The Relative Efficiency of Clawback Provisions in Compensation Contracts

Carolyn B. Levine[1]
Michael J. Smith[2]

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[1]Rutgers Business School, Rutgers University
[2]Boston University. Please send correspondence to Michael Smith, Boston University School of Management, 595 Commonwealth Avenue, Boston MA 02215. Phone: 617-353-6673. e-mail: msmith22@bu.edu

Abstract

Clawbacks are retractions of previously-awarded bonuses. In our model, the manager takes a first-period effort that stochastically determines a first-period signal and a second-period cash flow. Both the cash flow and the signal are noisy indicators of effort. The agent can manipulate the signal, i.e, manage earnings. The no-clawback contract pays the agent in the first period for a good signal. The clawback contract also rewards the good signal, but the payment is in the second period and may be lower if the cash realization is low. The agent is impatient and prefers a first-period payment. We find that the no-clawback contract dominates the clawback contract if the cash realization is relatively noisy, earnings management is difficult, or the agent is very impatient. Earnings management may be optimal even though the actual cash realization is contractible. A contract involving restricted stock is always dominated by the clawback contract. The results demonstrate that the optimal *ex ante* alignment of manager and shareholder interests does not imply perfect *ex post* alignment of manager and shareholder payoffs.

1 Introduction

This paper addresses compensation contract provisions, called clawbacks, that allow firms to recover bonuses previously awarded to managers in the event of subsequent poor financial performance. After the financial crisis of 2008, several high profile firms, including Morgan Stanley, Credit Suisse, UBS, and the Royal Bank of Canada, implemented clawback provisions. For example, UBS in 2008 adopted clawbacks for asset writedowns, for personal misconduct, for breaches of risk rules and for missing performance targets (Hosking [2008]). French banks have also agreed to use clawback contracts (Gauthier-Villars [2009]) stipulating that traders receive a maximum of one-third of their bonus payouts in the first year, and risk the loss of the remaining bonus if they incur losses in the second and third years. The G20 Summit on Financial Markets and the World Economy has also called for reforms of executive pay, though not explicitly calling for clawbacks.

There is little debate on the effectiveness and fairness of at-fault clawbacks, such as those mandated by Section 304 of the Sarbanes Oxley Act, calling for repayment of bonuses by senior managers in the event of an accounting restatement resulting from managerial misconduct. There is more controversy surrounding performance-based clawbacks (i.e., those that do not hinge on managerial misconduct). Proponents of performance-based clawbacks argue that making pay contingent on long-term performance better aligns manager and shareholder interests. Opponents argue that the provisions could make hiring and retaining valuable employees more expensive. We formalize the tensions inherent in clawback provisions in our theoretical analysis.

In our two-period model, the manager takes a first-period action that affects the distribution of second-period cash flows (either high or low). Though the cash flows do not arrive until the second period, the distribution is set in the first. A first-period signal provides information about the realized distribution of cash flows. Under a no-clawback contract, the principal pays the manager in the first period if the signal is good and the subsequent cash flow realization plays no role in the contract. Under a clawback contract, the principal defers payment of the good-signal bonus until the second period. If the cash flow realization contradicts the good signal, the principal may release only a portion of the bonus to the agent. We also assume that the agent is less patient than the principal, valuing second-period payments less than first-period payments. This impatience can arise from a higher discount rate, or a shorter employment horizon related either to the agent's age or to alternative employment opportunities.

The principal observes neither the manager's effort nor the realized distribution of cash flows. Three sources of randomness complicate the principal's inference of effort from the signal and cash flow realizations. First, the signal is imperfect and may misclassify a low distribution as high. Second, the manager can influence the signal, which we interpret as earnings management. Third, a low cash flow realization can occur regardless of agent effort. That is, both the signal and the cash flow realization are noisy indicators of the realized cash flow distribution, itself a noisy indicator of effort.

Though the model applies to any multi-period project in which the benefit from current-period effort arrives in future periods, it fits particularly well in a financial services setting. One can interpret the effort, for example, as related to the origination of structured financing vehicles whose cash flows will not be realized until subsequent periods. While the ultimate payoff depends on the actual future cash flows, interim information about the project, in the form of a mark-to-market balance sheet value, is available to the principal for contracting purposes. Because of the lack of stated quotes or the potential illiquidity of a market, this signal may be noisy. The manager may behave opportunistically in seeking and providing information necessary to determine the mark-to-market value, particularly when fair value can be calculated using a mark-to-model approach. The future cash flow realization is also a noisy indicator of managerial effort, however. In particular, it may depend on macroeconomic events beyond the manager's control. One cannot distinguish a low outcome caused by bad luck from one caused by low effort.

We derive the properties of the best no-clawback and clawback contracts. A no-clawback contract that eliminates earnings management is not feasible if it is too easy to manage earnings. If a no-clawback/no-EM is feasible, it dominates the no-clawback/EM contract.

We also find that it is always feasible to eliminate earnings management with a clawback contract, and that this contract dominates the clawback contract that fails to eliminate earnings management. If the earnings report is less informative about effort than the cash flow realization, then a full-clawback (the agent forfeits the entire bonus if the cash flow realization is low) contract is best. If earnings are more informative, then a partial-clawback contract is optimal. In this case, the low cash flow realization is not a reliable signal and risk-sharing requires the principal to balance the payments to the manager.

Next, we compare the best clawback and no-clawback contracts to determine which of the two yields the highest expected surplus for the principal. If the agent is patient, i.e., has no preference for first-period cash payments, then the clawback contract dominates. This is consistent with the informativeness principle of Holmstrom (1982), which states that an efficient contract must use all non-redundant information. The agent's impatience is a contracting friction that undermines the informativeness principle, in a sense forcing the principal to pay for the second-period information. As a result, it may be optimal to settle the contract before receiving all of the information.

In general, the no-clawback contract is optimal if the agent is impatient enough. The threshold patience level below which the no-clawback contract is optimal is lower if earnings is less informative than the cash flow realization. Noisier accounting reports mean that the principal is willing to pay inflated second-period bonus payments to obtain cash flow information about agent effort.

If the agent is patient and a clawback contract is optimal, the contract requires full clawbacks if the signal noise is higher and partial clawbacks if the cash noise is higher. The full-clawback contract is the only one in which the *ex post* manager and shareholder payoffs are perfectly correlated. Under both a partial-clawback contract and a no-clawback contract, the manager receives compensation even if the cash flow realization is 0. Therefore, the perception that efficient incentive contracting requires perfect alignment of *ex post* payoffs holds only for a limited parameter space in our model.

Finally, earnings management occurs if the agent is impatient enough that a no-clawback contract is optimal and earnings management is easy enough that a no-clawback/no-EM contract is infeasible. Thus, though the principal can always suppress earnings management, it is in some cases not optimal to do so. If earnings management is too easy, then inducing shirking with a flat contract dominates the no-clawback/no-EM contract.

We also consider the use of a restricted stock contract to motivate the agent. Under the restricted stock contract, the principal gives the agent an equity stake in the future cash flows at the beginning of the contract period. The restricted stock contract guarantees that the shareholder and manager *ex post* payoffs are perfectly aligned. The clawback/no-EM contract dominates issuing stock, however. In essence, the restricted stock contract is equivalent to a clawback/no-EM contract in which the principal claws back the entire bonus. As a constrained version of the clawback/no-EM contract, it is weakly dominated.

We can frame the results in terms of the current debate about incentive contracting. Many have argued that compensation contracts at financial services promoted a short-term focus at the cost of long-term incentives. The implicit argument is that appropriate contracting requires an *ex post* alignment between shareholder and manager payoffs. Our results contradict this notion. Though the restricted stock contract induces a perfect correlation between shareholder and manager payoffs, it is never the optimal contract for two reasons. First, the principal may achieve better risk sharing with a clawback contract that releases some of the bonus even if the cash flow realization is low. Second, managers may be less patient than shareholders. While a contract may induce a manager to increase the weight on long-term firm payoffs in his effort decision, it cannot change his fundamental preferences over the timing of cash receipts. If he has a short-term focus (is highly impatient), then a short-term no-clawback contract may be optimal.

The results also support the argument that clawback provisions may make it difficult to attract and retain skilled employees. One interpretation of impatience is that the agent has many outside employment opportunities, implying that he is less likely still to be with the firm for the scheduled second-period cash payment. The agent will rationally incorporate this possibility into his first-period effort decision, requiring a much larger final bonus payment to compensate for the possibility that he will forfeit it by leaving. While it is always feasible to write a clawback contract with such an employee, it may be prohibitively expensive.

The paper makes several contributions. First, the paper informs the current debate over the form of compensation contracts for managers in financial services firms. This is an important debate due to the perception that flawed compensation packages were at the heart of the 2008 financial crisis. To our knowledge no other papers explicitly address the use of clawbacks in compensation contracts. Holtan (1999) and Moreno, Vazquez and Watt (2006) address the use of malus payments in optimal insurance contracts, a setting that is at best loosely applicable to compensation contracts. As a guide to compensation committees and policy makers, our paper establishes explicit conditions under which no-clawback contracts dominate clawback contracts. In particular, we show that instances in which agents receive high bonuses but shareholders receive low cash flows can be consistent with optimal *ex ante* contracting.

Second, our paper adds to the understanding of the use of accrual accounting numbers in performance evaluation. In a valuation setting, the terminal cash flow realization reveals all useful information. It is irrelevant to the shareholders whether a low cash flow realization was an unlucky outcome of a high cash flow distribution or the natural outcome of a low one. This distinction is relevant in a performance evaluation setting, however. The ideal performance measure allows an unambiguous inference of managerial effort. Neither the accounting signal, confounded by signal noise and possibly by earnings management, nor the cash flow realization, confounded by cash flow noise, allows the principal to make such an inference. So, while earnings management and noise diminish the information in the accounting signal, it may still be more useful for performance evaluation than the cash flow realization. A no-clawback contract sometimes rewarding failure (if a low cash flow distribution generates a high signal) may be more efficient than a full clawback contract sometimes punishing success (if a high cash flow distribution generates a low cash flow). The intuition is similar though distinct from Paul (1992), who contrasts the valuation and incentive roles of accounting information in a multitask agency setting. In Paul (1992), valuation depends on the realization of cash-flow relevant information that is noise with respect to managerial effort. Hence, basing pay on the stock price is inefficient, as it is in our model.

Third, our paper adds to the understanding of the interplay between earnings management and performance evaluation. Other papers examining earnings management in a contracting setting area include (1988), Evans and Sridhar (1996), Arya, Glover, and Sunder (1998), Demski and Frimor (1999), and Dutta and Gigler (2002). In particular, we show that earnings management can persist for some parameter values even if the aggregate realized cash flow is a contractible variable. That is, the *ex post* settling up property of accrual accounting has only a limited ability to eliminate accrual management. Evans and Sridhar (1996) obtain a similar result. In their two-period model, the manager receives private signals about both economic earnings and the amount of financial reporting flexibility. In a single-period model, the principal finds it too expensive to prevent earnings management via the compensation contract. The manager may report economic earnings, but only if there is no financial reporting flexibility. In the two-period model, the settling-up feature of accrual accounting acts as a second control on the manager's behavior and makes eliminating earnings management feasible. If the *ex ante* level financial reporting flexibility is low, however, the optimal contract induces earnings management even in the two-period model. The details of our model are quite different. For example, there is no private information or reporting in our model, unlike most in the earnings management literature. Our earnings management technology is similar to the modeling in Dutta and Gigler (2002), in which the agent's personally costly window-dressing effort probabilistically affects the report generated by the accounting system.[1] Also, the manager's intertemporal preferences over cash drive our results, a force absent in Evans and Sridhar (1996).[2] The tenor of the results is similar, however. Though *ex post* settling up makes the elimination of earnings management feasible in both papers, it may be too expensive to implement.

[1] In Dutta and Gigler (2002), the agent probabilistically influences the accounting signal, but also makes a report interpreted as an earnings forecast.

[2] Lambert (1999), in his discussion of Demski and Frimor (1999), anticipates a role for employment horizon playing a role in earnings management.

Finally, our paper speaks to the role of employment horizons in incentive contracting. Dikolli (2001) proposes a two-period multi-task agency model in which first-period effort has both short- and long-term effects. The principal includes both trailing and forward-looking performance measures in the agent's contract. The main result of the paper is that the principal increases the relative weight on the forward-looking performance measure as the agent's employment horizon shortens. Analogously, we find that the no-clawback contract, which relies exclusively on the noisy forward-looking signal, dominates if the agent's employment horizon is short enough.

The outline for the rest of the paper is as follows. Section 2 describes the model. Section 3 provides the analysis. Section 4 summarizes and discusses the results.

2 The model

A risk-neutral principal hires a risk- and work-averse agent to manage the firm. The agent has utility function $U(x) = \sqrt{x}$ and reservation utility $U_0 = 0$.[3] In the first of two periods, the agent chooses high effort at cost k_e, or low effort at no cost. Agent effort induces a high or a low cash flow distribution, which in turn generates a cash flow. Uncertainty about the cash flow is resolved in two stages. The cash flow distribution is determined in the first period. Neither the principal nor the agent observes the type of the cash flow distribution. The actual cash flow occurs in the second period. Effort affects the probability of realizing a high cash flow distribution, but does not further affect the expected cash flow conditional on the realization of the distribution. If the agent works, the high cash flow distribution occurs with probability w (for work) and the low cash flow distribution occurs with probability $1 - w$. If the agent shirks, the probabilities of high and low type are s (for shirk) and $1 - s$, with $w > s > 0$. A high cash distribution produces a second-period cash flow ($\frac{C}{h}$) with probability h, and 0 otherwise, with $0 \leq h < 1$. A low cash flow distribution always produces a cash flow of 0. We refer to the probability $1 - h$ as the cash flow noise. While the principal can

[3]We believe that the results would be qualitatively similar for a more general utility function. The square-root utility function is useful for technical reasons because the Kuhn-Tucker gradient conditions are linear in the utilities.

unambiguously infer that a high cash flow distribution generated a cash flow of $\frac{C}{h}$, both cash flow distributions can generate a cash flow of 0. The value of the cash flow realization as a contracting variable is decreasing in $1 - h$.

While the type of cash flow distribution is unobservable, the principal has access to a signal at the end of the first period. We interpret this as an accrual accounting signal on the as-yet unrealized cash flows. The signal is noisy and also susceptible to influence by the agent. A high cash flow distribution always generates a good signal, Y_g. In the absence of earnings management, a low cash flow distribution generates a good signal with probability e and a bad signal Y_b with probability $1 - e$, with $0 \leq e < 1$. We label e as the signal noise. Though only a low cash flow distribution can produce a bad signal, both can produce a good signal, confounding the inference about managerial effort. As a result, the value of the accounting signal as a contracting variable is decreasing in e.

At personal cost $k_m < k_e$, the agent can engage in earnings management activities that increase the probability that a low cash flow distribution generates a good signal from e to $m + e$, with $0 \leq m + e \leq 1$. Because the agent cannot observe the type of cash flow distribution, he manages earnings if it is *ex ante* optimal by taking cash-neutral real actions or by making opportunistic assumptions and estimates in the computation of accrual earnings. For example, if the computation of earnings requires marking to market a balance sheet asset, the manager could solicit a quote for an asset of a smaller size, and then scale it up even though the bid would likely be lower for the full notional amount of the asset.

Our model applies to any agency setting in which the firm benefits from current-period effort in future periods. The model maps naturally into various financial services setting. The agent, for example, could be responsible for generating portfolios of mortgage loans. Effort could be related to both the volume of loans, which would determine the realization of the first-period signal. A high volume of loans does not guarantee high terminal cash flows, however. Alternatively, the agent could be responsible for constructing a speculative derivatives position. A properly constructed trading position may not guarantee high cash flows because of constantly fluctuating market conditions. The assumptions necessary to mark the position to market may give the agent a greater ability to manipulate the interim signal (higher m) than in the mortgage case.

Based on the signal realization, the principal awards the agent a bonus of either W_g or W_b at the end of the first period. Under a no-clawback contract, the principal pays the manager the bonus in cash at the end of the first period, and the settlement of the contract is complete. Under a clawback contract, the principal holds the W_g award in escrow, awaiting the realization of the cash flow at the end of the second period. If the cash flow realization is $\frac{C}{h}$, the principal distributes the bonus to the agent. Otherwise, the principal releases only a portion of the bonus. We assume that the firm has sufficient cash to pay the agent in the first period under a no-clawback contract, and also to pay the agent in the second period under the clawback contract even if the cash realization is 0. Implicitly, we model only one segment of a larger firm.

Finally, the manager is impatient relative to the principal. The agent attaches a weight of d to the utility derived from second-period cash payments, with $0 < d \leq 1$. We interpret d in several ways. First, it could simply mean that the agent has a higher discount rate than the principal. Second, it could mean that the agent's employment horizon (age or retirement) is shorter than the firm's horizon. This interpretation requires an implicit assumption that the agent forfeits the bonus if he leaves the firm voluntarily. While clawback clauses could conceivably be written in many different ways, this interpretation seems reasonable. Third, and related to the last interpretation, d could serve as a proxy for the agent's outside employment opportunities. While a full model of the labor market is beyond the scope of the paper, it is reasonable to conjecture that a better agent is more likely to leave the employment relationship voluntarily. At the time of signing the contract, the agent does not know for certain whether he will retire or leave the firm for another job. A rational agent, however, will incorporate this possibility into his decision to accept or reject a contract stipulating deferred cash payments.

Figure 1 provides the timeline of the model. Figure 2 illustrates the information structure of the basic model.

3 Analysis

We will first derive the optimal no-clawback and clawback contracts, and then compare the two. As a preliminary step in all analyses, we note that the combination of square-root utility and a reservation utility of 0 implies that the wage payment for the low earnings report is 0.[4]

3.1 No-clawback contract

Under the no-clawback contract, the wage payment is contingent only on the interim signal. The cash flow realization occurs after the contract has been settled and is therefore irrelevant. We first analyze the optimal no-earnings management contract, then the optimal contract involving earnings management, then compare the two to determine the best choice of no-clawback contract.

3.2 No-clawback contract/no earnings management

In this section, we establish the conditions under which the principal can suppress earnings management with a no-clawback contract and characterize the details of the contract. The agent's expected utility under the no-clawback contract if he does not manage earnings is

$$[w + e(1-w)]U_g - k_e. \tag{1}$$

The optimization problem is

$$\text{Max}_{U_g} \qquad wC - [w + e(1-w)]U_g^2$$

subject to

$$[w + e(1-w)]U_g - k_e \geq 0 \qquad IR$$

$$[w + e(1-w)]U_g - k_e \geq [s + e(1-s)]U_g \qquad WNSN$$

$$[w + e(1-w)]U_g - k_e \geq [w + (m+e)(1-w)]U_g - k_e - k_m \qquad WNWY$$

[4] If the reservation utility is high enough, the principal minimizes the cost of motivating high effort by offering non-zero high and low wages. We can obtain qualitatively similar results in this extended model, though at some expositional cost.

$$[w+e(1-w)]U_g - k_e \geq [s+(m+e)(1-s)]U_g - k_m \qquad WNSY$$

$$U_g \geq 0 \qquad NN$$

The cash flow distribution is high with probability w. The expected value for a high distribution is $h\frac{C}{h} = C$. Thus, the *ex ante* expected cash flow to the firm is wC. From this the principal must deduct the high wage payment when the good signal occurs. We express the program in terms of the agent's contingent utility level rather than the explicit wage: $U_g = U(W_g) = \sqrt{W_g}$, equivalent to $W_g = U^{-1}(U_g) = U_g^2$. The first constraint is the participation constraint. The second constraint is the incentive compatibility constraint ensuring that the agent prefers working and not managing earnings to shirking and not managing earnings.[5] The third constraint is the incentive compatibility constraint ensuring that the agent prefers working and not managing earnings to working and managing earnings. Earnings management increases the probability that the agent receives U_g to $w+(m+e)(1-w)$ at cost k_m. The fourth constraint is the incentive compatibility constraint ensuring that the agent prefers working and not managing earnings to shirking and managing earnings. The final constraint is the non-negativity constraint on U_g. The following proposition outlines the solution to the contracting problem. We define m^H and m^L as follows: $m^L \equiv \frac{k_m(w-s)(1-e)}{k_e(1-s)}$ and $m^H \equiv \frac{k_m(w-s)(1-e)}{k_m(w-s)+k_e(1-w)}$. These thresholds classify the relative effectiveness of earnings management.[6]

Lemma 1 *If earnings management is relatively ineffective ($m < m^L$), then $U_g = \frac{k_e}{(1-e)(w-s)}$ and the expected surplus is $wC - [w+e(1-w)][\frac{k_e}{(1-e)(w-s)}]^2$. If earnings management is in the middle range of effectiveness ($m^L \leq m \leq m^H$), then $U_g = \frac{k_e - k_m}{(w-s)(1-e)-m(1-s)}$ and the expected surplus is $wC - [w+e(1-w)]\frac{(k_e-k_m)^2}{[(w-s)(1-e)-m(1-s)]^2}$. If earnings management is highly effective ($m > m^H$), then a no-earnings management no-clawback contract is not feasible.*

[5] The convention for labeling the constraints is that the first two letters correspond to the actions on the LHS of the constraint and the third and fourth letters correspond to the actions on the RHS. WNSY, then, is the constraint ensuring that work/no-EM dominates shirk/EM, where Y designates earnings management.

[6] As long as $k_e > k_m$, $m^H > m^L$.

The intuition for the proposition is that the principal must make U_g high enough to motivate high effort, but not so high that it rewards earnings management. If earnings management is relatively ineffective ($m < m^L$), then the principal can focus on effort management alone in setting U_g. That is, the minimum payment necessary to induce high effort does not justify the agent incurring the personal cost of k_m to manage earnings. In this range, U_g, and the principal's expected payoff are fixed with respect to m. If earnings management is easier ($m^L < m < m^H$), then the minimum payment necessary to secure high effort also rewards earnings management. To discourage earnings management, the principal must increase U_g to increase the marginal benefit from high effort vis a vis the shirk/EM alternative. In this range, U_g is increasing in m, and the principal's payoff is decreasing. If earnings management is even more effective ($m > m^H$), then the minimum utility payment necessary for work/no-EM to dominate shirk/EM is high enough that the agent prefers to work and manage earnings. In this region, there is no feasible no-EM contract.

3.2.1 No-clawback contract/earnings management

The agent's expected utility if he manages earnings in a no-clawback contract is

$$[w + (m + e)(1 - w)]U_g - k_e - k_m. \tag{2}$$

The optimization problem is

$$\text{Max}_{U_g} \qquad wC - [w + (m + e)(1 - w)]U_g^2$$

subject to

$$[w + (m + e)(1 - w)]U_g - k_e - k_m \geq 0 \qquad IR$$

$$[w + (m + e)(1 - w)]U_g - k_e - k_m \geq [s + (m + e)(1 - s)]U_g - k_m \qquad WYSY$$

$$[w + (m + e)(1 - w)]U_g - k_e - k_m \geq [w + e(1 - w)]U_g - k_e \qquad WYWN$$

$$[w + (m + e)(1 - w)]U_g - k_e - k_m \geq [s + e(1 - s)]U_g \qquad WYSN$$

$$U_g \geq 0 \qquad NN$$

The first and fifth constraints are the participation and non-negativity constraints. The second and fourth constraints ensure that the agent prefers work/EM to shirk/EM and shirk/no EM, respectively. The third constraint ensures that the agents prefers work/EM to work/no EM. This does not hold automatically because earnings management is costly to the agent. The following proposition characterizes the no-clawback/earnings management contract.

Lemma 2 *If $m \leq m^H$, then $U_g = \frac{k_m}{m(1-w)}$ and the expected surplus is $wC - [w + (m+e)(1-w)]\frac{k_m^2}{m^2(1-w)^2}$. If $m > m^H$, then the principal sets $U_g = \frac{k_e}{(w-s)(1-m-e)}$ and the expected surplus is $wC - [w + (m+e)(1-w)]\frac{k_e^2}{(w-s)^2(1-m-e)^2}$.*

A no-clawback contract inducing earnings management is always feasible. If earnings management is relatively ineffective ($m \leq m^H$), then the minimum payment necessary to motivate EM also induces hard work. The utility level U_g is decreasing in m over this range, and the expected surplus is increasing. If earnings management is relatively easy ($m > m^H$), then the minimum payment necessary to induce hard work also rewards earnings management. In this range, U_g is increasing and the expected surplus is decreasing in m.

3.2.2 Comparison of no-clawback contracts

We now compare the EM and no-EM contracts to determine the optimal no-clawback contract.

Proposition 1 *If earnings management is relatively ineffective ($m \leq m^H$), then the principal chooses a no-earnings management contract. Otherwise, the principal chooses an earnings management contract.*

The result follows in a straightforward manner from Lemmas 1 and 2. If earnings management is relatively hard ($m < m^L$), then the no-EM incentive-compatibility constraints in the no-EM optimization are not binding. As discussed earlier, the payment that motivates high effort does not induce earnings management for low m. Because there is no cost to eliminating earnings management, the no-EM contract dominates the EM contract. On the other hand, if earnings management is relatively easy ($m > m^H$), then the principal cannot write a contract that simultaneously eliminates earnings management and induces high effort. By default, the EM contract dominates. In the middle range ($m^L \leq m \leq m^H$), the EM contract incentive-compatible payment satisfies all of the no-EM contract constraints, but is higher than the no-EM incentive compatible payment. Therefore, the no-EM contract dominates.

3.3 Clawback contract

Under the clawback contract, the principal awards a bonus of U_g^2 to the agent if a good signal is realized, but places it in escrow. The principal pays the agent cash in the amount of the bonus if the second-period cash flow realization is $\frac{C}{h}$. If the cash flow realization contradicts the good signal, the principal pays the agent U_n^2.[7] We restrict U_n to be lower than U_g.[8] The agent discounts the second-period utility by $d < 1$.

3.3.1 No earnings management

The agent's expected utility under a clawback contract without earnings management is

$$whdU_g + d[w(1-h) + e(1-w)]U_n - k_e. \tag{3}$$

Let $\pi_n = w(1-h) + e(1-w)$, the joint probability of a high signal and low cash flow given effort. The principal's maximization problem is

$$\text{Max}_{U_g, U_n} \qquad wC - whU_g^2 - \pi_n U_n^2$$

[7] An alternative modeling choice would be to assume that the principal pays the agent cash of U_n^2 in the first period if the signal is good, and pays $U_g^2 - U_n^2$ (0) in the second period if the cash flow realization is $\frac{C}{h}$ (0). In this way, the principal would avoid the delay penalty for at least that portion of the total bonus that will be paid regardless of the cash realization. As later analysis shows, the results would be exactly the same for the $e > 1-h$ case because full clawbacks are optimal. In the $1-h > e$ case, the results would be qualitatively similar, with the parameter space over which the clawback contract is optimal slightly expanded.

[8] This will occur in equilibrium in an unconstrained optimization unless the firm is attempting to motivate earnings management. In this case, it may be necessary to pay the agent more for a good signal/low cash flow realization than for a good signal/high cash flow realization.

subject to

$$whdU_g + d\pi_n U_n - k_e \geq 0 \qquad IR$$

$$whdU_g + d\pi_n U_n - k_e \geq shdU_g + d[s(1-h) + e(1-s)]U_n \qquad WNSN$$

$$whdU_g + d\pi_n U_n - k_e \geq whdU_g + d[w(1-h) + (m+e)(1-w)]U_n - k_e - k_m \qquad WNWY$$

$$whdU_g + d\pi_n U_n - k_e \geq shdU_g + d[s(1-h) + (m+e)(1-s)]U_n - k_m \qquad WNSY$$

$$U_n \geq 0 \qquad NN$$

$$U_g \geq U_n \qquad CL$$

The constraints have the same interpretations as in the no-clawback setting. The following proposition characterizes the principal's choice of optimal no-EM clawback contract. Let $m^{SY} = \frac{k_m(w-s)(eh+w(1-e)(1-h-e)]}{w(1-h-e)(1-s)k_e}$.

Lemma 3 *If the signal noise is higher than cash noise ($e \geq 1-h$), then $U_g = \frac{k_e}{dh(w-s)}$ and $U_n = 0$. If $1-h > e$ and $m < m^{SY}$, then $U_g = \frac{k_e[w(1-h)+e(1-w)]}{[d(w-s)[eh+w(1-e)(1-h-e)]}$ and $U_n = \frac{w(1-h-e)k_e}{[d(w-s)[eh+w(1-e)(1-h-e)]}$. If $1-h > e$ and $m \geq m^{SY}$, then $U_g = \frac{mk_e(1-s)-k_m(e-1+h)(w-s)}{dm(1-s)(1-e)(w-s)}$ and $U_n = \frac{k_m}{md(1-s)}$.*

The relative sizes of the signal noise (e) and the cash noise ($1-h$) play a significant role in the form of the clawback/no-EM contract. If the signal noise is higher than the cash noise ($e > 1-h$), then a low cash flow realization contradicts a good signal relatively frequently. In this case, clawing back the high signal bonus is effective in suppressing earnings management. It is so effective, in fact, that the principal would like to be able to require the manager not only to forfeit the entire bonus but to pay an additional penalty. This is barred by the non-negativity constraint. For all m, the principal claws back the entire bonus for a cash flow realization of 0.

If the cash noise is higher than the signal noise ($1 - h > e$), then the clawback is a less effective tool because of the extra compensation risk it imposes on the agent. If earnings management is not highly effective (if $m < m^{SY}$), then the only binding constraint involves ensuring that work/no-EM dominates shirk/no-EM. The principal finds the cost-minimizing pair of payments that exactly satisfies the WNSN constraint. The utility levels and expected payoff are fixed with respect to m. For $e = 1-h$, the principal claws back 100% of the bonus. As $1 - h$ increases relative to e, the principal offsets the increased riskiness of the contract by clawing back a smaller percentage of the bonus. If window-dressing is highly effective (if $m > m^H$), then shirking/EM becomes the more attractive alternative for the agent. As a result, both the WNSN and WNSY constraints bind. For risk-sharing purposes, the principal prefers small clawbacks. Small clawbacks, however, induce the manager to window-dress. As a result, the clawback is increasing in m.

3.3.2 Earnings management

The no-EM contract constraints involving earnings management bind only if $1 - h > e$ and $m \geq m^{SY}$. In this region, it is conceivable that the EM contract is optimal. Otherwise, the no-EM contract is optimal. We characterize the optimal EM contract in this section.

The agent's expected utility under a clawback contract with earnings management is

$$whdU_g + d[w(1-h) + (e+m)(1-w)]U_n - k_e - k_m. \tag{4}$$

Let $\pi_\eta = w(1-h) + (e+m)(1-w)$. The optimization problem is

$$\text{Max}_{U_g} \qquad wC - whU_g^2 - \pi_\eta U_n^2$$

subject to

$$whdU_H + d\pi_\eta U_n - k_e - k_m \geq 0 \qquad IR$$

$$whdU_H + d\pi_\eta U_n - k_e - k_m \geq shdU_H + d[s(1-h) + (e+m)(1-s)]U_n - k_m \qquad WYSY$$

$$whdU_H + d\pi_\eta U_n - k_e - k_m \geq whdU_g + d[w(1-h) + m(1-w)]dU_n - k_e \qquad WYWN$$

$$whdU_H + d\pi_\eta U_n - k_e - k_m \geq shdU_H + d[s(1-h) + e(1-s)]U_n \qquad WYSN$$

$$U_n \geq 0 \qquad NN$$

$$U_g \geq U_n \qquad CL$$

The following propositions characterizes the optimal clawback/earnings management contract.

Lemma 4 *For low values of window-dressing effectiveness ($m \leq m^H$), the principal does not claw back any of the bonus: $U_g = U_n = \frac{k_m}{md(1-w)}$. If window-dressing is more effective ($m > m^H$), the principal claws back: $U_n = \frac{k_m}{md(1-w)}$ and $U_H = \frac{[mk_e(1-w)+(w-s)(e-1+h+m)k_m]}{mdh(w-s)(1-w)}$.*

If earnings management is relatively ineffective ($m \leq m^H$), the principal must provide strong incentives to induce window-dressing. The principal accomplishes this by rewarding the good signal/low cash flow outcomes that are likely to occur under earnings management. Thus, the CL constraint binds in this range. Ideally, the principal would set U_n higher than U_g. Not surprisingly, given that the principal takes strong measures to motivate deleterious earnings management, the expected surplus is quite low for this range of m and always strictly dominated by the no-EM contract. We include the analysis for completeness. If earnings management is more effective ($m > m^H$), then it is not as difficult to induce the agent to manage earnings. For this range of m, the principal claws back some of the bonus in the event of a 0 cash flow realization, with the clawback percentage increasing in m.

3.3.3 Comparison of clawback contracts

The following proposition characterizes the optimal clawback contract.

Proposition 2 *Regardless of the manager's ability to manipulate earnings, the optimal clawback contract suppresses earnings management.*

Both contracts are feasible over the entire range of earnings management effectiveness. As discussed above, if $m < m^{SY}$, only the work/no-EM vs shirk/no-EM constraint binds in the no-EM contract program. That is, at the utility levels that satisfy this constraint, the manager strictly prefers shirk/no-EM to work/EM or shirk/EM. Because the suppression of earnings management does not constrain the principal in her choice of payments, the no-EM contract must be optimal. If $m \geq m^{SY}$, it can be shown that the optimal EM contract payments satisfy all of the no-EM contract constraints. Thus, the no-EM contract also dominates in this range.

3.4 Comparison of contracts

Having established the optimal no-clawback and clawback contracts, we determine the optimal contract for different ranges of earnings management effectiveness in this section. The first result in this section pertains to the role impatience plays in the model.

Lemma 5 *If $d = 1$, then the principal weakly prefers the clawback contract to the no-clawback contract for all parameter values.*

The informativeness principle states that a contract using all of the available non-redundant information is more efficient. In our setting, only the clawback contract uses the information in the cash flow realization. If there is no penalty for delaying the payment to the agent, then the clawback contract weakly dominates the no-clawback contract. Without impatience, the no-clawback contract is a constrained version of the clawback contract. The lemma, while straightforward, emphasizes the role of impatience in the model as a contracting friction undermining the informativeness principle. We now address the principal's optimal contract choice in the absence of earnings management.

Proposition 3 *If the signal noise is greater than the cash noise ($e > 1 - h$), then the no-clawback contract dominates if $d \leq d_1 = \sqrt{\frac{w(1-e)^2}{h[w+e(1-w)]}}$. If the cash noise is greater than the signal noise ($e < 1 - h$),then the no-clawback contract dominates if $d \leq d_5 = \sqrt{\frac{w(1-e)^2[e(1-w)+w(1-h)]}{[w+e(1-w)][eh+w(1-e)(1-h-e)]}}$.*

If the agent is impatient enough, the no-clawback contract is optimal for all parameter values. In general, the threshold patience level below which the no-clawback contract dominates depends on how valuable the cash flow realization is for contracting purposes. If the cash flow noise is high relative to the signal noise, then the cash realization provides little incremental information about the agent's effort. As a result, the threshold patience level is high. That is, the no-clawback contract is optimal unless the agent is very patient. If, on the other hand, signal noise is high relative to cash noise, then the threshold is relatively low. The cash flow realization provides so much information that the principal is willing to pay the delay penalty to obtain it. As a result, the clawback contract is optimal unless the agent is very impatient.

The next proposition incorporates earnings management.

Proposition 4

i. The possibility of earnings management expands the range for which the clawback contract dominates relative to the no-EM case in Proposition 3

ii. No-clawback, full-clawback, and partial-clawback contracts can be optimal.

iii. The no-clawback/EM contract dominates for impatient agents when earnings management is effective, but not so effective that the principal prefers to induce shirking by offering a flat contract.

Figure 3 fully characterizes the optimal contract choice if the signal noise exceeds the cash noise ($e > 1 - h$). Before discussing the characterization in more detail, we comment on the most salient aspects of the solution. First, earnings management undermines the quality of the signal for contracting purposes. As a result, the principal is willing to pay higher delay penalties in order to incorporate the cash flow realization information into the contract. This has the practical result of lowering the patience threshold below which the no-clawback contract dominates.

Second, all three types of contracts can be optimal depending on the parameters. Only the full-clawback contract results in perfect *ex post* alignment between manager and shareholder payoffs. With the other two contracts, it is *ex ante* optimal to write a contract that may result in the manager receiving a high reward despite shareholder losses. This result holds because the low cash flow realization can occur even if the manager exerts and the cash-flow distribution is high. Clawbacks are useful to regulate earnings management and reverse the effects of lucky signal realizations, but, because the cash flow realization does not perfectly reveal effort or type, risk-sharing may require that the agent still receives a partial payment if low cash occurs. Furthermore, if the agent is impatient enough, the principal may optimally settle the contract based on the imperfect signal before the cash flow realization occurs, resulting in potentially large *ex post* disparities between managerial compensation and shareholder returns. The results illustrate that aligning manager and shareholder interests *ex ante* does not imply perfectly correlated *ex post* payoffs. The empirical observation of the simultaneous occurrence of high managerial rewards and low shareholder returns, therefore, can be consistent with appropriate incentive contracting.

Third, earnings management can occur for some parameter values. This occurs when the agent is impatient enough that a no-clawback contract is better and earnings management is easy enough that a no-clawback contract suppressing it is not feasible. If EM is too easy, the contracting losses are sufficiently high that the principal instead chooses a flat contract inducing shirking. For a range of EM under both noise-dominant cases, though, the no-clawback/EM contract is optimal. The result shows that the ability to contract on the cash flow realization, after the accrual reversal occurs, is not enough to discourage earnings management in all cases. Just as accruals are useful in a valuation setting because of their timeliness, the accounting signal is useful in our contracting setting because it provides the principal with a basis for settling the contract and avoiding delay penalties resulting from the agent's impatience.

We now discuss Figure 3, which characterizes the choice of optimal contract for the $e > 1 - h$ setting. Panel A summarizes the best no-clawback and clawback contracts for different levels of earnings management. If feasible, the no-EM contract dominates for both types of contract. The only range for which a no-EM contract is infeasible is $m > m^H$ for the no-clawback contract. Determining the overall optimal contract requires direct comparison of the best no-clawback and clawback contracts in each range. As Panel B shows, a characterization of the full solution requires classifying levels of impatience as well as ease of earnings management. For $m \leq m^H$, the clawback contract is optimal if the agent is patient enough. Otherwise, the no-clawback/no-EM contract is optimal. If earnings management is relatively effective ($m > m^H$), then the principal selects the clawback contract if the manager is patient enough. If not, the principal optimizes with a no-clawback contract even though it is infeasible for this range of m to suppress earnings management. For extremely impatient agents, the principal may prefer to induce low effort through a fixed payment contract rather than write a no-clawback/EM contract.

The characterization of the $1 - h > e$ setting is complicated by the fact that the high range of m is further split into $m^H \leq m < m^{SY}$ and $m^{SY} \leq m \leq 1$. The solution to the contracting problem is qualitatively similar, with the clawback/no-EM contract optimal if the agent is patient and earnings management is relatively easy, the no-clawback/no-EM contract optimal if the agent is impatient and earnings management is relatively hard, and the no-clawback/EM contract optimal if the agent is impatient and earnings management is relatively easy (assuming the principal still finds it worthwhile to motivate effort). One difference is that the threshold patience levels below which the no-clawback contract dominates are higher in this setting because the high cash noise reduces the informativeness of the cash realization and thus the value of clawbacks.

3.5 Restricted stock

Commentators have also suggested that firms can align the interests of managers and shareholders through the use of restricted stock grants in which managers receive their compensation via a stock position in the company that can be liquidated only after a stipulated amount of time. We model restricted stock by assuming that the principal issues a grant of

$B\%$ of the project to the agent at the beginning of the contract.[9] The purpose of this ownership interest is to motivate future performance, not to reward past performance. Hence, the agent receives the grant prior to selecting effort. The manager is prohibited from selling the ownership interest prior to the cash flow realization. Because the agent's payoff does not depend on the interim signal, there is no reason to manage earnings in this setting.

The agent's expected utility under a restricted stock contract is

$$dwh\sqrt{B\frac{C}{h}} - k_e. \tag{5}$$

The optimization problem is

$$\text{Max}_B \qquad wC(1-B)$$

subject to

$$dwh\sqrt{B\frac{C}{h}} - k_e \geq 0 \qquad IR$$

$$dwh\sqrt{B\frac{C}{h}} - k_e \geq dsh\sqrt{B\frac{C}{h}} \qquad IC$$

$$B \geq 0 \qquad NN$$

Because the restricted stock contract eliminates the incentive for earnings management, there is only a single incentive compatibility contract related to effort in the program.

The following proposition characterizes the optimal restricted stock contract.

Lemma 6 *The optimal ownership interest to grant to the manager is* $B = \frac{k_e^2}{Cd^2h(w-s)^2}$.

The following proposition compares the restricted stock program to the other compensation mechanisms available to the principal.

[9] The alternative of making the ownership grant in the first-period contingent on a good signal is less efficient for contracting. It provides incentives for earnings management, but is no more flexible in the second period.

Proposition 5 *The clawback contract weakly dominates the restricted stock contract.*

The restricted stock contract is equivalent to a no-EM full-clawback contract ($U_n = 0$). A no-EM clawback contract allowing partial clawbacks, therefore, weakly dominates the restricted stock contract. The restricted stock contract is the weakly optimal overall contract over the range for which the full-clawback contract is optimal. This can occur if the agent is relatively patient, window-dressing is effective, and the signal noise is greater than the cash flow noise.

In superficial ways, the claim that a restricted stock contract perfectly aligns manager and shareholder interests is accurate. The imperfect, non-cash accounting signal is irrelevant, the manager has no incentive to manage earnings, and the manager's *ex post* payoff is perfectly correlated with the shareholders'. Our results, however, show that restricted stock is a relatively inefficient contracting vehicle. This holds for two reasons. First, unless the cash flow realization perfectly reveals agent effort, the accounting signal, while imperfect, offers incremental information useful for contracting. A restricted stock contract ignores that information. Second, and more fundamental to the contribution of our paper, the manager and shareholders have different time horizons. The restricted stock contract forces the manager to consider only the long-term outcome in choosing his effort level. This may be to the shareholders' detriment, however. If the manager has distaste for long-term cash payments, the shareholders would be better off inducing a short-term focus. The compensation contract cannot change the manager's fundamental preferences. Thus, even in an unlikely setting in which long-term cash flows perfectly reveal effort, it may still be optimal to pay the agent based on an imperfect short-term accounting signal.

4 Conclusion

We analyze the use of clawback provisions in compensation contracts in a two-period agency model. The principal can pay the agent based on a short-term accounting signal or based on the joint realizations of the short-term accounting signal and the actual cash flow. The agent has a shorter time horizon than the firm and values second-period cash payments less than first-period payments. This represents an endogenous cost to contracting on the incremental information in the second-period cash flow realization. We find that a no-clawback contract is optimal if the agent is sufficiently impatient. Otherwise, the clawback contract dominates. The agent can manage earnings (manipulate the signal). Increasing the ease of earnings management limits the parameter space for which no-clawback contracts are optimal because it adds noise to the signal. The threshold patience level below which the no-clawback contract is optimal is generally lower if the signal is relatively noisy. The best *ex ante* contract need not not perfectly align the *ex post* payoffs of the manager and the shareholders. We also find that the principal may optimally write a contract that induces earnings management when the manager is impatient and earnings management is relatively easy. Thus, the ability to contract on the realized cash flow does not necessarily eliminate earnings management. The results speak to the current debate over compensation practices. Many financial services firms have implemented clawback provisions. We formalize the conditions under which these are effective.

While we have incorporated what we believe are the most important aspects of this contract setting (impatience, noisy signal, noisy cash flow realization) into the model, our model is not fully general. We believe our assumption of a square-root utility function allows us to illustrate in closed-form results that would hold qualitatively for other utility functions. We also assume that the agent cannot affect the firm's payoff after his effort stochastically determines the type of the cash flow distribution in the first period. That is, the project initiated by the agent does not benefit from active management in the second period. If it did, the cash flow realization would be a more informative signal on effort and clawbacks would be more valuable. We believe our modeling is applicable to a broad range of activities. For example, the agent could be responsible for generating a pool of loans, for research and development, or for developing a computerized trading program. The agent's initial effort is more important to the final payoff than subsequent active management for all of these examples.

Not all of our assumptions work against clawbacks. In particular, we assume that partial-clawback contracts are credible. First, the firm has sufficient cash to make the partial-clawback payment even though the payoff from the agent's project is 0. Second, the firm has the ability to honor the contract. If the agent believes either that an adverse outcome will render the firm insolvent or that forces outside the firm will prevent it from making partial clawback payments, then only a full-clawback contract is credible. The latter concern is important given the political controversy surrounding bonuses at firms receiving US government bailout money in the 2009 financial crisis. Eliminating partial payments would significantly limit the range of parameters for which a clawback contract is optimal.

5 Proofs

5.1 Proof of No Clawback

5.1.1 No Earnings Management

$$\text{Max}_{U_g} \qquad wC - [w + e(1-w)]U_g^2$$

subject to

$$[w + e(1-w)]U_g - k_e \geq 0 \qquad IR$$

$$[w + e(1-w)]U_g - k_e \geq [s + e(1-s)]U_g \qquad WNSN$$

$$[w + e(1-w)]U_g - k_e \geq [w + (m+e)(1-w)]U_g - k_e - k_m \qquad WNWY$$

$$[w + e(1-w)]U_g - k_e \geq [s + (m+e)(1-s)]U_g - k_m \qquad WNSY$$

$$U_g \geq 0 \qquad NN$$

At $U_g = 0$m only WNWY is greater than 0. Also, WNWY is decreasing in U_g. So we can solve WNWY to find the upper bound on U_g of $\frac{k_M}{m(1-w)}$. Evaluating WNSY at the upper bound yields $\frac{k_m(-1+e-m)(w-s)+mk_e(1-w)}{m(-1+w)}$. Equating to 0 and solving for m yields $\frac{k_m(w-s)(1-e)}{k_m(w-s)+k_e(1-w)} = m^H$. So, if $m > m^H$, then the constraints cannot be simultaneously satisfied and the principal cannot motivate effort without inducing earnings management.

Now assume that $m \leq \frac{k_m(w-s)(1-e)}{k_m(w-s)+k_e(1-w)}$ so that it is feasible for the principal to prevent earnings management. That is, we consider only utility levels below the level which induces earnings management(note that $\frac{k_m(w-s)(1-e)}{k_m(w-s)+k_e(1-w)}$ is lower than $\frac{k_m}{m(1-w)}$). WNSN binds at $U_g = \frac{k_e}{(w-s)(1-e)}$, which is less than the upper bound on U_g as long as m exceeds the threshold given. We now evaluate WNSY at $U_g = \frac{k_e}{(w-s)(1-e)}$, yielding $k_m - \frac{m(1-s)}{(w-s)(1-e)}k_e$. This is positive if $m < \frac{(1-e)(w-s)k_m}{k_e(1-s)}$. So, when WNSN=0, $WNSY > 0$, implying that WNSN binds, if $m < \frac{(1-e)(w-s)k_m}{k_e(1-s)}$. Otherwise, WNSY binds.

To summarize, if $m > \frac{k_m(w-s)(1-e)}{k_m(w-s)+k_e(1-w)}$, then no-EM is not feasible. If $0 \leq m < \frac{k_m(1-e)(w-s)}{k_e(1-s)}$, then WNSN binds, implying that $U_g = \frac{k_e}{(w-s)(1-e)}$ and the surplus is $[wC - [w+e(1-w)](\frac{ke}{(w-s)(1-e)})^2$. If $\frac{k_m(w-s)(1-e)}{k_e(1-s)} \leq m < \frac{k_m(w-s)(1-e)}{k_m(w-s)+k_e(1-w)}$,then WNSY binds, $U_g = \frac{k_e-k_m}{(w-s)(1-e)-m(1-s)}$, and the surplus is $wC - [w+e(1-w)](\frac{k_e-k_m}{w-c-m(1-s)})^2$.

5.1.2 Earnings Management

The optimization problem is

$$\text{Max}_{U_g} \qquad wC - [w + (m+e)(1-w)]U_g^2$$

subject to

$$[w + (m+e)(1-w)]U_g - k_e - k_m \geq 0 \qquad IR$$

$$[w + (m+e)(1-w)]U_g - k_e - k_m \geq [s + (m+e)(1-s)]U_g - k_m \qquad WYSY$$

$$[w + (m+e)(1-w)]U_g - k_e - k_m \geq [w + e(1-w)]U_g - k_e \qquad WYWN$$

$$[w + (m+e)(1-w)]U_g - k_e - k_m \geq [s + e(1-s)]U_g \qquad WYSN$$

$$U_g \geq 0 \qquad NN$$

To satisfy WYWN, $U_g = \frac{k_m}{m(1-w)}$. We now evaluate the difference WYSY-WYSN at this utility level, yielding $-(1-s)mU_g + k_m$, which is positive only if $U_g < \frac{k_m}{m(1-s)}$, which is less than the utility level necessary to satisfy WYWN. We conclude that is WYWN is satisfied, and WYSN is not binding. We now evaluate WYSY at $U_g = \frac{k_m}{m(1-w)}$. If the sign is negative, then WYSY is binding. Otherwise, WYWN is. We obtain $\frac{(w-s)(1-m)(1-e)}{m(1-w)}k_m - k_e$, which is negative if and only if $m > \frac{k_m(w-s)(1-e)}{k_m(w-s)+k_e(1-w)}$. So WYSY is binding if $m > m^H$.

To summarize, it is always feasible to motivate earnings management. If $m < \frac{k_m(w-s)(1-e)}{k_m(w-s)+k_e(1-w)}$, then WYWN is binding, $U_g = \frac{k_m}{m(1-w)}$, and the surplus is $wC - [w+(m+e)(1-w]\frac{k_m^2}{m^2(1-w)^2}$. If $m > \frac{k_m(w-s)(1-e)}{k_m(w-s)+k_e(1-w)}$, then WYSY is binding, $U_g = \frac{k_e}{(w-s)(1-m)}$, and the surplus is $wC - [w+(m+e)(1-w)]\frac{k_e^2}{(w-s)^2(1-m)^2}$.

5.1.3 Comparison

If $m > \frac{k_m(w-s)(1-e)}{k_m(w-s)+k_e(1-w)}$, then only earnings management is feasible, $U_g = \frac{k_e}{(w-s)(1-m)}$, and the surplus is $wC - [w+(m+e)(1-w)]\frac{k_e^2}{(w-s)^2(1-m)^2}$.

If $m = m^H \frac{k_m(w-s)(1-e)}{k_m(w-s)+k_e(1-w)}$, then the incentive-compatible payments are equal under both EM and no-EM contracts. The incentive-compatible EM payment is decreasing in m and the incentive-compatible no-EM payment is increasing in m. Therefore, the no-EM payment is lower for $m < m^H$. Furthermore, the agent receives the payment more often under EM. Thus, the no-EM contract dominates for this range, and the utilities and surpluses are as outlined above.

5.2 Proof of Clawback

5.2.1 No Earnings Management

Let $\pi_n = w(1-h) + e(1-w)$, the joint probability of a high signal and a low cash flow. The principal's maximization problem is

$$\text{Max}_{U_g,U_n} \qquad wC - whU_g^2 - [w(1-h) + e(1-w)]U_n^2$$

subject to

$$whdU_g + d\pi_n U_n - k_e \geq 0 \qquad IR$$

$$whdU_g + d\pi_n U_n - k_e \geq shdU_g + d[s(1-h) + e(1-s)]U_n \qquad WNSN$$

$$whdU_g + d\pi_n U_n - k_e \geq whdU_g + d[w(1-h) + (m+e)(1-w)]U_n - k_e - k_m \qquad WNWY$$

$$whdU_g + d\pi_n U_n - k_e \geq shdU_g + d[s(1-h) + (m+e)(1-s)]U_n - k_m \qquad WNSY$$

$$U_g, U_n \geq 0 \qquad NN$$

$$U_g \geq U_n \qquad CL$$

We can rewrite the incentive compatibility constraints as

$$WNSN : k_e - dh(w-s)U_g - d(w-s)(1-h-e)U_n \leq 0$$

$$WNWY : m(1-w)dU_n - k_m \leq 0$$

$$WNSY : k_e - k_m - dh(w-s)U_g - d[(w-s)(1-h-e) - m(1-s)]U_n \leq 0$$

$$NN : -U_n \leq 0$$

$CL : U_n - U_g \leq 0.$

The Lagrangian is

$$L : -wC + whU_g^2 + [w(1-h) + e(1-w)]U_n^2 + \lambda_1[k_e - dh(w-s)U_g - d(w-s)(1-h-e)U_n]$$

$$+\lambda_2[m(1-w)dU_n - k_m] + \lambda_3[k_e - k_m - dh(w-s)U_g - d[(w-s)(1-h-e) - m(1-s)]U_n]$$

$$+\lambda_4[-U_n] + \lambda_5[U_n - U_g].$$

The Kuhn-Tucker gradient conditions are

$$LUH = \frac{\partial L}{\partial U_H} = 2whU_g - \lambda_1 dh(w-s) - \lambda_3 dh(w-s) - \lambda_5 = 0$$

$$LUN = \frac{\partial L}{\partial U_n} = 2[w(1-h) + e(1-w)]U_n - \lambda_1 d(w-s)(1-h-e)$$

$$+\lambda_2 md(1-w) - \lambda_3 d[(w-s)(1-h-e) - m(1-s)] - \lambda_4 + \lambda_5 = 0$$

At the optimal utility and multiplier vectors, we also require

$$WNSN = k_e - dh(w-s)U_g - d(w-s)(1-h-e)U_n \leq 0$$

$$WNWY = m(1-w)dU_n - k_m \leq 0$$

$$WNSY = k_e - k_m - dh(w-s)U_g - d[(w-s)(1-h-e) - m(1-s)]U_n \leq 0$$

$$NN = -U_n \leq 0$$

$$CL = U_n - U_g \leq 0$$

The complementary slack conditions are (at the optimal utility and multiplier vectors):

$$\lambda_1[k_e - dh(w-s)U_g - d(w-s)(1-h-e)U_n] = 0$$

$$\lambda_2[m(1-w)dU_n - k_m] = 0$$

$$\lambda_3[k_e - k_m - dh(w-s)U_g - d[(w-s)(1-h-e) - m(1-s)]U_n] = 0$$

$\lambda_4[-U_n] = 0$

$\lambda_5[U_n - U_g] = 0$

Finally, the non-negativity conditions are

$\lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5 \geq 0$

Assume that $e > 1 - h$. We conjecture that WNSN and NN bind, implying that $U_g = \frac{k_e}{dh(w-s)}$ and $U_n = 0$. We use this candidate vector, $\lambda_2 = \lambda_3 = \lambda_4 = 0$, and LUH and LUN to solve for λ_1 and λ_5. We obtain $\lambda_1 = \frac{2wk_e}{d^2h(w-s)} > 0$ and $\lambda_5 = \frac{2[e-(1-h)]}{dh(w-s)} > 0$. Next, we substitute the candidate solution into WNWY and WNSY and obtain in both cases after simplification $k_m > 0$, so both constraints are satisfied and non-binding. All the Kuhn-Tucker conditions are satisfied. Furthermore, the objective and the constraints are convex functions, so $U_g = \frac{k_e}{dh(w-s)}$ and $U_n = 0$ are the cost-minimizing contract payments.

Now assume that $(1-h) > e$ and $m < m^{SY} = \frac{k_m(w-s)[eh+w(1-e)(1-h-e)]}{w(1-h-e)(1-s)k_e}$. We conjecture that only WNSN binds, so that $\lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = 0$. Solve LUH, LUN and WNSN simultaneously to find $U_g = \frac{k_e[w(1-h)+e(1-w)]}{[d(w-s)[eh+w(1-e)(1-h-e)]}$, $U_n = \frac{w(1-h-e)k_e}{[d(w-s)[eh+w(1-e)(1-h-e)]}$, and $\lambda_1 = \frac{2k_e w[(1-h)w+e(1-w)]}{[d(w-s)[eh+w(1-e)(1-h-e)]} > 0$. Now plug the candidate solution into WNWY and WNSY and simplify. WNWY is satisfied as long as $m < \frac{k_m(w-s)[eh+w(1-e)(1-h-e)]}{w(1-h-e)(1-w)k_e}$. WNWY is satisfied as long as $m < \frac{k_m(w-s)[eh+w(1-e)(1-h-e)]}{w(1-h-e)(1-s)k_e}$. The latter condition is more difficult to satisfy (because lower), so define it as the m^{SY} in the proposition. NN is satisfied as long as $1-h > e$. All the Kuhn-Tucker conditions are satisfied. Furthermore, the objective and the constraints are convex functions, so $U_g = \frac{k_e[w(1-h)+e(1-w)]}{[d(w-s)[eh+w(1-e)(1-h-e)]}$, $U_n = \frac{w(1-h-e)k_e}{[d(w-s)[eh+w(1-e)(1-h-e)]}$ are the cost-minimizing contract payments.

We now assume that $1 - h > e$ and $m > m^{SY}$. We conjecture that WNSN and WNSY bind, implying that $U_g = \frac{mk_e(1-s)-k_m(e-1+h)(w-s)}{dm(1-s)(1-e)(w-s)}$ and $U_n = \frac{k_m}{md(1-s)}$. Using $\lambda_2 = \lambda_4 = \lambda_5 = 0$, the candidate solution, and LUH and LUN, we solve for λ_1 and λ_3. We find that $\lambda_3 > 0$ when $m > m^{SY}$. The shadow price λ_1 is a complicated expression. It can be shown that it is positive for all parameter values. Evaluating WNWY at the candidate solution yields $\frac{k_m(w-s)}{1-s}$). All the Kuhn-Tucker conditions are satisfied. Furthermore, the objective and the constraints are convex functions, so $U_g = \frac{mk_e(1-s)-k_m(e-1+h)(w-s)}{dm(1-s)(1-e)(w-s)}$ and $U_n = \frac{k_m}{md(1-s)}$ are the cost-minimizing contract payments.

5.2.2 Earnings management

Let $\pi_\eta = w(1-h) + (e+m)(1-w)$. The optimization problem is

$$\text{Max}_{U_g} \qquad wC - whU_g^2 - \pi_\eta U_n^2$$

subject to

$$whdU_H + d\pi_\eta U_n - k_e - k_m \geq 0 \qquad IR$$

$$whdU_H + d\pi_\eta U_n - k_e - k_m \geq shdU_H + d[s(1-h) + (e+m)(1-s)]U_n - k_m \qquad WYSY$$

$$whdU_H + d\pi_\eta U_n - k_e - k_m \geq whdU_g + d[w(1-h) + m(1-w)]dU_n - k_e \qquad WYWN$$

$$whdU_H + d\pi_\eta U_n - k_e - k_m \geq shdU_H + d[s(1-h) + ((1-s)]U_n \qquad WYSN$$

$$U_g, U_n \geq 0 \qquad NN$$

$$U_g \geq U_n \qquad CL$$

We can rewrite the constraints as

$$WYSY : k_e - d(w-s)hU_g - d(w-s)(1-h-e-m)U_n \leq 0$$

$$WYWN : k_m - md(1-w)U_n \leq 0$$

$$WYSN : k_e + k_m - d(w-s)hU_g - d[(w-s)(e-1+h) + m(1-w)]U_n \leq 0$$

$$NN : -U_n \leq 0$$

$$CL : U_n - U_g \leq 0$$

The Lagrangian is

$$L = -wC + whU_g^2 + [w(1-h) + (e+m)(1-w)]U_n^2$$

$$+\lambda_1[k_e - d(w-s)hU_g - d(w-s)(1-h-e-m)U_n] + \lambda_2[k_m - md(1-w)U_n]$$

$$+\lambda_3[k_e + k_m - d(w-s)hU_g - d[(w-s)(e-1+h) + m(1-w)]U_n] + \lambda_4[-U_n] + \lambda_5[U_n - U_g]$$

The Kuhn-Tucker gradient conditions are

$$LUH = 2whU_g - \lambda_1 dh(w-s) - \lambda_3 dh(w-s) - \lambda_5$$

$$LUN = 2[w(1-h) + (e+m)(1-w)]U_n - \lambda_1 d(w-s)(1-h-e-m)$$

$$-\lambda_2 md(1-w) - \lambda_3 d[(w-s)(e-1+h) + m(1-w)]\lambda_3 - \lambda_4 + \lambda_5$$

At the optimal utility and multiplier vectors, we also require

$$WYSY = k_e - d(w-s)hU_g - d(w-s)(1-h-e-m)U_n \leq 0$$

$$WYWN = k_m - md(1-w)U_n \leq 0$$

$$WYSN = k_e + k_m - d(w-s)hU_g - d[(w-s)(e-1+h) + m(1-w)]U_n \leq 0$$

$$NN = -U_n \leq 0$$

$$CL = U_n - U_g \leq 0$$

The complementary slack conditions are (at the optimal utility and multiplier vectors):

$$\lambda_1[k_e - d(w-s)hU_g - d(w-s)(1-h-e-m)U_n] = 0$$

$$\lambda_2[k_m - md(1-w)U_n] = 0$$

$$\lambda_3[k_e + k_m - d(w-s)hU_g - d[(w-s)(e-1+h) + m(1-w)]U_n] = 0$$

$$\lambda_4[-U_n] = 0$$

$$\lambda_5[U_n - U_g] = 0$$

Finally, the non-negativity conditions are

$$\lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5 \geq 0$$

Assume that $m \leq m^H = \frac{k_m(w-s)(1-e)}{k_m(w-s)+k_e(1-s)}$. We conjecture that WYWN and CL bind, implying that $U_g = U_n = \frac{k_m}{dm(1-w)}$. Using the candidate utilities, $\lambda_1 = \lambda_3 = \lambda_4 = 0$, and LUH and LUN, we solve for $\lambda_2 = \frac{2k_m[w+(e+m)(1-w)]}{d^2m^2(1-w)^2} > 0$ and $\lambda_5 = \frac{2k_m wh}{md(1-w)} > 0$. Evaluating WYSY at the candidate solution yields a positive number as long as $m < m^H$. Evaluating WYSN at the candidate solution yields a positive number as long as $m < \frac{(w-s)(1-e)k_m}{k_e(1-w)}$, which is greater than m^H. All the Kuhn-Tucker conditions are satisfied. Furthermore, the objective and the constraints are convex functions, so $U_g = U_n = \frac{k_m}{dm(1-w)}$ are the cost-minimizing contract payments.

Now assume that $m > m^H$. We conjecture that WYWN and WYSY bind, implying that $U_g = \frac{mk_e(1-w)+(w-s)(e-1+h+m)k_m}{mdh(w-s)(1-w)}$ and $U_n = \frac{k_m}{md(1-w)}$. Using $\lambda_3 = \lambda_4 = \lambda_5 = 0$, the candidate solution, and LUH and LUN, we solve for $\lambda_1 = \frac{2wU_g}{d(w-s)} > 0$ and λ_2. λ_2 is a complicated function of the parameters, but can be shown to be positive. Evaluating WYSN at candidate solutions yields $\frac{k_m(w-s)}{1-w} > 0$. Also, CL is satisfied as long as $m > m^H$. All the Kuhn-Tucker conditions are satisfied. Furthermore, the objective and the constraints are convex functions, $U_g = \frac{mk_e(1-w)+(w-s)(e-1+h+m)k_m}{mdh(w-s)(1-w)}$ and $U_n = \frac{k_m}{md(1-w)}$ are the cost-minimizing contract payments.

5.2.3 Comparison

If $m < m^{SY}$, then the no-EM constraints (WNWY an WNSY) are not binding. Therefore, the no-EM contract dominates in this range. If $m > m^{SY}$, the incentive-compatible EM utility levels also satisfy the no-EM constraints. In particular, WNSN evaluated at the EM-utility levels is $\frac{k_m(w-s)}{1-w}$, and WNWY and WNSY evaluated at the candidate solution are both 0. The intuition is that the EM constraints make the agent indifferent between managing and not managing earnings. Furthermore, the expected payoff for the principal is higher because the non-earnings-managing agent is paid less often. Therefore, the no-EM contract also weakly dominates for $m > m^{SY}$.

5.3 Proof of Lemma 5

Proof: There are three distinct signal-cash realizations in the model: $(Y_g, \frac{C}{h})$, $(Y_g,0)$, $(Y_b, 0)$, and therefore three distinct potential utility levels the principal can use. If $d = 1$, then the agent receives no more utility from a wage payment in period 1 than the same wage payment in period 2. The principal can write a clawback contract replicating the no-clawback contract by setting the good signal/high cash and good signal/low cash clawback contract payments equal to the no-clawback good signal payment. Since the no-clawback contract is a constrained version of the clawback contract, the clawback contract is weakly superior.

5.4 Proof of Proposition 4

We will prove the proposition by fully characterizing the $e > 1 - h$ case. All of the claims made in the proposition are illustrated here.

$\underline{m < m^L}$: For this range, the no-EM contract is best for both clawbacks and no-clawbacks. The expected surpluses are both independent of m because the effort-inducing payments do not motivate window-dressing. So, the no-clawback contract dominates if $d > d_1$, where d_1 is defined as the relevant solution in terms of d to[10]:

$$wC - \frac{wk_e^2}{d^2h(w-s)^2} = wC - \frac{k_e^2[w + e(1-w)]}{(1-e)^2(w-s)^2}$$

$\underline{m^L < m < m^H}$: The optimal clawback contract is the same as in the $m < m^L$ case. The optimal no-clawback contract now depends on m. Define d_2 as the relevant solution in terms of d to:

$$wC - \frac{wk_e^2}{d^2h(w-s)^2} = wC - \frac{(k_e - k_m)^2[w + e(1-w)]}{[(1-e)(w-s) - m(1-s)]^2}.$$

Note that d_2 is a function of m. Define three ranges of d: $d_1 < d < 1$, $d_2(m^H) < d < d_1$, and $d < d_2(m^H)$. In the $d_1 < d < 1$ range, the clawback/no-EM contract, by the definition of d_1, dominates the no-clawback/no-EM contract in which $m = 0$. Therefore, the clawback contract dominates the no-clawback contract for $m^L < m < m^H$. In the $d < d_2(m^H)$ range, the no-clawback/no-EM contract, by the definition of d_2, dominates the clawback contract

[10] The equation is a quadratic in d, so that there are two roots.

for all m such that $m^L < m < m^H$. In the $d_2(m^H) < d < d_1$ range, the no-clawback contract dominates for $m < d_2^{-1}(d)$, and the clawback contract dominates otherwise.

$\underline{m^H < m < 1}$: The optimal clawback contract is the same as in the other two cases. The optimal no-clawback contract now entails earnings management. Define d_3 as the relevant solution in terms of d to:

$$wC - \frac{wk_e^2}{d^2h(w-s)^2} = wC - \frac{k_e^2[w+(e+m)(1-w)]}{(1-e-m)^2(w-s)^2}.$$

With earnings management so effective, the shirk contract is a viable alternative for the principal. Define m^* as the relevant solution in terms of m to

$$wC - \frac{k_e^2[w+(e+m)(1-w)]}{(1-e-m)^2(w-s)^2} = sC,$$

and define d_4 as the relevant solution in terms of d to:

$$wC - \frac{wk_e^2}{d^2h(w-s)^2} = sC.$$

m^* is the earnings management level above which shirk dominates no-clawback/EM. d_4 is the patience level below which shirk dominates clawback/no-EM.

Define three ranges: $d_3(m^H) \leq d \leq 1$, $d_4 < m < d_3(m^H)$, and $0 \leq d < d_4$. In the $d_3(m^H) < d < 1$ range, the clawback/no-EM contract, by the definition of d_3, dominates the no-clawback/EM contract. In the $d_4 \leq m < d_3(m^H)$ range, shirking, by the definition of d_4 is dominated. The no-clawback/EM contract is optimal for $m < d_3^{-1}(d)$ in this range. Otherwise, the clawback/no-EM contract is optimal. In the $0 \leq d < d_4$ range, the shirk contract dominates the clawback/no-EM contract. By the definition of m^*, the no-clawback/EM contract is optimal in this range. Otherwise, the shirk contract is optimal.

Glossary of Notation

Term	Meaning
U_0	reservation utility (equal to 0)
w	probability cash distribution is high given work
s	probability cash distribution is high given shirk
C	high terminal cash flow
h	probability cash realization is C given high distribution
Y_i	signal realization $i =$ good or bad
e	baseline probability that low cash distribution generates good signal
m	increase in Prob Y_g given low cash distribution due to earnings management
k_e	personal cost of effort
k_m	personal cost of earnings management
d	impatience (amount by which agent discounts second-period pay
U_g	high utility payment to agent
U_n	clawback utility payment to agent for good signal/low cash
B	proportion of ownership granted to agent under stock contract

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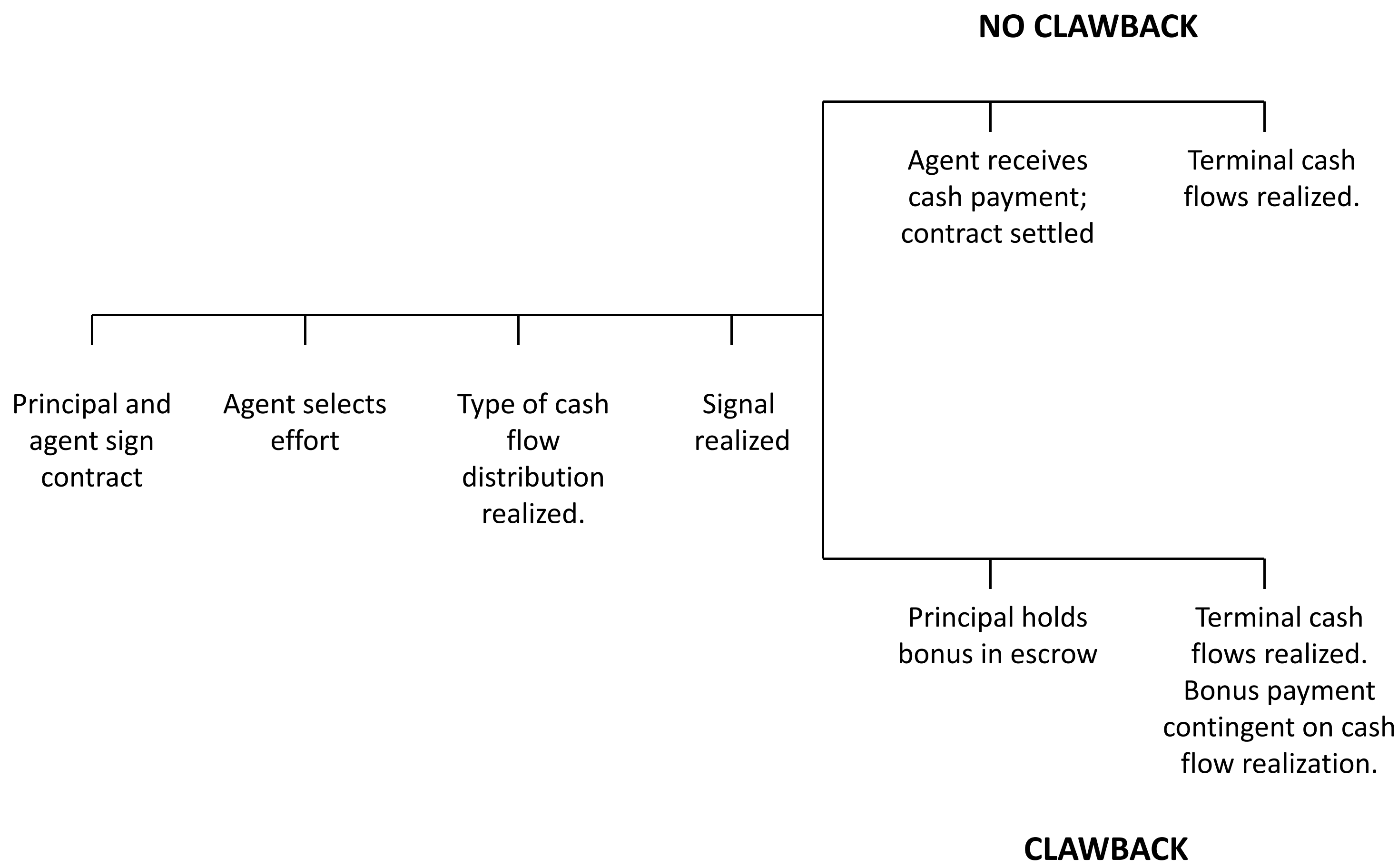
FIGURE 1



NO CLAWBACK
Agent receives cash payment; contract settled
Terminal cash flows realized.
Principal and agent sign contract
Agent selects effort
Type of cash flow distribution realized.
Signal realized
Principal holds bonus in escrow
Terminal cash flows realized. Bonus payment contingent on cash flow realization.
CLAWBACK

FIGURE 2

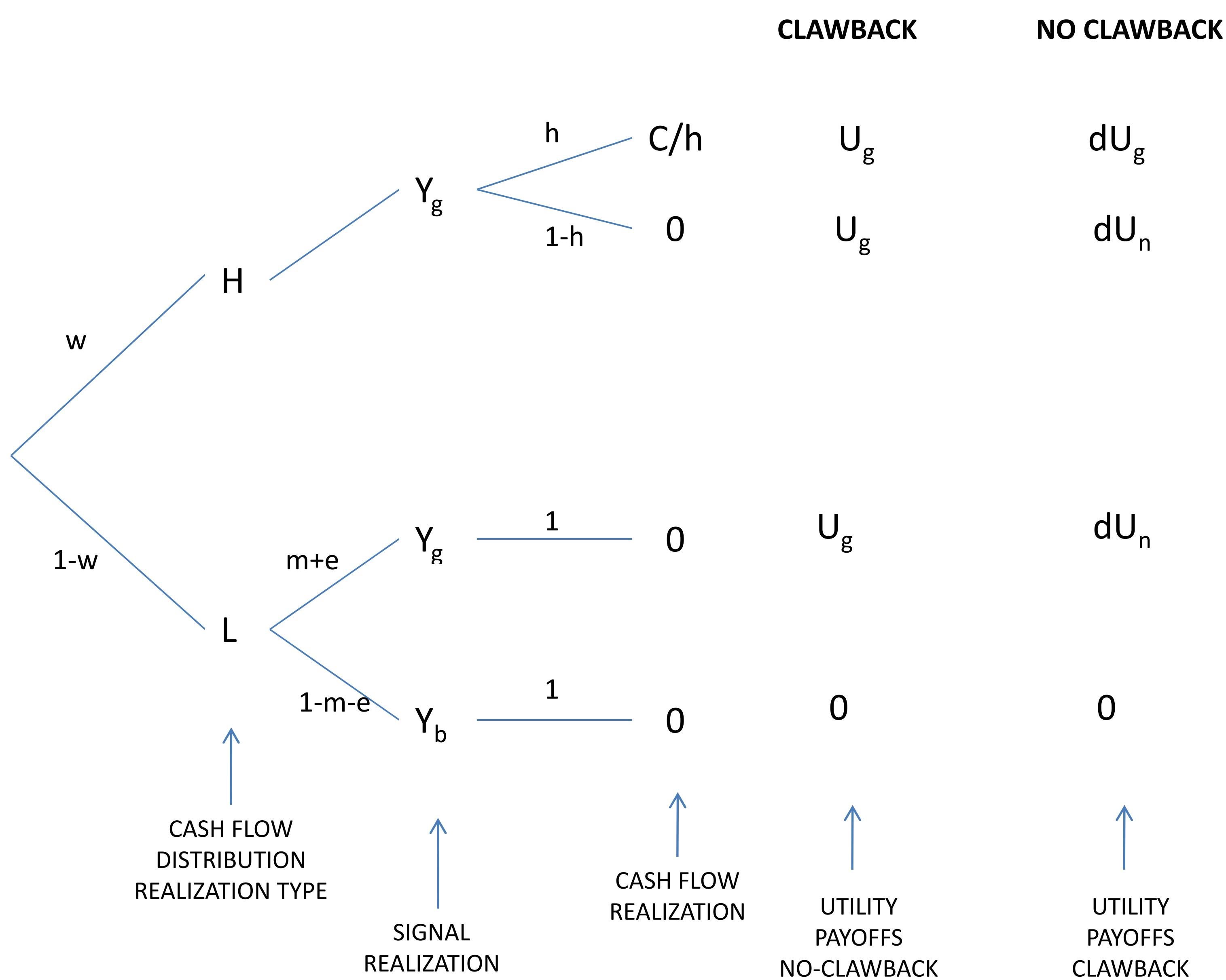

CLAWBACK
NO CLAWBACK
w
1-w
H
L
Y
g
Y
g
Y
b
m+e
1-m-e
h
1-h
1
1
C/h
0
0
0
U
g
U
g
U
g
0
dU
g
dU
n
dU
n
0
CASH FLOW
DISTRIBUTION
REALIZATION TYPE
SIGNAL
REALIZATION
CASH FLOW
REALIZATION
UTILITY
PAYOFFS
NO-CLAWBACK
UTILITY
PAYOFFS
CLAWBACK

FIGURE 3

PANEL A	**$0 < m \leq m^L$**	**$m^L < m \leq m^H$**	**$m^H < m \leq 1$**
NO-CLAWBACK	NO EM	NO EM	EM
CLAWBACK	NO EM	NO EM	NO EM

Panel A shows the optimal contract within each category for different levels of easiness of earnings management (m).

Panel B compares the best no-clawback contract to the best clawback contract within each level of earnings management and shows the winner. To characterize the solution, it is necessary also to classify in terms of the agent's impatience (d).

PANEL B	**$0 < m \leq m^L$**	**$m^L < m \leq m^H$**	**$m^H < m \leq 1$**
$d_1 < d < 1$	C/NO EM	C/NO EM	C/NO EM
$d_2(m^H) \leq d < d_1$	NC/NO EM	NC/NO EM C/NO EM	C/NO EM
$d_3(m^H) \leq d < d_2(m^H)$	NC/NO EM	NC/NO EM	C/ NO EM
$d_4 \leq d < d_3(m^H)$	NC/NO EM	NC/NO EM	NC/EM C/NO EM
$0 \leq d < d_4$	NC/NO EM	NC/NO EM	NC/EM LOW EFFORT

$m=d_2^{-1}(d)$

$m=d_3^{-1}(d)$

$m=m^*$

In this example, w = .80, s = .35, C = 25, k_e = .45, k_m = .15, e = .38 and 1-h = .21.

d_1 = .667, $d_2(m^H)$ = .381, $d_3(m^H)$ = .370, d_4 = .300, m* = .331, m^L =.143, m^H = .266.