frac{dS_1}{dM_1}\frac{dM_1}{dx_1}$, the contract is an increasing function of M_1, because smoothing is an increasing function of the m_1, $\frac{dM_1}{dx_1} > 0$. Part (b) follows directly from E1 and E2. Q.E.D.

[28] We appeal to Corollary 6.6 in Border 1985 (p. 29). The following conditions are met: (a) the message is chosen from a convex and compact set (satisfied by our assumption on the support of the probability density function). (b) The reporting strategy is a continuous function of the first-period outcome. . See Giusti, 2003.

Proof of Proposition 2

Since the demand for smoothing has already been established by Lemma A1, it remains to prove threshold-beating for Region II^{R}-III^{R}, and threshold-meeting at $x_1=\underline{x}_1$ (Region I^{R}).

As a preliminary step, we solve the board's program by adding the point-wise constraints that no first-period report is lower than the first-period threshold, $\forall x_1,\ T_1 - m_1^{R}(x_1) \leq 0$. The Lagrange multipliers are zero if the threshold is met for only one outcome and the firm beats the threshold for all other outcomes. To prove that coefficients are not binding, suppose, by contradiction, that there is a range of outcomes that are lower than T_1 for which the report just meets the threshold. This introduces a flat region in the contract, which by Lemma A1 is inferior to an outcome-revealing contract.

Reporting more than the first-period threshold increases the expected restatement costs, EC, and the chance of missing the second period threshold, EG. Hence, in region II^{R}, the board designs the margin between the report and the truth to be so low that the incremental expected restatement costs and the cost of missing the threshold in the second period are lower than the saving in compensation cost.

We next prove that the margin increases in the outcome, i.e., for any two realizations of x_1, x_1^O, and $x_1=x_1^O+\Delta x$, $\Delta x>0$, at which the firm beats the threshold by $e(x_1^O)$ and $e(x_1^O+\Delta x)$, respectively, $e(x_1^O) < e(x_1^O+\Delta x)$. Suppose, by contradiction that $e(x_1^O) \geq e(x_1^O+\Delta x)$. That, is:

$m_1(x_1^O) = T_1 + e(x_1^O)$, $m_1(x_1^O+\Delta x) = T_1 + e(x_1^O+\Delta x) \leq T_1 + e(x_1^O)$.

$e(x_1^O)=e(x_1^O+\Delta x)$ cannot be an equilibrium because two outcomes yield the same report and hence a non truth-revealing contract. The thrust of the proof that $e(x_1^O)$ is lower than $e(x_1^O$

$+ \Delta x$) is that the expected cost of missing the second-period threshold is reduced upon switching the margin so that $m_1(x_1^O) = T_1 + e(x_1^O + \Delta x)$ and $m_1(x_1^O + \Delta x) = T_1 + e(x_1^O)$.

When the first period outcome is x_1^O, the switch decreases the expected loss by

$$\Delta \mathrm{E}[G(x_1^O)] = -\int_{\underline{x}_2}^{T_1+e(x_1^O)-x_1^O} G(T_2 - x_2 - x_1^O + e(x_1^O))\, f(x_2 | a_2) dx_2 \qquad \text{(A3(i))}$$

$$+ \int_{\underline{x}_2}^{T_1+e(x_1^O+\Delta x)-x_1^O} G(T_2 - x_2 - x_1^O + e(x_1^O + \Delta x))\, f(x_2 | a_2) dx_2. \qquad \text{(A3(ii))}$$

When the first period outcome is $x_1^O + \Delta x$, the switch increases the expected loss by

$$\Delta \mathrm{E}[G(x_1^O + \Delta x)] = -\int_{\underline{x}_2}^{T_1+e(x_1^O+\Delta x)-x_1^O-\Delta x} G(T_2 - x_2 - x_1^O - \Delta x + e(x_1^O + \Delta x))\, f(x_2 | a_2) dx_2 \qquad \text{(A3iii)}$$

$$+ \int_{\underline{x}_2}^{T_1+e(x_1^O)-x_1^O-\Delta x} G(T_2 - x_2 - x_1^O - \Delta x + e(x_1^O))\, f(x_2 | a_2) dx_2. \qquad \text{(A3iv))}$$

To show that $\Delta \mathrm{E}[G(x_1^O)] + \Delta \mathrm{E}[G(x_1^O + \Delta x)] < 0$, observe that upon dividing through by Δx, A3(i)) combined with A3(iv) is the negative of the derivative of the expected G with respect to x_1 at $x_1 = x_1^O - \Delta x$ when the margin is $e(x_1^O)$, and A3(ii) combined with A3(iii) is the derivative of the expected G with respect to x_1 at $x_1 = x_1^O - \Delta x$ when the margin is $e(x_1^O + \Delta x)$. By the convexity of G, $e(x_1^O) > e(x_1^O + \Delta x)$ implies that $\Delta \mathrm{E}[G(x_1^O)] + \Delta \mathrm{E}[G(x_1^O + \Delta x)] < 0$. That is, the board is better of with an increasing margin. The proof that the margin increases in outcome also establishes that meeting the first-period threshold occurs at the minimum outcome, since threshold meeting s is a private case of threshold beating by setting $e(\underline{x}_1) = 0$.

In Region III^R, the firm can meet or beat thresholds in both periods but the smoothed message is not strictly adequate. Since a flat-region contract reduces the welfare of the board, the report satisfies two conditions: (i) $m_1^R > T_1$, and (ii), $m_1^R < x_1 - Q$. That is, the firm beats the first-period threshold. The difference between Region II^R and Region III^R is that in the latter, the difference between the threshold and report could be larger.

To prove that there is no discontinuity between Region II^R and Region III^R, observe that the board chooses the right-hand-side boundary of Region II^R, $\hat{x}$, by equating to zero the derivative of the board's Lagrangian, L, with respect to $\hat{x}$,

$$\frac{\partial L}{\partial \hat{x}} = \frac{\partial}{\partial \hat{x}}\left[-\int_{\underline{x}_2}^{\hat{x}} G(T_2 - x_2 - x_1 + T_1 + e(x_1) f(x_2 | a_2) dx_2 + \int_{\hat{x}}^{\overline{x}_2} G(T_2 - x_2 - x_1 + T_1 + h(x_1)) f(x_2 | a_2) dx_2 \right] = 0.$$

The derivative yields that $G(T_2 - x_2 - \hat{x}_1 + T_1 + e(\hat{x}_1)$ $= G(T_2 - x_2 - \hat{x}_1 + T_1 + h(\hat{x}_1)$. That is, the reporting strategy at $\hat{x}$ satisfies the Erdmann Wierestrass condition for continuity at the change from Region II^R to Region III^R.

Lastly, the proof that Region III^R lies to the left of Region IV^R follows from the properties of the smoothing strategy: If the smoothed report is not strictly adequate because it is lower than the first-period threshold, this limitation may disappear at higher levels of x_1 since $dM_1/dx_1 > 0$. If the smoothed report is i not strictly adequate because it is too high and depletes the reserve required to meet the second-period threshold, this limitation may disappears at higher x_1 since $dM_1/dx_1 < 1$.

This proof indicates that $h(x_1)$ is an increasing function, since by the continuity of reporting strategy in region III^R and the fact that its left-hand side border is lower than its right-hand-side boarder, $h(x_1)$ that reveals the truth is a strictly increasing function of x_1.

This discussion also indicates that for some firms, either Region III^R or Region IV^R may not exist. In the former case, the smoothed report is strictly adequate at the right-hand-side border of Region II^R, In the latter case, the smoothed report is not strictly adequate at the highest first-period outcome.

The proof of part (b) follows from the optimality of paying the manager the smoothed-message compensation established in Lemma A1, which is feasible because the report reveals the outcome in each region. Q.E.D.

Proof of Proposition 3:

Region I^L($x_1 < Q + \underline{x}_1$): The proof that the firm takes a bath is by contradiction. Let the firm report $m_1 = \underline{x}_1$, and consider a deviation to $m_1 = \underline{x}_1 + \varepsilon > \underline{x}_1$, where $\varepsilon \to 0$, so that the difference has an infinitesimal impact on the compensation of the manager. This deviation decrease the loss of missing the first-period threshold from $G(T_1 - \underline{x}_1)$ to $G(T_1 - \underline{x}_1 - \varepsilon) \cong G'\varepsilon,$ and increases the expected cost of failing to meet or beat a threshold in the second period by approximately $\int_{T_2-(x_1-\underline{x}_1)}^{T_2-(x_1-\underline{x}_1-\varepsilon)} gf(x_2 | a_2) dx_2 \cong gf(T_2 - (x_1 - \underline{x}_1 - \varepsilon))\varepsilon > G'\varepsilon.$ Since the deviation is not profitable, the board will induce the manager to take a bath by penalizing him when the failure to meet the second-period threshold reveals that he did not do so.

Region II^L ($x_1 - Q < T_1$): Because g is large, the optimal program that avoids the cost of missing the second-period threshold is to subject it to the additional constraints that $\forall\ x_1$, $m_1^L \le x_1 - Q$. In Region II^L, these reporting constraints are binding because $x_1 - Q < T_1$. Reporting the maximum first-period outcome that still guarantees meeting or beating the threshold in the second period reduces the board's welfare loss associated with failing to meet or beat the threshold in the first period.

Region III^L (x_1=T_1+Q): meeting the threshold guarantees meeting or beating the thresholds in both periods.

Regions IV^L and V^L (x_1>T_1+Q): The proof for regions IV^L and V^L is similar to the proof for regions III^R and IV^R in Proposition 2.

The proof of part (b) follows from part (a) and Lemma A1, and the fact that the report reveals the truth except for Region I^L. Q.E.D.

Lemma A2:

(i) The aggressiveness of the MBT firm increases in T_1, and decreases in T_2,

$$\frac{\partial \mathrm{E}[M^{\mathrm{J}}(x_1)]}{\partial T_1} > 0,\ \frac{\partial \mathrm{E}[M^{\mathrm{J}}(x_1)]}{\partial T_2} < 0,\quad \text{j=R,L.}$$

(ii) The aggressiveness of an MBT economy (weakly) decreases in the proportion of long-run MBT firms, δ, $\frac{\partial\left((1-\delta)\mathrm{E}[M^{\mathrm{R}}(x_1)] + \delta \mathrm{E}[M^{\mathrm{L}}(x_1)\right)}{\partial \delta} < 0.$

Proof:

Part (a):

Upon denoting the right-hand side boundary of Region II^R by T_1+Q+ϕ the expected report of a short-run MBT firm is[29]

$$\mathrm{E}[M^{\mathrm{R}}(x_1)] = \underbrace{\int_{\underline{x}_1}^{T_1+Q+\phi} [T_1 + e(x_1)] f(x_1|a_1)dx_1}_{\text{Region I}^{\mathrm{R}} + \text{II}^{\mathrm{R}}} + \underbrace{\int_{\substack{T_1+Q+\phi \\ m_1^{**} \notin (T_1, x_1 - Q]}}^{\bar{x}_1} [T_1 + h(x_1)] f(x_1|a_1)dx_1}_{\text{Region III}^{\mathrm{R}}}$$

[29] Reminder: Meeting a threshold is a special case of beating a threshold where e (.)=0.

$$+ \int_{\substack{T_1+Q+\phi \\ m_1^{**}\in(T_1,x_1-Q]}}^{\bar{x}_1} M_1^{**}(x_1) f(x_1|a_1)dx_1. \qquad \text{(A4)}$$

Region IV^R

Derivating (A4) with respect to T_1 yields

$$\frac{\partial \mathrm{E}[M^R(x_1)]}{\partial T_1} = \{T_1 + e(T_1+Q+\phi) - \mathbf{1}[T_1 + h(T_1+Q+\phi)] - (1-\mathbf{1}) m_1^{**}(T_1+Q+\phi)]\} f(T_1+Q+\phi|a_1)$$

$$+ \int_{\underline{x}}^{T_1+Q+\phi} f(x_1|a_1)dx_1 + \mathbf{1}\int_{\substack{T_1+Q+\phi \\ m_1^{**}\notin(T_1,x_1-Q]}}^{\bar{x}} f(x_1|a_1)dx_1 > 0, \qquad \text{(A5)}$$

where **1** is an indicator function, taking the value of 1 if Region III^R exists, and zero if not.

If Region III^R does not exist, (A5) simplifies to:

$[T_1+e(T_1+Q+\phi)-m_1{**}(T_1+Q+\delta)]f(T_1+Q+\phi\,|a_1) + F(T_1+Q+\phi\,|a_1) = F(T_1+Q+\delta\,|a_1)$ >0, since similar to the choice of the boundary of Region II^R in Proposition 2's proof, the boundary here is chosen at the point where the Erdmann Wierestrass continuity condition is satisfied, and the first two terms in (A5) cancel out. A similar argument establishes the proof when Region III^R exists.

. Since $Q=T_2-\underline{x}_2$, , the larger $_2T$, the larger is Region II^R wherein the firm beats the first-period threshold marginally rather than beating non-marginally or smoothing.

The expected report of a long-run MBT firm is

$$\mathrm{E}[M^L(x_1)] = \int_{\underline{x}_1}^{Q+\underline{x}_1} \underline{x}_1 f(x_1|a_1)dx_1 + \int_{Q+\underline{x}_1}^{T_1+Q} (x_1-Q) f(x_1|a_1)dx_1 + \int_{\substack{T_1+Q \\ m_1^{*}\notin(T_1,x_1-Q]}}^{\bar{x}_1} [T_1+h(x_1)] f(x_1|a_1)dx_1$$

Region I^L Regions $II^L + III^L$ Region IV^L

$$+ \int_{\substack{T_1+Q \\ m_1^{**}\in T_1,x_1-Q]}}^{\bar{x}} M^{**} f(x_1|a_1)dx_1. \qquad \text{(A6)}$$

Region V^L

The proof is similar to that for the short-run MBT firm.

Part (b):

The proof that the larger δ is, the more conservative the economy is, is immediate from Corollary 1, since when $x_1 \leq T_1+Q$, a short-run MBT firm is more aggressive than a long-run MBT firm, and when $x_1>T_1+Q$, both adopt the same strategy. Q.E.D.

Proof of Proposition 4:

Part (a)

Consider the extreme cases: (1) $T_1=\overline{T}_1 \to \overline{x}_1$, $T_2=\underline{T}_2 \to \underline{x}_2$, $\delta \to 0$, and (2) $T_1=\underline{T}_1 \to \underline{x}_1$, $T_2=\overline{T}_2 \to \overline{x}_2$, $\delta \to 1$. By Propositions 2 and 3, the MBT economy is more aggressive (conservative) than a smoothing economy in case 1 (2), because the only region is the first (last) one. Because the aggressiveness of the MBT economy relative to that of a smoothing economy changes sign in the two extreme cases of threshold profiles T_1, T_2, and δ, by Lemma A2, there are interim values that produce indifference. Furthermore, by Lemma A2, for all triplets $(\delta,-T_1,T_2)$ that lie above H, an MBT economy is more conservative.

Part (b)

The result on $T_1^{\max}(T_2,\delta)$ is a corollary to Part (a), and that for $T_1^{\min}$ is derived from our assumption on the GAAP restriction and the fact that in Region I^R, short-run MBT firms overstate the truth .[30] Q.E.D.

[30] We remind the readers that the smoothed reports in Region IV^L must be lower than the actual earnings, because the long-run MBT firm hoards reported earnings to ensure that it does not miss the threshold in the second period.

Proof of Proposition 5:

This result is a corollary to propositions 2 and 3, since when $m^{R}_{1} > x_1$, the short-run MBT firm may miss the second period threshold and when $m^{L}_{1} < T_1$, the long-run MBT firm misses the first-period threshold and when $x_1+x_2 < T_1+T_2$, it misses the second-period threshold as well. Q.E.D.

Proof of Proposition 6:

Part (a): As provided in the proof of Proposition 1, taking a total derivative of (IC.*m*) with respect to x_1 yields:

$$\forall x_1,\ \ \frac{\partial(\mathrm{U}_1'S_1')}{\partial m_1}\frac{dm_1}{dx_1} = -\frac{dm_1}{dx_1}\int\frac{\partial(\mathrm{U}_2'S_{21}')}{\partial m_1}f(x_2|a_2)dx_2 + \left[1-\frac{dm_1}{dx_1}\right]\int\frac{\partial(\mathrm{U}_2'S_{22}')}{\partial m_2}f(x_2|a_2)dx_2.$$

Rearranging

$$\forall x_1,\ \ \frac{dm_1}{dx_1} = \frac{\int\frac{\partial(\mathrm{U}_2'S_{22}')}{\partial m_2}f(x_2|a_2)dx_2}{\frac{\partial(\mathrm{U}_1'S_1')}{\partial m_1}+\int\frac{\partial(\mathrm{U}_2'S_{21}')}{\partial m_1}f(x_2|a_2)dx_2+\int\frac{\partial(\mathrm{U}_2'S_{22}')}{\partial m_2}f(x_2|a_2)dx_2} > 0. \qquad \text{(A7)}$$

By our assumption that each element of Equ. (A7) is a strictly concave function of the relevant message, $0 < \mathrm{d}m_1/\mathrm{d}x_1 < 1$.

Part (b): The proof of Propositions 2 and 3 extends to the moral hazard setting. Q.E.D.

Proof of Proposition 7:

We prove for a_1 of a long-run MBT firm. The proof for a_2 and for a short-run MBT firm is similar. Denote the objective function of a board of a smoother by O^s and that of a long-run MBT firm by O^L. The former's board induces effort, $a_1^{s*} = \underset{a_1}{\arg\max}(\mathrm{O}^s\}$, i.e., $\frac{\partial \mathrm{O}^s}{\partial a_1}\Big|_{a_1=a_1^{s*}} = 0$; the latter $a_1^{L*} = \underset{a_1}{\arg\max}(O^L\}$, i.e., $\frac{\partial O^L}{\partial a_1}\Big|_{a_1 = a_1^{L*}} = 0$. Since $O^L = O^s$ –Eg(T_1)–EG(T_2), and by the

($F_a(x_t|a_t)$<0, , $-\frac{\partial EG}{\partial a_1}$>0, $\frac{\partial O^L}{\partial a_1}\Big|_{a_1 = a_1^{S*}} > 0$. That is, an MBT firm chooses a higher level of effort

that a smoother. Since this choice is feasible for a smoother, a_1^{s*} does not maximize the value of

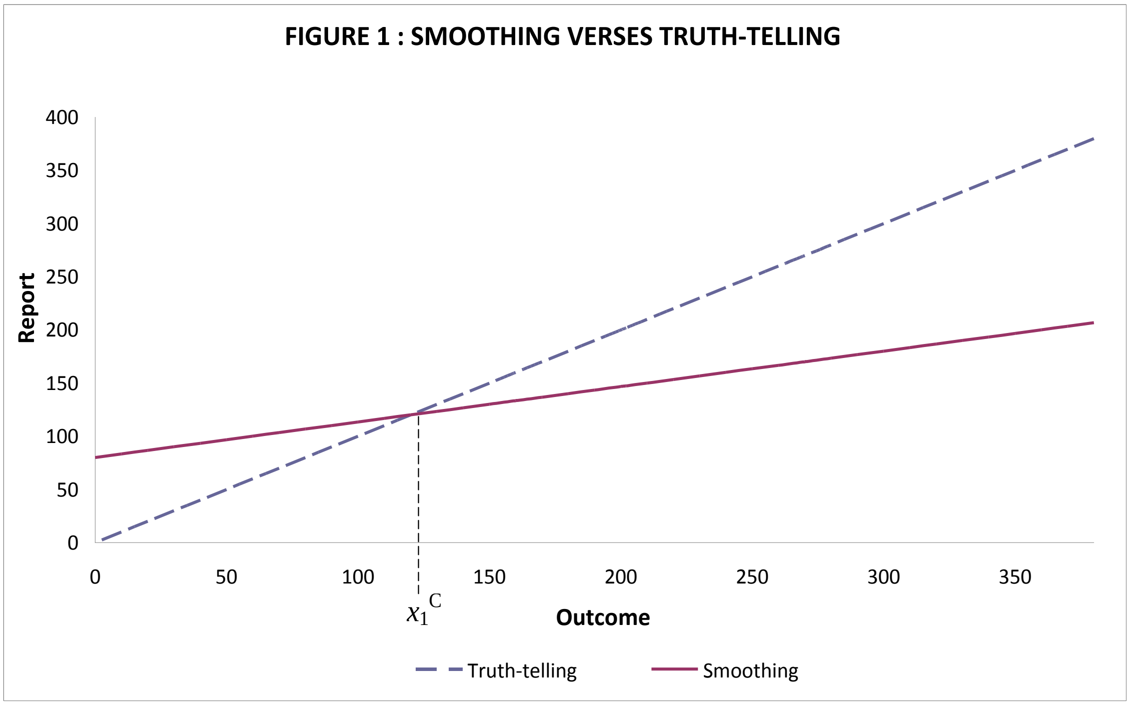
the firm, E(x–S(.)). Q.E.D.

TABLE 1: THE EQUILIBRIUM REPORTING STRATEGIES

First-period outcome	Short-run MBT firm	Long-run MBT firm
At the outcome's minimum level	Threshold meeting	"taking a bath"
Outcome exceeds the minimum but is insufficient to meet or beat thresholds in either period	Marginal threshold beating	"taking a bath"
Outcome is sufficient to meet or beat thresholds in one period only	Marginal threshold beating	"cookie jar reserve" if meeting or beating thresholds in the second period is assured and "taking a bath" if not
Outcome equals the sum of the thresholds of both periods	Threshold beating	Threshold meeting
Outcome exceeds the sum of both periods' thresholds	Smoothing if a smoothed message affords meeting or beating thresholds in both periods and threshold beating if not.	

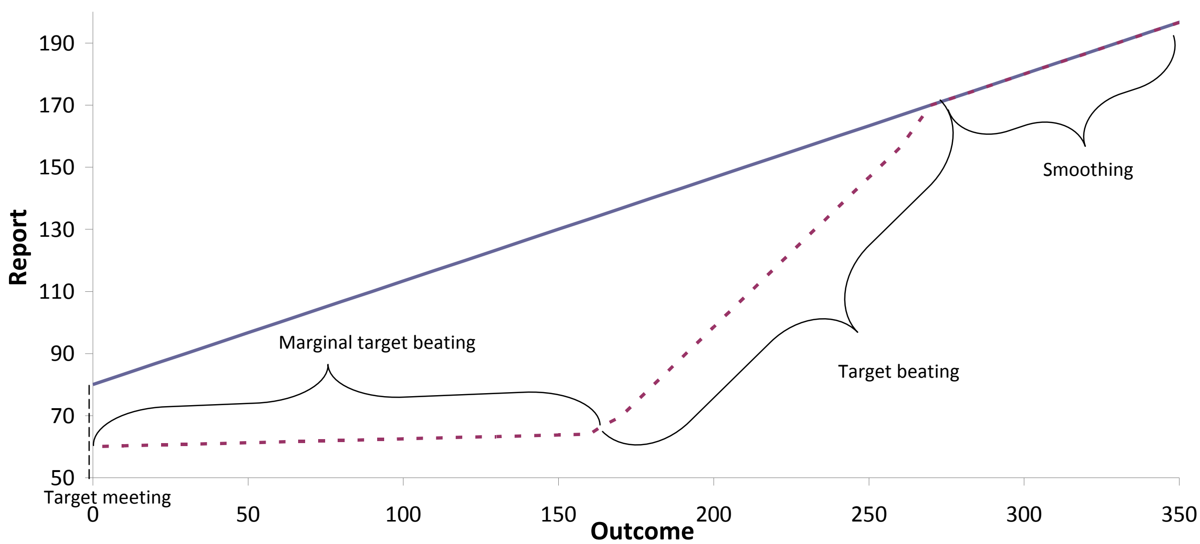
Definitions:

Threshold meeting–	the report equals the threshold.
Threshold beating –	the report exceeds the threshold.
Marginal threshold beating –	the report exceeds the threshold by a very small margin.
Smoothing –	the report overstates (understates) low (high) outcomes.
"Taking a bath" –	the report equals the minimum outcome.
"cookie jar reserve"–	the report is the difference between the truth and a reserve of earnings that will be reported in the following period.



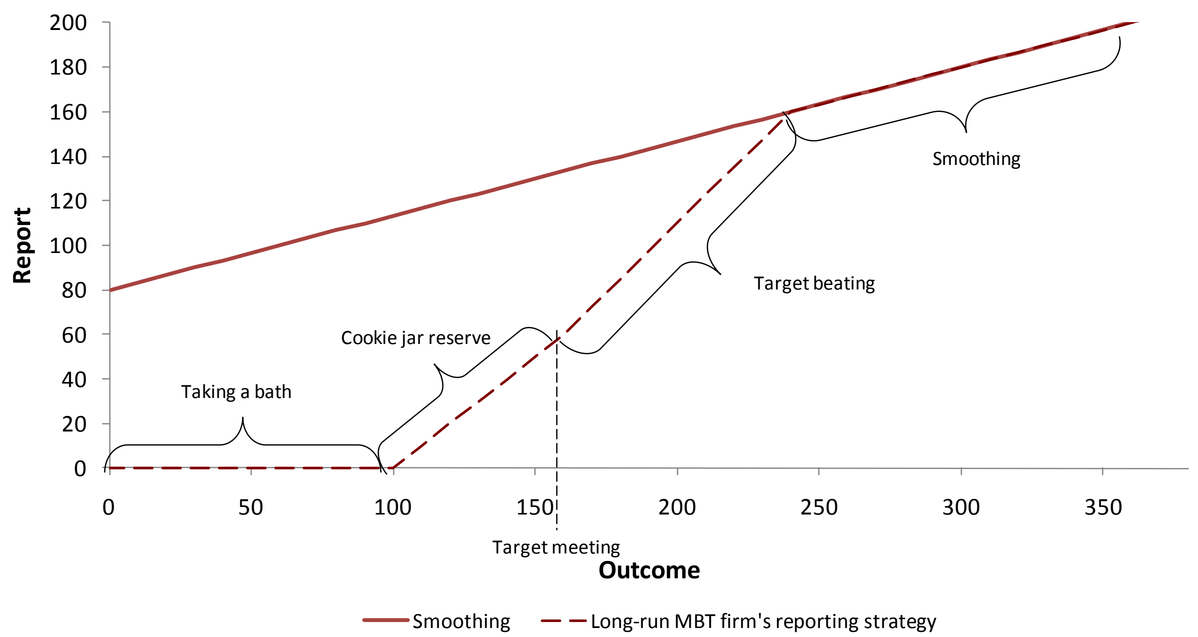
Smoothing: m_1=80+1/3*x_1

FIGURE 2 : THE REPORTING STRATEGY OF A SHORT-RUN MBT FIRM



T_1=60; T_2=100.
Marginal threshold beating (in Region II^R): $M^R = T_1+0.025(x_1 - T_1)$.
Threshold beating(in Region III^R): $M^R(x_1)$=60+0.9636*(x_1-60) -4 almost everywhere.
Smoothing ((in Region IV^R):): $M^R = M^{**}$ =80+1/3 x_1.
Target meeting in Region I^R.

FIGURE 3 : THE REPORTING STRATEGY OF A LONG-RUN MBT FIRM



T_1=60; T_2=100.
"Taking a bath" (in Region I^L): $M^L = 0$.
"Cookie jar reserve" (in Region II^L): $M^L = x_1 - T_2$.
Threshold beating (in Region IV^L): $M^L = M^L(x_1) = 55+0.9636*(x_1-160) +k$, k is a scalar.
Smoothing (in Region V^L): $M^L = M^R = M^{**} = 80+1/3\ x_1$.
Target meeting in Region III^L.