# A Contracting Approach to Conservatism and Earnings Management *

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**Abstract**

This paper provides one analytical formalization of the contracting explanation of conservatism articulated in the literature (e.g., Watts (2003a)). In a model in which accounting measurement is used to implement a state-contingent covenant, the optimal measurement rule is conservative under two sufficient conditions. First, the contract rewards a manager for better performance. Second, the manager's ex post earnings management is not contractible. In presence of managerial opportunism, measurements generated by a conservative rule are less biased than those by a neutral rule. Using a new way to model accounting measurement, the paper refines the contracting explanation of conservatism and reconciles it with its information-based criticisms. The paper also provides a theory of the equilibrium existence of transparent earnings management.

**Key Words:** Conservatism, Accounting Measurement, Debt Covenant, Earnings Management, Accounting-motivated Transaction

# 1 Introduction

This paper provides one analytical formalization of the contracting explanation of conservatism articulated in the literature (e.g., Watts (2003a)). When facing uncertainty, accountants guided by conservatism require stronger support of evidence to recognize gains than to recognize losses. Conservatism's long and pervasive influence on accounting around the world has been well documented in empirical studies (see Watts (2003b) for a survey).

One rationale for conservatism is that it facilitates a firm's contracting with its stakeholders, an explanation tracing its root back to the theory of firm (Coase (1937)). A firm organizes economic activities through "a nexus of contracts" (Jensen and Meckling (1976), Sunder (1997)). As part of a *firm*'s institution, accounting evolves to mitigate contracting costs by establishing ex ante agreement among stakeholders (Watts and Zimmerman (1978), Watts and Zimmerman (1986), Ball (1989)). In other words, not only does accounting provide information for unilateral decisions, it also, probably more importantly, provides measurement for settling contracts (*i.e.*, multi-lateral relations). When accounting measurement is used to settle contracts, the asymmetric verification requirement of conservatism arises as a response to the friction that managers have both incentives and ability to inflate ex post measurement. Watts and Zimmerman (1990) summarizes the argument concisely:

> "Reacting to the incentive of managers to exercise accounting discretion opportunistically, the accepted set includes 'conservative'(e.g., lower of cost or market) and 'objective' (e.g., verifiable) accounting procedures."

As intuitive and general as the contracting explanation appears, there exists surprisingly little analytical work that substantiates it. This lack of analytical formalization of the contracting explanation has turned researchers to the informational efficiency approach for explanations of conservatism.[1] This approach assumes that the primary function of accounting measurement is to improve agents' beliefs that guide their unilateral decisions; accordingly conservatism is often interpreted as a property of information technology that trades off the

[1] Guay and Verrecchia (2006) pointed out: " We do not argue that informational efficiency is the primary objective of accounting reports, but rather that the merit of asymmetric informational efficiency in accounting reports requires articulation of a contracting or other economic explanation."

type I and type II errors in accounting signals. As a result, the *generality* of the value of conservatism has been doubted on the ground that a priori there does not seem to be a fundamental asymmetry in the value of good versus bad news. For example, Leuz (2001) points out that under-investment could be as severe a problem as over-investment, a theme echoed by Guay and Verrecchia (2006) and Lambert (2010). Gigler, Kanodia, Sapra, and Venugopalan (2009) further observes the cost of excessive liquidation must exceed that of excessive continuation after a project is financed, deepening the skepticism about conservatism.

In this paper I provide one model to formalize the contracting explanation of conservatism and differentiate it from the informational efficiency approach. The model identifies two sufficient conditions for the contracting explanation of conservatism to hold. First, a contract rewards a manager for better performance. Second, the manager's ex post influence on performance measurement is not contractible. Both conditions are fairly descriptive. The first is a general prescription of incentive theories. Rewarding a manager for bad performance creates perverse incentives for the manager to sabotage the firm. The second is consistent with the significant difficulty accounting standard setters encounter in fighting against accounting-motivated transactions (e.g., SEC (2005)). The simplicity and generality of the rationale for conservatism seem to match the persistent and pervasive influence of conservatism.

The model is a stylized debt financing setting. A manager (firm) finances a long term project whose pledgeable income is smaller than its total income. As a result, the demand for a state-contingent covenant, which allocates the control right to the lender in the bad state and to the manager in the good state, arises endogenously. To implement the covenant, contracting parties negotiate an ex ante measurement rule that will be used to generate an ex post measurement of the state based on which the covenant will be settled.

The main friction in designing the measurement rule is that the manager, who has incentives for one-sided earnings management, also has the ability to do so. Earnings management is ex post rational for the manager but ex ante inefficient. Ex post, the manager can keep out the lender's intervention and pursue his own interest at the lender's expense, as long as the state is *measured* as good according to the pre-specified rule. Ex ante, the lender anticipates the ex post exploitation and demands a higher interest rate as compensation. The ex ante price protection, however, does not eliminate the manager's ex post distortionary earnings management. The measurement rule is designed to mitigate the manager's timing inconsistency problem.

The main contribution of this paper is to provide a model of accounting measurement that differentiates the contracting and information views. In particular, I open the black box of accounting measurement by modeling its ex post implementation as a two-step process. First, the firm's underlying state manifests itself in characteristics of the firm's transactions. Second, these transaction characteristics are converted into an accounting recognition by a pre-specified measurement rule. That is, a measurement rule is operationalized as a vector of weights assigned to each transaction characteristic in support of the recognition of their respective states. A measurement rule is conservative if it assigns a smaller weight to a positive transaction characteristic than to a negative (but equally informative) one. Earnings management is modeled as the manager's activities to generate more positive transaction characteristics (e.g., accounting-motivated transactions). Without earnings management, conservatism only mismeasures the good state and thus reduces the efficiency of contracting. With earnings management, however, conservatism could improve contracting efficiency by mitigating the manager's incentives to engage in distortionary earnings management. The optimal degree of conservatism of the measurement rule is determined by the trade-off between its benefit of restraining managerial opportunism and its cost of mismeasuring the good state.

The formalization of the contracting explanation of conservatism makes several contributions. First, it provides a coherent framework to compare the contracting and informational efficiency views of conservatism. In the model, it is the ex post accounting recognition of the state that settles the covenant. The contracting parties' ex post beliefs about the state are not directly relevant. This provides a direct empirical test to differentiate the two views. Accounting measurement is useful for contracting as long as it is *correlated* with the state; in particular, it *does not have to be* incrementally informative to contracting parities. In contrast, the information function works only to the extent that accounting measurement is *incrementally* informative.

Empirical evidence seems to favor the contracting view. On one hand, the value relevance literature has established the robust *association* between accounting measurement and stock prices (see Barth, Beaver, and Landsman (2001) for a survey). On the other hand, accounting measurement is not a timely source of (new) information (e.g, Ball and Brown (1968), Ball and Shivakumar (2008), Beyer, Cohen, Lys, and Walther (2010)). The combination of the two appears to lend discriminating support to the contracting view of accounting measurement.

Second, the formalization strengthens the contracting explanation. By pinpointing the two sufficient conditions for conservatism to be efficient, the model also identifies factors that are not necessary for the contracting explanation. For example, non-observability of managers' earnings management is not necessary. In other words, conservatism is efficient for contracting even if managers do not have private information or earnings management is observable. This equilibrium existence of *transparent* earnings management is empirically important. Many empirical studies of earnings management use direct proxies for earnings management and thus assume that earnings management is observable. These studies would be self-contradictory if they relied on a theory that requires earnings management be non-observable.

Third, the formalization substantiates empirical predictions about the consequences and determinants of conservatism. When viewed as an institutional parameter, conservatism is predicted to constrain earnings management, lower interest rate and increase a firm's pledgeable income and financing capacity. When viewed as a choice variable, conservatism is shown to be higher if the verifiability of a firm's transactions is lower or if the agency cost associated with the manager's opportunism is higher. These predictions are consistent with existing evidence (e.g., Ball, Kothari, and Robin (2000), Watts (2003b), Zhang (2008), and Watts and Zuo (2011)).

Finally, the model might have some implications for accounting standard setting. Arguably, one of the most difficult issues in standard setting is to deal with the manager's opportunistic response to standards often through accounting-motivated transactions. This difficulty, as evident in standards for such controversial issues as consolidation, securitization and leases, attests to the significance of the gap between ex post observable information and ex ante contractible information. In presence of this gap and managers' opportunistic incentives, my model shows that measurements generated by a conservative rule are more neutral (less biased) than those by a neutral rule. This issues a cautionary note to the approach of pursing neutral measurement via neutral measurement rules.

Formally, my model is one in which an agent can take non-contractible actions to increase the measured performance without improving the real performance (e.g., Milgrom (1988) and Holmstrom and Milgrom (1991)). Thus, it is related to the earnings management literature in the principle-agent framework (see Lambert (2001) for a survey). The two-step process of accounting measurement in my model might be useful for enriching our understanding of managers' influence on accounting measurement.

The paper also has implications for the incomplete contracts literature. This literature has focused mainly on mechanism design to circumvent the exogenous constraint of the lack of contractible information. Scant attention has been paid to the institutions, like accounting, that create contractible information in practice. For example, in Aghion and Bolton (1992) and Rajan (1992), the efficiency of the game increases in the precision of an exogenous, contractible signal. My model could be viewed as one way to endogenize the contractible signals in their models. As such, my model shows that the incompleteness in contracts can arise endogenously from the existence of ex post earnings management. The long history of accounting standard setters fighting against accounting-motivated transactions may shed some fresh lights on the question about the ultimate source of incompleteness in contracts.

The rest of the paper proceeds as follows. Section 2 reviews explanations of conservatism in the literature. Section 3 describes the model and the two-step measurement process. In Section 4, I show that the optimal measurement rule is conservative as long as the manager's one-sided earnings management is not contractible. The determinants of the optimal level of conservatism are studied. Section 5 considers several extensions, including renegotiation and multi-period contracting. Section 6 discusses the model's empirical and policy predictions. Section 7 discusses the limitations of the model and avenues for future research.

## 2 Review of explanations of conservatism

Explanations of conservatism are inherently derived from the views about the primary economic function of accounting measurement. I briefly discuss two views in the literature. One is that accounting measurement provides contractible information that facilitates contracting. This view is at the heart of the positive accounting theory (Watts and Zimmerman (1978), Holthausen and Leftwich (1983), Watts and Zimmerman (1986)). Similarly, Ijiri (1975) views accounting as a "system to facilitate smooth functioning of accountability relationships among interested parties." Ball (1989) views accounting as "a specialist function for providing information that assists firms in establishing their quasi-prices (for contracting)". Leuz (1998) argues that accrual accounting is useful for contracting because the accrual process creates contingencies through the use of transactions and events. Holthausen and Watts (2001) and Kothari, Ramanna, and Skinner (2010) develop these arguments in more details. As discussed in Introduction, conservatism arises as an ex ante safeguard against managers' one-sided influence on the measurement process. The absence of managerial opportunism makes the value of conservatism in Antle and Gjesdal (2001) dubious.

The other view of accounting measurement is that it provides information that guides agents' actions by updating their beliefs. For example, accounting measurement plays a contracting function when it is used to settle a covenant; in contrast, it plays an information function when the contracting party with the control right uses accounting information to choose actions. The former is a multi-person problem while the latter is effectively a single-person decision. Both functions are better served the more accurately accounting measurement reflects the underlying state. However, the key difference is that the contracting function requires that accounting measurement be correlated with the state while the information function requires further that accounting measurement be *incrementally* informative.

Many theoretical models of conservatism effectively take an informational efficiency approach. For example, even though accounting signals in Gigler, Kanodia, Sapra, and Venugopalan (2009) are used to both transfer the control right and update the contracting parties' beliefs, the latter ultimately determines the efficiency of their game.[2] Starting from this infor-

[2] In a similar setting, Li (2010) shows accounting measurement is irrelevant if states are observable but non-

mational efficiency view, conservatism is modeled as an information technology that reduces the conditional probability of receiving a high signal. Using statistical language and treating the low state as the null, conservatism reduces the type I error (undue optimism) at the expense of an increase in the type II error (false alarm). The efficiency of conservatism is determined by the trade-off of costs resulting from the type I versus type II errors.

Based on this perspective, Gigler, Kanodia, Sapra, and Venugopalan (2009) observes that if a project has been financed ex ante, the type II error is more costly than the type I error by definition. As a result, conservatism reduces debt contracting efficiency. By adding a non-contractible ex post asset substitution problem that raises the cost of type I error, Caskey and Hughes (2011) shows that conservatism could be efficient when the asset substitution problem is sufficiently severe. Lu, Sapra, and Venugopalan (2011) introduces a value-enhancing expansion opportunity that is traded off with an asset substitution problem. In Nan and Wen (2011), conservatism could be efficient if the proportion of bad firms is large, which makes the type I error more costly.

Chen, Hemmer, and Zhang (2007), Gox and Wagenhofer (2009a) and Gox and Wagenhofer (2009b) also take the informational efficiency approach in different settings. In Chen, Hemmer, and Zhang (2007), accounting information affects outsiders' inference about the state based on which their pricing decisions are made (e.g., Stein (1989)). Because they take the information approach, earnings management in their model is done to influence outsiders' inference and thus has to be non-observable. In Gox and Wagenhofer (2009a) and Gox and Wagenhofer (2009b), a debt contract is negotiated *after* the revelation of an accounting signal. Firms in the medium range have positive NPVs but do not have sufficient pledgeable income. Conservatism reveals only the low range values accurately. This allows firms in the medium range to pool with those in the high end, increasing a firm's ex ante chance of receiving financing.

There are also models on conservatism in a principal-agent setting. Antle and Lambert (1988) motivates conservatism from the auditor's asymmetric loss function and Antle and

contractible and if renegotiation is costless. The introduction of observable states nullifies the information function. The similar observation could also be gained from Jiang (2011) who introduces soft information, information that is ex post observable but ex ante non-contractible.

Nalebuff (1991) further endogenizes the auditor's preference from the strategic interaction between the auditor and the privately informed manager. Gigler and Hemmer (2001) models the link between the bias in accounting measurement and the incentives for managers to issue voluntary disclosure. They argue that the concave earnings-return relation does not necessarily result from conservatism in accounting. In Kwon, Newman, and Suh (2001), conservatism loosens the limited liability of the agent and thus improves efficiency. Bagnoli and Watts (2005) and Chen and Deng (2010) model conservatism as a signaling device to convey the manager's private information. Raith (2009) uses conservatism to overcome the friction that the manager cannot commit to a long term contract with the principal. Guay and Verrecchia (2007) studies conservatism in a model with disclosure to capital market. They show that by forcing disclosure of bad news conservatism is efficient because the manager has one-sided incentives to disclose good news.

# 3 The model

In Subsection 3.1, I present a setting that demands a debt covenant endogenously. Given the demand for covenant, Subsection 3.2 describes the problem of designing the measurement rule for the covenant.

## 3.1 A model of demand for a debt covenant

An owner-managed firm (henceforth the manager or the firm) has a project that requires an initial investment of $I$ at date 0. The manager finances his project with a standard debt contract at date 0. The lender provides $I$ at date 0 and in return receives a prioritized payment up to the face value $D$ at date 2. The implied interest rate equals $\frac{D}{I} - 1$. Because $I$ is a constant, I call $D$ face value or interest rate interchangeably. Both the manager and the lender are risk neutral and the risk free rate is 0. The lending market is competitive at date 0 and thus the lender breaks even. As a result, the lender's Individual Rationality (IR) condition binds in equilibrium and the surplus to the manager also measures the efficiency of the contract. Ex ante (ex post) refers to the time before (after) signing the debt contract.

At date 1, the project could be liquidated for cashflow $L < I$. Alternatively, the project could be continued to date 2 with its payoffs determined by the state $\omega$ realized at date 1. $\omega$ could be *Bad* ($B$), *Good* ($G$), or *Superb* ($S$), *i.e.*, $\omega \in \{B, G, S\}$. Each state occurs with probability $q_\omega$ with $q_B + q_G + q_S = 1$. The observability of $\omega$ at date 1 does not affect the main results and will be explained in detail at the end of next subsection. If the state at date 1 is $\omega$, the project at date 2 will yield a cashflow $F_\omega \geq 0$ and a private benefit for the manager $X_\omega > 0$, $\omega \in \{B, G, S\}$.

The difference between cashflow and private benefit is that private benefit cannot be paid out to the lender. That is, $X_\omega$ is non-pledgeable. Since the manager has spent time in initiating, developing, and implementing the project, he cares not only about the cashflow of the project but also about other non-monetary aspects such as social objectives, employee relationship, reputation, etc. Further, the manager may also accumulate skills and human capitals from implementing the project in his own way that could improve his value in the labor market in the future. Most of these benefits are non-pledgeable.[3]

The *Superb* state derives its name from the assumption that the cashflow in this state ($F_S$) is so large that the project can always be financed at date 0, regardless of the design of contract. Without this simplification, we would have to track both the surplus of the project conditional on it being financed and whether the project is financed, whenever we vary the design of contract. This is the role played by the *Superb* state in the model.

The labels, "*Good*" and "*Bad*," originate from the assumption that continuing the project is a positive NPV (Net Present Value) decision in the *Good* state but a negative one in the *Bad* state, when the total payoff, including both cashflow and private benefit, is considered. That is, $F_G + X_G > L > F_B + X_B$. Thus, the socially optimal continuation decision at date 1 is to liquidate the project *if and only if* the state is *Bad*.

Finally, I assume $L > F_G$. It means that in the *Good* state the liquidation value is higher than the cashflow of the project.[4]

[3] Models using private benefit for similar purposes include, among others, Diamond (1991), Aghion and Bolton (1992), Dewatripont and Tirole (1994), and Zingales (1995). There has also been a large empirical literature confirming the existence and importance of private benefit, including Barclay and Holderness (1989), Doidge (2004), and Dyck and Zingales (2004), and Doidge, Karolyi, Lins, Miller, and Stulz (2009).

[4] If the opposite $L < F_G$ is assumed, the socially optimal actions at date 1 can be implemented by a short term debt contract through which the manager refinances the debt at date 1. The lender will refuse to roll over

With these assumptions, the lender and the manager have diverging preferences for the continuation decision at date 1, neither of which coincides with the socially optimal ones. More importantly, the conflict cannot be fully resolved by the interest rate of the debt contract alone, as shown in the following Lemma.

**Lemma 1** *For any interest rate $D$ in a feasible debt contract that does not use a covenant, the socially optimal actions are not implemented in all states. In particular,*

1. *In the Bad state when the socially optimal action is to liquidate the project, the lender prefers to liquidate but the manager prefers to continue.*
2. *In the Good state when the socially optimal action is to continue the project, the manager prefers to continue but the lender prefers to liquidate.*
3. *In the Superb state when the socially optimal action is to continue the project, both the lender and the manager prefer to continue.*

Lemma 1 is proved by comparing in each state the payoff to each party across two actions. Because $D \geq I$ and $I > L$, $D > L$. That is, the face value exceeds the liquidation value. As a result, when the project is liquidated, the lender receives all the proceeds from liquidation and the manager receives nothing. In contrast, if the project is continued in state $\omega$, the total payoff is $F_\omega + X_\omega$, which is divided as $\min\{D, F_\omega\}$ to the lender and $F_\omega + X_\omega - \min\{D, F_\omega\}$ to the manager. Because $F_S \geq D > L > F_G$ and $L > F_B$, the lender receives $\min\{D, F_B\} = F_B, \min\{D, F_G\} = F_G$, and $\min\{D, F_s\} = D$, in three states, respectively. Because $F_B < L$, $F_G < L$, and $D > L$, the lender prefers continuation only in the *Superb* state. Similarly, the manager receives $X_B, X_G$, and $F_S + X_G - D$, in three states, respectively. Because $X_B > 0$, $X_G > 0$ and $F_S + X_G - D > 0$, the manager prefers continuation in all states. The payoff structure is summarized in Table 1.

Note that the conflicting preferences exist for any interest rate. No interest rate at date 0 can induce the manager or the lender to take the socially optimal actions in all states. The

the short-term debt and demand liquidation in and only in the *Bad* state, which coincides with the socially optimal actions. Therefore, there will be no demand for either a long-term debt contract or a covenant.

implementation of the socially optimal actions requires that the lender intervene selectively: intervene in the *Bad* state but not in the *Good* state. Interest rate at date 0 alone cannot induce such state contingencies, resulting in the possibility of both under-investment and over-investment. For convenience, I denote $\Delta^{Over} \equiv L - (X_B + F_B)$ as the ex post efficiency loss from the inefficient continuation of the project in the *Bad* state, or the ex post cost of over-investment. Similarly, $\Delta^{Under} \equiv (X_G + F_G) - L$ is the ex post efficiency loss from the excessive liquidation in the *Good* state, or the ex post cost of under-investment. $q_B\Delta^{Over}$ and $q_G\Delta^{Under}$ are the ex ante cost of over-investment and under-investment.

Table 1: Payoffs of project, lender, and manager

| | State | *Bad* | *Good* | *Superb* |
|---|---|---|---|---|
| | Probability | $q_B$ | $q_G$ | $q_S$ |
| Continuation | Cashflow | $F_B$ | $F_G$ | $F_S$ |
| | Private benefit | $X_B$ | $X_G$ | $X_S$ |
| | Total payoff | $F_B + X_B$ | $F_G + X_G$ | $F_S + X_S$ |
| | Lender's payoff | $F_B$ | $F_G$ | $D$ |
| | Manager's payoff | $X_B$ | $X_G$ | $F_S + X_S - D$ |
| Liquidation | Cashflow (total payoff) | $L$ | $L$ | $L$ |
| | Lender's payoff | $L$ | $L$ | $L$ |
| | Manager's payoff | 0 | 0 | 0 |

We thus face the classic "difficulty of selective intervention," a term coined by Williamson (1985). What promotes the efficiency of the contracting relation in this situation is to provide the *right* protection to both the lender and the manager, that is, to allocate the control right to the lender in the *Bad* state and to the manager in the *Good* state. This is exactly what a state-contingent covenant attempts to do.

In practice, the implementation of a state-contingent covenant requires the measurement of the state at date 1, of which accounting is one major source. How to design the measurement rule at date 0 for this contracting purpose is the central question of the paper and will be specified in the next subsection.

I make one further simplification before turning to the design of the measurement rule for the covenant. Because there is no conflict of interest in the *Superb* state, I assume that the payoffs of the project in the *Superb* state are *realized* at date 1. As a result, there is no measurement issue with the *Superb* state and I can focus only on the measurement of the *Good* and *Bad* states.[5]

### 3.2 The covenant and its measurement rule

Denote by $r$ the accounting measurement (recognition) of state $\omega$ at date 1 according to whatever measurement rules specified in the covenant, $r \in \{g, b\}$. Without loss of generality, I assume that the covenant stipulates that the manager retains the control right if the state is *recognized* as *good* ($r = g$), and the lender receives the control right if the state is *recognized* as *bad* ($r = b$).

The central question of the paper is the design of the measurement rule at date 0 that will be used to generate accounting recognition $r$ at date 1. The key difficulty of the design problem arises from the fact that the measurement rule has to be specified at date 0 but will be implemented only at date 1. This pre-commitment nature of the measurement rule makes the ex post measurement more vulnerable to manipulation, as we will see soon.

While the design of the measurement rule and its implementation involve various parties and numerous institutional details, I abstract away from the details to focus on the interaction between the ex ante rule design and the ex post implementation in a stylized model. I start with the implementation of a measurement rule at date 1 and decompose it to two steps.

First, the firm's underlying state $\omega$ manifests itself in various characteristics of the transactions the firm has engaged in. Without loss of generality, I assume that the transaction

[5]It is worthwhile to highlight the role of private benefit in creating the demand for a covenant in the debt contract. The non-pledgeability of private benefit creates the discrepancy between the total payoff and the total *pledgeable* payoff of the project. This discrepancy is responsible for the difficulty of selective intervention in Lemma 1. This parsimonious device makes the model tractable enough to study the design of the measurement rule for the covenant. An alternative modeling device is to invoke moral hazard explicitly. Assume that the payoff of the project at date 2 requires a non-contractible effort from the manager between date 1 and date 2. This moral hazard problem requires that some payoff at date 2 be given to the manager as incentive to exert the effort. As a result, not all the payoff of the project at date 2 can be paid out to the lender. Therefore, the role of the (non-pledgeable) incentive pay to the manager is similar to that of the private benefit used here (see more examples and discussions in Tirole (2006)). The benefit of using private benefit is that it avoids the extra complexity of modeling the moral hazard problem, which is not the focus of the paper.

characteristic is either positive or negative. Further, I assume that the transaction characteristics are perfectly correlated with their respective states in the absence of the manager's manipulation. That is, if the underlying state is *Good*, the transaction characteristic is positive with probability 1; if the underlying state is *Bad*, the transaction characteristic is negative with probability 1. I discuss this assumption at the end of this subsection.

Second, the measurement rule specified at date 0 is implemented as a mapping from transaction characteristics to accounting recognition $r$ at date 1. I assume that when the negative transaction characteristic is observed, the state is recognized as bad ($r = b$) with probability 1. In contrast, when the positive transaction characteristic is observed, the state is recognized as good ($r = g$) with probability $1 - c$ and recognized as bad ($r = b$) with probability $c$, $c \in [0, 1)$. Therefore, the measurement rule is captured by the vector $(1, 1 - c)$, the weight assigned to each transaction characteristic in support of the recognition of their respective states. $c$ is simply referred to as the measurement rule because it is the only parameter of the measurement rule. The two-step measurement process at date 1 is depicted in Figure 1.

$c$ is also a measure of the level of conservatism of the measurement rule. It captures the differential verification requirement for recognizing the *Good* versus *Bad* states. The negative transaction characteristic receives weight 1 in support of the recognition of the *Bad* state, but the positive transaction characteristic, which is equally informative in absence of the manager's manipulation, receives weight $1 - c$ in support of the recognition of the *Good* state. For example, the limiting case $c = 1$ means that the positive characteristic is ignored and $r = g$ is never recognized.[6]

This two-step measurement process could be illustrated with an example of revenue recognition. The state is whether the firm has earned revenue from a transaction. The state is not directly contractible. Instead, characteristics of the transaction that could be informative about the state are collected and analyzed. For example, whether there exists a sales contract between the firm and the customer, whether the product has been delivered, whether

[6] $c = 1$ could be interpreted as unconditional conservatism. For example, if a transaction is an expenditure, $c = 1$ means that it is always expensed and never recognized as an asset, regardless of the news (the transaction characteristics that are informative about the future benefit of the expenditure). Therefore, unconditional conservatism could be understood as a limiting version of conditional conservatism in my model.

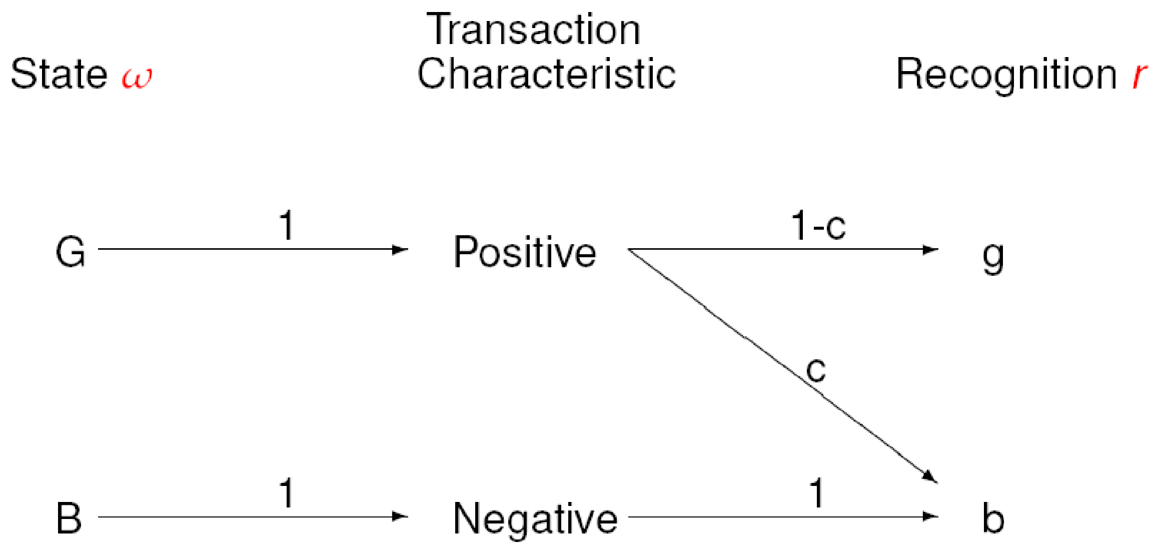


Figure 1: Accounting Measurement without Earnings Management

the customer has paid or has the ability to pay, and so on. The first step of the measurement process corresponds to the mapping from the true earnings process to the transaction characteristics. For example, a true sale is more likely to exhibit the positive transaction characteristics such as cash receipt and product delivery. The second step implements a revenue recognition rule that effectively assigns a weight to each transaction characteristic in support of the recognition of revenue. A revenue recognition rule is more conservative if it assigns lower weights to positive transaction characteristics and thus effectively requires more evidence for the recognition of revenue.

With this two-step process, we can model the manager's ex post manipulation of accounting measurement. Note that the manager has one-sided incentives to inflate accounting recognition $r$ ex post. After signing the contract at date 0, the manager can keep out the intervention by the lender as long as the state is *recognized* as *good* ($r = g$) at date 1 by the measurement rule $c$ specified at date 0. Thus, the manager could engage in costly activities to manipulate the transaction characteristics and I refer to these activities as earnings management. In particular, I assume that between date 0 and date 1, that is, before the transaction characteristics are observed, the manager can increase the probability that its transactions generate the positive characteristic by $\beta \in [0, 1]$ at a cost.[7] This improves (weakly) the

[7]The main results are qualitatively the same if it is assumed that the manager could alter the transaction

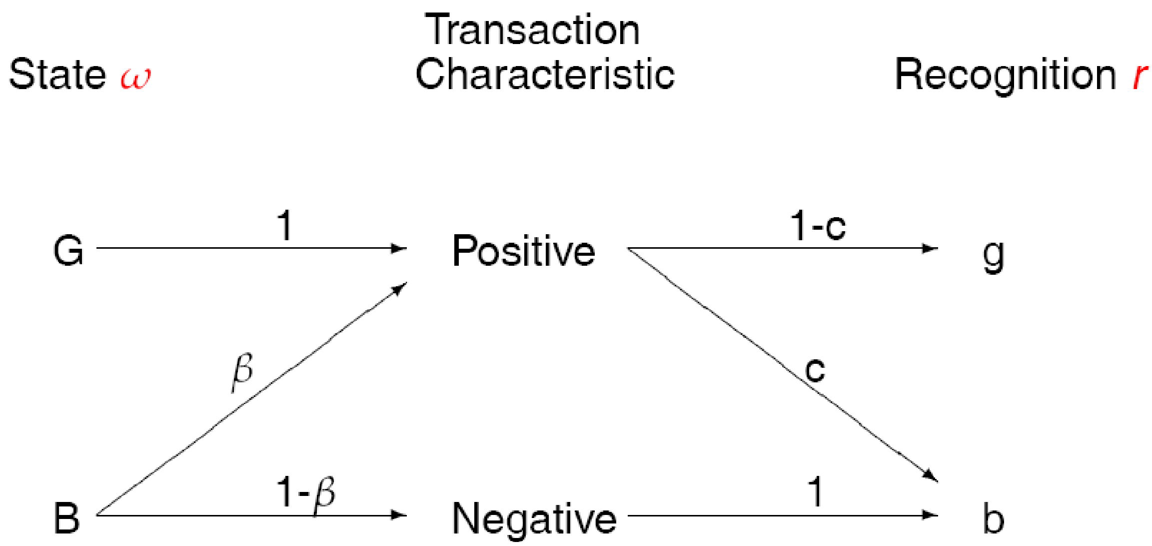


Figure 2: Accounting Measurement with Earnings Management

chance that the manager receives $r = g$ for any given measurement rule and for any future state. The earnings management converts Figure 1 to Figure 2, with the only change that the transaction characteristic could be positive with probability $\beta$ even if the true state is *Bad*.

The manager incurs a private cost $hK(\beta)$ for the manipulation.[8] $h > 0$ measures the vulnerability of a transaction characteristic to the manager's manipulation. A higher $h$ means that it is more costly for the manager to manipulate the characteristic. Thus, $h$ could be interpreted as reliability, or verifiability, or hardness of a transaction characteristic. $K(\beta)$ has the following properties:

- Assumption 1: $K^{'} \geq 0$, $K^{''} > 0$, $K^{'}(0) = 0$, and $K^{'}(1)$ is sufficiently large;
- Assumption 2: $\frac{\partial}{\partial \beta}[\frac{K^{'}}{K^{''}}] = \frac{(K^{''})^2 - K^{'}K^{'''}}{(K^{''})^2} > 0$.

Assumption 1 is standard. Earnings management is costly ($K^{'} \geq 0$) and its marginal cost is increasing ($K^{''} > 0$). Further, $K^{'}(0) > 0$ and $K^{'}(1)$ being sufficiently large guarantee

characteristics *after* the state is observed by the manager. This different assumption only scales the cost function of earnings management by $q_B$, the probability that the *Bad* state occurs at date 1.

[8] The manipulation cost could be readily endogenized by assuming that the manipulation of the transaction characteristics induce the manager to take some suboptimal actions that reduce the cashflow of the transaction in some or all states. The main results are qualitatively the same.

that the earnings management choice is interior. Assumption 2 sets a bound on the speed at which $K^{''}$ increases. $K^{''}$ could be increasing, constant, or decreasing, as long as it does not increase too fast.[9] Assumption 2 is needed solely for the generality of results. For example, the standard quadratic cost function $K(\beta) = \frac{\beta^2}{2}$ satisfies Assumption 2.

One example of this type of earnings management is accounting-motivated transactions. The Securities and Exchange Committee (SEC) defines accounting-motivated structured transactions as "those transactions that are structured in an attempt to achieve reporting results that are not consistent with the economics of the transaction" (SEC (2005)). The report identifies a long list of areas where firms engage in accounting-motivated transactions, including consolidation, securitization, leases and pensions. The accounting literature has well established the prevalence of accounting-motivated transactions. For example, Imhoff and Thomas (1988) shows that around the adoption of SFAS 13 firms restructure lease contracts to enhance the chance of being recognized as operating leases (as opposed to capital lease) that present favorable accounting leverage ratio.

In sum, the timeline of the events is as follows:

1. At date 0, the manager chooses interest rate $D$ and measurement rule $c$ of the debt contract; the lender decides whether to take the contract;

2. At date $\frac{1}{2}$ (between 0 and 1), the manager chooses the level of earnings management $\beta$;

3. At date 1, transaction characteristics occur, accounting recognition $r$ is generated according to the pre-specified measurement rule $c$, the covenant is settled, and the decision to continue or liquidate is made.

4. At date 2, cashflow realizes and payment is made.

The timeline is also depicted in Figure 3.

[9] As Shleifer and Wolfenzon (2002) explains, this assumption on the cost function eliminates the "boil them in oil" results, in which earnings management is prevented entirely with sufficiently large punishment for even small amount of earnings management.

| Date 0 | $\frac{1}{2}$ | 1 | 2 |
|---|---|---|---|
| Interest rate and measurement rule are negotiated; Contract signed. | Manager chooses level of earnings management. | State realized; measurement conducted; covenant settled; decisions made. | Cash flow realized and paid. |

Figure 3: Timeline

Note that the allocation of the control right is settled by accounting recognition $r$. This is the contracting function of accounting. It is isolated from the information function because both the lender and the manager's continuation decisions are not affected by their beliefs about the underlying state. As long as they receive the control right, the lender liquidates the project and the manager continues the project in both the *Good* and *Bad* states, as discussed in Lemma 1. As a result, accounting recognition $r$ does not play the information function of influencing contracting parties' continuation decision in the model. This irrelevance of the contracting parties' beliefs for the continuation decision means that whether the state at date 1 is observable or not does not affect the results of the model. To make the contracting explanation as transparent as possible, I have assumed that the transaction characteristics at date 1 are perfectly informative about the underlying state and that both the transaction characteristics and the earnings management are observable. In other words, the state $\omega$ at date 1 is observable. If the state were assumed to be non-observable, the results regarding conservatism would be the same, but the distinction of the contracting and information functions would be less stark.

# 4 The main results

In this section I solve the model using backward induction and explain how conservatism arises as ex ante optimal response to ex post earnings management.

## 4.1 The formulation of the problem

At date 1, given the manager's earnings management $\beta$, the contracting parties' (expected) payoffs depend on both state $\omega$ and its accounting recognition $r$. Since these payoffs are repeatedly used later, I summarize them in Table 2.

Table 2: Expected Payoffs in Various Scenarios at date 1

| State $\omega$ | Recognition $r$ | Probability | Lender's Payoff | Manager's Payoff |
|---|---|---|---|---|
| $B$ | $b$ | $q_B(1-\beta(1-c))$ | $L$ | $0$ |
| $B$ | $g$ | $q_B\beta(1-c)$ | $F_B$ | $X_B$ |
| $G$ | $b$ | $q_G c$ | $L$ | $0$ |
| $G$ | $g$ | $q_G(1-c)$ | $F_G$ | $X_G$ |
| $S$ | $N/A$ | $q_S$ | $D$ | $F_S + X_S - D$ |

The table is self-explanatory. For example, the first row describes the payoffs when the *Bad* state occurs and is recognized as *bad*. This combination occurs with probability $q_B(1-\beta(1-c))$. When it occurs, the lender receives the control right, liquidates the project, and gets all the liquidation value $L$. The manager receives 0. Other rows can be explained similarly.

At date 0, the lender anticipates that the manager will choose the level of earnings management after signing the contract. Denote the lender's date-0 expectation of earnings management as $\hat{\beta}$ and the manager's date-0 expectation of earnings management as $\beta^*$. The firm's debt contract design problem at date 0 can be formulated as the following maximization problem, labeled as Problem 1:

$$
\begin{aligned}
\max_{(D,c)} V(D,c) &= q_B\beta^*(1-c)X_B + q_G(1-c)X_G + q_S(F_S + X_S - D) - hK(\beta^*) && (1)\\
& \text{subject to} \\
I &\leq q_B((1-\hat{\beta}(1-c))L + \hat{\beta}(1-c)F_B) + q_G(cL + (1-c)F_G) + q_S D && (\text{IR })\\
\beta^* &= \arg\max_{\beta} \quad q_B\beta(1-c)X_B - hK(\beta) && (\text{IC})\\
\beta^* &= \hat{\beta} && (\text{ Rational Expectations})
\end{aligned}
$$

The manager chooses interest rate $D$ and measurement rule $c$ at date 0 to maximize his expected payoff, subject to the lender' break-even condition, the anticipated ex post earnings management, and the rational expectations requirement. The objective function $V(D,c)$ is the manager's expected payoff at date 0. It is calculated as the inner product of the third and fifth columns of Table 2 with $\beta$ being replaced by $\beta^*$ net of the cost of earnings management $hK(\beta^*)$. The right hand side of the lender's IR condition is the lender's expected payoff from the debt contract. It is based on the lender's conjecture about the manager's ex post earnings management $\hat{\beta}$ and calculated as the inner product of the third and fourth columns of Table 2 with $\beta$ being replaced by $\hat{\beta}$.

The manager's IC (incentive compatible) condition describes the manager's decision at date $\frac{1}{2}$. Earnings management benefits the manager only if the *Bad* state occurs and $r = g$ is recognized at date 1, which occurs with probability $q_B\beta(1-c)$. In this case, the manager receives $X_B$ instead of 0. Therefore, the expected benefit of earnings management $\beta$ at date $\frac{1}{2}$ is $q_B\beta(1-c)X_B$. $hK(\beta)$ is the cost of earnings management borne by the manager. The existence of the IC condition means that the ex ante measurement rule in the debt contract cannot rule out all the activities the manager could engage in to influence the ex post measurement, which is the main friction in the model.

Finally, the rational expectations require that the lender's conjecture about the manager's ex post earnings management be consistent with the manager's actual choice.

## 4.2 Benchmark: contractible earnings management

To highlight the role of non-contractible earnings management, we first look at the benchmark in which all the manager's activities to influence the ex post measurement could be contracted ex ante. That is, the IC condition is dropped from Problem 1, $\beta$ becomes a choice variable in Problem 1, and the lender's anticipated earnings management $\hat{\beta}$ is the same as the contractual choice of $\beta$. The only remaining constraint in Problem 1, the IR condition for the lender, binds, which determines the interest rate: $D^{BM}(\beta, c) = \frac{I - q_B((1-\beta(1-c))L + \beta(1-c)F_B) - q_G(cL + (1-c)F_G)}{q_S}$. "$BM$" standards for BenchMark. Substituting $D^{BM}$ for $D$ in the objective function and rearranging the terms, we get

$$V^{BM}(\beta, c) = V^{FB} - q_G \Delta^{Under} c - q_B \Delta^{Over} \beta(1-c) - hK(\beta). \tag{2}$$

$V^{FB}$ is defined as the manager's expected surplus when the socially optimal actions are implemented, that is, the project is liquidated in and only in the *Bad* state. It is calculated as follows:

$$V^{FB} \equiv q_B L + q_G(F_G + X_G) + q_S(F_S + X_S) - I.$$

**Proposition 1** *When earnings management is contractible, the optimal earnings management level is* 0. *Conservatism reduces the ex ante debt contracting efficiency by distorting the measurement of the Good state.*

Proposition 1 is straightforward from inspecting equation 2. Recall that $\Delta^{Under}$ ($\Delta^{Over}$) is the ex post cost of under-investment (over-investment) resulting from allocating the control right wrongly to the lender (manager). Ex ante, earnings management is both distortionary and wasteful. It increases the chance that the *Bad* state is recognized as *good*, resulting in the suboptimal continuation of the project in the *Bad* state ($q_B \Delta^{Over}$). It also consumes real resources $hK(\beta)$. Thus, the optimal level of earnings management is 0 if it is contractible. With no earnings management, conservatism only increases the chance that the *Good* state is recognized as *bad*, resulting in the suboptimal liquidation of the project in the *Good* state ($q_G \Delta^{Under} c$). This cost could be minimized at $c = 0$.

The non-contractibility of ex post earnings management is thus necessary for the efficiency of conservatism.

### 4.3 Non-contractible ex post earnings management

In practice, accounting-motivated transactions are one of the most difficult issues in accounting standard setting. As soon as a rule is specified, managers could take actions to influence the implementation of the rule to their advantage. We turn to examine the effects of such earnings management on the design of the measurement rule.

The manager's earnings management decision at date $\frac{1}{2}$ is described in the IC condition in Problem 1. The optimal earnings management $\beta^*$ satisfies the following first-order condition:

$$q_B(1-c)X_B = hK^{'}(\beta^*). \tag{3}$$

The second order condition for a maximum is satisfied with Assumption 1. From the manager's perspective, the left hand side of the first-order equation (equation 3) is the marginal benefit of earnings management and the right hand side the marginal cost.

**Proposition 2** *Suppose Assumption 1 holds. The optimal earnings management, $\beta^*$, satisfies these properties:*

1. $\beta^* > 0$;

2. $\beta^*$ decreases in conservatism $c$.

Part 1 is proved by Assumption 1 that $K^{'}(0) = 0$ and $K^{''} > 0$. It suggests that earnings management is ex post rational for the manager. After signing the contract (ex post), the manager could keep out the external intervention as long as the state is *recognized* as good by the pre-specified measurement rule. Any activities that are not specified in the ex ante measurement rule can be used by the manager to improve the measurement. Notably, what is necessary for earnings management to arise in equilibrium is the non-contractibility, rather than the non-observability, of earnings management. In other words, earnings management for contracting purpose could be transparent, while earnings management for information purpose has to be non-observable. Therefore, accounting measurement for contracting is much more vulnerable to manipulation than accounting measurement for information purpose.

Part 2 is obtained by differentiating the first-order equation with respect to $c$. It implies that ex ante conservatism makes ex post earnings management less attractive. By putting a smaller weight on the positive transaction characteristic, conservatism diminishes the benefit of generating the positive transaction characteristic through costly earnings management.

With Part 2 of Proposition 2, I take a detour to have a closer look at the information content of accounting recognition $r$. Suppose an econometrician observes only accounting measurement $r$ in the model and starts out to examine its informational properties. She will find the following result.

**Proposition 3** *As the measurement rule becomes more conservative, good news ($r = g$) becomes more informative and bad news ($r = b$) becomes less informative of their respective states.*

It is proved by the application of the Bayes rule. Conditional on $r = g$, the probability that the state is *Good* ($\omega = G$) is calculated by the Bayes rule: $\Pr(\omega = G|r = g) = \frac{q_G}{q_G + q_B \beta^*}$. The information content of $r = g$ is contaminated by $\beta^*$ because earnings management makes it more likely that $r = g$ comes from $\omega = B$. As conservatism increases, $\beta^*$ drops, making $r = g$ more informative. Similarly, $\Pr(\omega = B|r = b) = \frac{\frac{q_B}{q_G+q_B}(1-\beta^*(1-c))}{\frac{q_B}{q_G+q_B}(1-\beta^*(1-c))+\frac{q_G}{q_G+q_B}c}$ and is shown to decrease in $c$ in the Appendix. The information content of $r = b$ is affected by conservatism $c$ in two ways. First, by discounting the positive transaction characteristic, $c$ makes it more likely that $r = b$ comes from $\omega = G$. Second, $c$ reduces earnings management and thus makes it more likely that $r = b$ comes from $\omega = B$. It is proved that the first effect dominates the second. As a result, conservatism makes $r = b$ less informative about the $\omega = B$.

In sum, my definition of conservatism is consistent with that used in the literature, such as in Venugopalan (2001) and Gigler, Kanodia, Sapra, and Venugopalan (2009). The two-step measurement process thus can be viewed as providing a micro-foundation of their definition. The advantage of the two-step measurement process is that it enables us to distinguish the contracting and information functions.

### 4.4 Ex ante design of the debt contract: interest rate $D$

The ex ante design of the debt contract has two elements, interest rate $D$ and measurement rule $c$. We examine them in turn. At date 0, the lender conjectures that the manager will choose $\hat{\beta}$ and prices the debt accordingly. Given the conjecture $\hat{\beta}$, the binding IR condition in Problem 1 determines the interest rate $D(c, \hat{\beta})$:

$$D(c, \hat{\beta}) = \frac{I - q_B((1 - \hat{\beta}(1 - c))L + \hat{\beta}(1 - c)F_B) - q_G(cL + (1 - c)F_G)}{q_S}. \tag{4}$$

**Proposition 4** *The interest rate $D(c, \hat{\beta})$ in equation 4 satisfies these properties:*

1. *it increases in the lender's conjecture about earnings management $\hat{\beta}$, i.e.,* $\frac{\partial D(c,\hat{\beta})}{\partial \hat{\beta}} > 0$;
2. *it decreases in conservatism $c$, given $\hat{\beta}$, i.e.,* $\frac{\partial D(c,\hat{\beta})}{\partial c} < 0$.

Proposition 4 is proved by differentiating the expression of $D(c, \hat{\beta})$ above with respect to $\hat{\beta}$ and $c$. The first part captures the notion of ex ante price protection. If the lender believes that the manager is more likely to engage in earnings management after contracting, which enables the manager to pursue his own interest at the expense of the lender's, the lender demands a higher interest rate at date 0. As a result of the price protection, the manager bears the consequences of ex post earnings management.

However, the ex ante price protection through the adjustment of interest rate does not eliminate the ex post opportunism. Because earnings management occurs after the interest rate is negotiated, the manager takes the interest rate as given when he chooses the level of earnings management. The first-order condition for the choice of earnings management, *i.e.*, equation 3, suggests that earnings management $\beta^*$ does not depend on the interest rate $D$. Therefore, interest rate alone in the debt contract does not perfectly align the contracting parties' preferences, leaving room for a covenant to improve efficiency.

Part 2 of Proposition 4 implies that the interest rate $D$ and the measurement rule $c$ are (imperfect) substitutes.[10] The lender demands a lower interest rate when the measurement rule in the covenant is more conservative. The reason is because conservatism increases the

[10] In equilibrium when $\hat{\beta} = \beta^*$ is imposed, we have $\frac{dD(c,\beta^*)}{dc} < 0$ as well because $\frac{\partial \beta^*}{\partial c} < 0$.

chance that the control right is transferred to the lender. The control right at date 1 is valuable and thus the lender is willing to receive less cashflow in return for more control right. In other words, the lender can be "protected" by either a higher interest rate or a more conservative measurement rule in the covenant.

### 4.5 Ex ante design of the debt contract: measurement rule $c$

We turn to the design of the measurement rule and show that the optimal measurement rule is conservative. Substituting $D(c, \hat{\beta})$ into the objective function $V$, imposing the rational expectations requirement of $\hat{\beta} = \beta^*$, and rearranging the terms, Problem 1 can be simplified as choosing conservatism $c$ to maximize $V(c)$ subject only to $c \in [0, 1)$:

$$V(c) = V^{FB} - q_B \beta^*(c)(1-c)\Delta^{Over} - q_G c \Delta^{Under} - hK(\beta^*(c)). \tag{5}$$

Recall $V^{FB}$ is the first-best efficiency when the socially optimal actions are implemented in all states. Equation 5 shows that even though earnings management is ex post rational for the manager, it is ex ante distortionary and wasteful. It lowers the efficiency of the contract by three terms relative to $V^{FB}$. The first is the cost of over-investment when the manager receives the control right in the *Bad* state as a result of earnings management. The second term is the cost of under-investment when the lender receives the control right in the *Good* state as a result of conservatism, which arises as a response to earnings management. Finally, earnings management directly consumes economic resources $hK$.

The level of conservatism $c$ is chosen to maximize $V(c)$ subject to the only constraint of $c \in [0, 1)$. Assuming first that the optimal level of conservatism is interior, that is, $c^* \in (0, 1)$. Then the trade-off of using conservatism to counteract earnings management is captured by the first-order condition:

$$\frac{dV(c^*)}{dc} = q_B \beta^*(c^*)\Delta^{Over} - q_B(1-c^*)\Delta^{Over}\frac{\partial \beta^*(c^*)}{\partial c} - q_G \Delta^{Under} - hK'\frac{\partial \beta^*(c^*)}{\partial c} = 0. \tag{6}$$

The second order condition for a maximum is satisfied with Assumption 2. Given earnings management $\beta^*$, conservatism diminishes the effectiveness of earnings management in obtaining the preferred treatment $r = g$, saving the cost of over-investment (the first term). Moreover, conservatism reduces earnings management (because $\frac{\partial \beta^*(c)}{\partial c} < 0$ from Part 2 of Proposition 2), resulting in further saving of the cost of over-investment (the second term) and in the saving of the direct cost of earnings management (the last term). Finally, discounting the positive transaction characteristic is costly because it increases the measurement error of the *Good* state, similar to the benchmark case. This explains the third term in the above first-order condition.

**Proposition 5** *Suppose both Assumption* 1 *and* 2 *hold, and* $c^* \in (0, 1)$. *The optimal measurement rule becomes more conservative, i.e.,* $c^*$ *increases, if*

1. *it is easier for the manager to manipulate the measurement process, i.e.,* $h$ *is smaller;*
2. *the ex ante cost of over-investment is larger, i.e.,* $q_B$ *or* $\Delta^{Over}$ *is larger*
3. *the ex ante cost of under-investment is smaller, i.e.,* $q_G$ *or* $\Delta^{Under}$ *is smaller.*

Proposition 5 is proved by differentiating the first-order condition $\frac{dV(c^*)}{dc} = 0$ with respect to relevant parameters. It characterizes the interaction of conservatism with earnings management. The optimal level of conservatism of the measurement rule increases as the ex post earnings management becomes more severe a problem, heightening the central contention of the paper that conservatism arises as an ex ante response to the manager's ex post opportunistic manipulation.

Consider Part 1 of Proposition 5 first. As $h$ decreases, it becomes increasingly easier for the manager to manipulate the accounting presentation of the firm's transactions, making it more attractive to use the costly conservatism to counteract. At one extreme, as $h$ goes infinitely large, the firm finds it too costly to engage in any ex post earnings management. This gets us back to the benchmark case in which conservatism only distorts the recognition of the *Good* state and thus the optimal level of conservatism is 0. At the other extreme, as $h$ goes to zero, earnings management becomes so severe that the optimal measurement rule does not recognize any good news at all, *i.e.*, $c^*$ approaches 0. For example, if it is extremely difficult to describe the differentiating characteristics of a capital lease ex ante and thus it is easy for the manager to restructure the lease terms to create these characteristics ex post, the optimal measurement rule for lease would be not to recognize operating lease at all. This saves the cost associated with the distortionary and wasteful manipulation at the expense of mismeasuring true operating leases.

Part 2 and 3 of Proposition 5 could be understood similarly. A higher ex ante cost of over-investment resulting from the wrong allocation of the control right to the manager makes conservatism more attractive, and a higher ex ante cost of under-investment resulting from the wrong allocation of the control right to the lender makes conservatism more costly.[11]

Now we discuss the condition under which $c^*$ is not at the corner, as assumed in Proposition 5. With Assumption 2, the second order condition for maximum is satisfied, that is, $\frac{d^2V(c)}{dc^2} < 0$. Thus, $\frac{dV(c)}{dc}$ is decreasing in $c$. Evaluating $\frac{dV(c)}{dc}$ at $c = 1$, $\frac{dV(c)}{dc}|_{c=1} = -q_G\Delta^{Under} < 0$. By the intermediate value theorem, $c^*$ is interior if and only if $\frac{dV(c)}{dc}|_{c=0} > 0$. Because $\frac{dV(c)}{dc}|_{c=0} = q_B\beta^*(0)\Delta^{Over} - q_B\Delta^{Over}\frac{\partial\beta^*}{\partial c}|_{c=0} - hK'\frac{\partial\beta^*}{\partial c}|_{c=0} - q_G\Delta^{Under}$, $\frac{dV(c)}{dc}|_{c=0} > 0$ could be rewritten as $q_B\Delta^{Over}(\beta^*(0) - \frac{\partial\beta^*}{\partial c}|_{c=0}) - hK'\frac{\partial\beta^*}{\partial c}|_{c=0} > q_G\Delta^{Under}$. Since neither $\beta^*(0)$ nor $\frac{\partial\beta^*}{\partial c}|_{c=0}$ is a function of $\Delta^{Over}$ or $\Delta^{Under}$ (more precisely, the free parameters in $\Delta^{Over}$ or $\Delta^{Under}$), the condition becomes a comparison of $q_B\Delta^{Over}$ and $q_G\Delta^{Under}$. As long as $q_B\Delta^{Over}$ is sufficiently larger than $q_G\Delta^{Under}$, the condition can always be satisfied.

Finally, note that the interaction of over-investment and under-investment with conservatism in the model differs from that under the information view. Under both views, the measurement error in accounting measure is ultimately responsible for the inefficient investment decision. Under the information view, it is the lack of information about the state that prevents the contracting parties from making the right investment decision. Under the contracting view, it is the lack of *contractible* information that leads to the wrong allocation of the control right and the inefficiency in the investment decision.

[11] Note that $\Delta^{Under} = F_G + X_G - L$. The change in $F_G$ or $X_G$ affects $\Delta^{Under}$ but not other parameters in first-order condition $\frac{dV(c^*)}{dc} = 0$. Thus, the statement should be viewed with respect to $F_G$ or $X_G$, rather than to $\Delta^{Under}$. Similarly, $F_B$ is a free parameter in $\Delta^{Over}$.

# 5 Extensions

## 5.1 Renegotiation

Renegotiation is assumed away in the baseline model. Empirically, debt covenants are often renegotiated (e.g., Roberts and Sufi (2009)). Because at date 1 the lender and the manager have information that is not captured by the measurement used in the contract, a natural question is that whether the contracting parties could improve efficiency through renegotiation. Does the possibility of costless renegotiation after the settlement of the debt covenant preempt the value of using conservative accounting measure? The answer is somewhat surprising: the possibility of ex post renegotiation intensifies earnings management and thus could make conservatism more attractive.

The only case in which renegotiation is possible is when the state is *Bad* but recognized as good.[12] The manager would continue the project inefficiently and incur the ex post efficiency cost of $\Delta^{Over}$. Thus, the lender could "bribe" the manager to liquidate the project by paying the manager some surplus from the saving of $\Delta^{Over}$. Denote the manager's bargaining power as $\mu \in [0,1]$ and consider a Nash bargaining solution. The manager's payoff in the *Bad* state with $r = g$ changes from $X_B$ to $X_B + \mu\Delta^{Over}$. Anticipating the increased payoff in the *Bad* state with $r = g$, the manager's earnings management $\beta^{**}$ is determined by the new first-order condition:

$$q_B(1-c)(X_B + \mu\Delta^{Over}) = hK^{'}(\beta^{**}). \tag{7}$$

Comparing it with its counterpart in the baseline model (eqn. 3), it is straightforward that $\beta^{**} \geq \beta^{*}$. In addition to receiving the private benefit, the manager also receives a fraction of the surplus resulting from the renegotiation. As a result, $r = g$ becomes more valuable to the manager, and the marginal benefit of earnings management increases, and the manager chooses a higher level of earnings management. Therefore, while renegotiation improves the continuation decision at date 1, it intensifies earnings management. As a result, conservatism

[12] If the state is good, there are two cases. In the case $r = g$ renegotiation is not necessary because the firm continues the project efficiently. In the case of $r = b$ renegotiation is not feasible because the firm does not have any wealth to pay the lender and the private benefit is not pledgeable. If the state is bad but recognized as bad, renegotiation is not necessary because the lender liquidates the project efficiently.

is more attractive.

## 5.2 Does the conservative bias in current contracts have to reverse in future contracts?

One criticism of conservatism is that the conservative bias in current period leads to upward bias in future periods. FASB's main complaint about conservatism is that "Understating assets or overstating liabilities in one period frequently leads to overstating financial performance in later periods" (FASB 2010 BC3.28), implying that whatever value conservatism has in one period is inevitably reversed in others. This concern is the main basis on which conservatism is eliminated from the FASB and IASB's joint conceptual framework (FASB (2010)), which guides the making of future accounting standards. In this extension, I show that while the reversal of the bias does exist, it does not diminish the efficiency of conservatism for contracting.

To examine this issue, the model has to be extended to multiple periods. A simple way is to repeat the same stage game every period. Suppose every period the firm discovers a project that needs financing. All the payoffs of the projects across periods are independent and identically distributed. The firm enters into one new contract to finance the newly discovered project each period. The timeline could be depicted as follows:

| date | $t-1$ | $t$ | $t+1$ | $t+2$ |
|---|---|---|---|---|
| Project $t$ | Contract $t$ signed | $\omega^t$ measured | $\omega^t$ realized | |
| Project $t+1$ | | Contract $t+1$ signed | $\omega^{t+1}$ measured | $\omega^{t+1}$ realized |

At date $t$, the state of project $t$, $\omega^t$, is measured as $r^t(\omega^t)$. The bias of the accounting measure for contract $t$ is conservative if $r^t(\omega^t) - \omega^t < 0$. Similarly, at date $t+1$, the state of project $t+1$, $\omega^{t+1}$, is measured as $r^{t+1}(\omega^{t+1})$. In addition, $\omega^t$ is realized at date $t+1$. The realization of $\omega^t$ then reverses the bias in the previous measurement $r^t(\omega^t)$. That is, the reversal, $-(r^t(\omega^t) - \omega^t)$, is added to the accounting measure at date $t+1$. The aggregate accounting measure at date $t+1$ is

$$r^{t+1}(\omega^t, \omega^{t+1}) = r^{t+1}(\omega^{t+1}) + (\omega^t - r^t(\omega^t)).$$

$r^{t+1}(\omega^t, \omega^{t+1})$ has an upward bias $\omega^t - r^t(\omega^t) > 0$ because contract $t$ has a conservative bias, *i.e.*, $r^t(\omega^t) - \omega^t < 0$. Under-measuring state $\omega^t$ at date $t$ leads to the over-measurement of state $\omega^{t+1}$ at date $t+1$. In this sense, FASB's observation is correct.

Does contract $t+1$ have to use $r^{t+1}(\omega^t, \omega^{t+1})$ as it is? From the information perspective, the answer is Yes because $r^t(\omega^t)$ is the best source of information at $t$. However, from the contracting perspective, recall that at date $t$ when contract $t$ is settled, $\omega^t$ is observed. In other words, the conservative bias $r^t(\omega^t) - \omega^t$ is transparent. Therefore, contract $t+1$ could use a modified accounting measure $r^{t+1}_{Modified}(\omega^t, \omega^{t+1}) = r^{t+1}(\omega^t, \omega^{t+1}) - (\omega^t - r^t(\omega^t)) = r^{t+1}(\omega^{t+1})$ to exclude the impact of the reversal of the conservative bias from contract $t$. As a result, the conservative bias used in contract $t$ is not carried over to contract $t+1$. FASB's reason for eliminating conservatism from the conceptual framework is thus flawed from the contracting perspective.

Consider the example in which R&D is expensed for the current contract. At the time the current contract is settled, there is a conservative bias in the accounting measure that will be reversed when the actual benefit of the R&D realizes in future. The key observation is that conservatism in the model affects the settlement of the current contract but does not affect contracting parties' information about the future benefit of the R&D. It is the latter that guides the negotiation of the new contract. As a result, the conservative bias in the current contract does not affect the new contract.

## 5.3 The optimality of state-contingent debt contracts

The baseline model has assumed that a state-contingent debt contract is used to finance the project. This assumption is made so as to create demand for accounting measurement. There are other solutions to the financing problem that may even not involve accounting measurement (see Tirole (2006) for a survey of other possible solutions). One question is that whether the state-contingent contract, as one solution to the financing problem, is dominated by other solutions. While it is difficulty to compare the state-contingent debt contract directly with all other possible solutions, it should be note that the state-contingent debt contract approaches the first best as $h$ approaches $\infty$. Therefore, by continuity there exists a neighborhood in which the state-contingent debt contract is dominant. As long as there is no other solution that always achieves the first best, there is room for the state-contingent debt contract studied in the model.

## 6 Empirical implications

My model generates a number of empirical predictions, most of which seem consistent with existing evidence.

First, the model predicts that the usefulness of accounting measurement for contracting increases in its association with the underlying state. In other words, accounting measurement for contracting does not have to be *incrementally* informative. Because accounting measurement is useless for the information (belief-updating) function unless it provides incremental information, a test could be designed to answer the question whether the primary economic function of accounting measurement is for contracting or for information. If accounting measurement is highly associated with stock returns but contributes little *new* information to stock returns, then the primary economic function of accounting measurement is for contracting rather than for informational efficiency. Empirical evidence combined from both the value relevance literature and the information content literature seems to favor the contracting view.

Second, accounting measurement for contracting is vulnerable to unobservable as well as observable ex post manipulation. This predicts the equilibrium existence of *transparent* earnings management. Many empirical studies of earnings management use direct proxies for earnings management and thus assume that earnings management is measurable or observable. These studies would be self-contradictory if they relied on a theory that requires earnings management be non-observable.[13]

[13] Earnings management is often seen "as sneaky managers pulling the wool over the eyes of gullible owners"

Third, the model clarifies the relationship between conservatism and a large set of variables such as interest rate, earnings management, and firm value. Conservatism might be both an institutional feature and a choice variable in practice. When conservatism is considered as an institutional parameter, my model predicts that conservatism constrains the manager's ex post opportunism and lowers interest rate. In addition, conservatism generates more pledgeable income and thus increases a firm's borrowing capacity. When conservatism is viewed as a choice variable, my model predicts that conservatism level is higher if the verifiability or hardness of a firm's transactions is lower or if the agency cost associated with the manager is higher. These predictions are consistent with the existing evidence such as Ball, Kothari, and Robin (2000), Watts (2003b), Zhang (2008) and Watts and Zuo (2011).

Finally, the model has several implications for accounting standard setting. First, the contracting function is not inconsistent with FASB's objective of providing information useful for investment decisions. In the model, providing contractible information improves the allocation of control right and makes the investment more efficient. Second, when the manager has one-sided incentives to manipulate the measurement, a conservative measurement rule generates a more neutral measurement than a neutral measurement rule does. Thus, the model issues a cautionary note to standard setters' approach of pursing neutral measurement via neutral measurement rules. Third, the equilibrium existence of transparent earnings management implies that transparency of the measurement process, for example, requiring the manager to disclose inputs used to estimate fair value, does not eliminate opportunistic earnings management. Finally, the model justifies the role for standards setters to keep revising the rules to accommodate the newly innovated transactions and make them more contractible.

# 7 Conclusion and limitations

The paper formalizes the contracting explanation of conservatism in a setting of debt contracting. It identifies two sufficient conditions for conservatism to be useful for debt contracting.

(Arya, Glover, and Sunder (1998)). Accordingly, the vast literature on earnings management has often focused on its interaction with the rational expectations (e.g., Stein (1989), Dye (2002), Ewert and Wagenhofer (2005)). In these theories, the non-observability of earnings management is the key for its equilibrium existence.

First, a debt contract rewards a manager for better performance. Second, the manager is able to influence performance measurement ex post. The combination of the two implies that the manager has one-sided incentives to manipulate accounting measurement. Such earnings management is ex post rational but ex ante inefficient. Conservatism serves as an ex ante safeguard against the ex post earnings management. As such, conservatism is part of a firm's efficient contracting technology.

The two sufficient conditions seem also descriptive of state-contingent contracts other than debt covenants. Rewarding a manager for good performance is the basic prescription of incentive theories. Otherwise, the manager will be induced to sabotage the firm. The nature of a manager's job and his proximity to the measurement process give him opportunities to influence the measurement. As a result, the above rationale for conservatism is likely to be more general. The simplicity and generality of this rationale seem to match the long-lasting and prevalent influence conservatism has on accounting.

The formalization strengthens the contracting explanation of conservatism. It is made clear that neither manager's private information nor the cost of excessive continuation being higher than that of excessive liquidation is necessary for the contracting explanation of conservatism. The formalization also substantiates empirical predictions about the determinants and consequences of conservatism.

The main theoretical contribution of the paper is to introduce the two-step accounting measurement process. It facilitates the formalization of the contracting explanation of conservatism in such a way that it could be distinguished from other information-based explanations. As such, a theory of the equilibrium existence of transparent earnings management is developed. This modeling device might also be useful for studying other accounting issues that involve a contracting-based mechanism, such as the difference between disclosure and recognition.

The simple model of accounting measurement leaves many questions unanswered. Because the model focuses exclusively on the design of the measurement *rule*, it leaves out the role of auditors in the measurement process. However, the model provides a natural setting to study the use of professional judgement by auditors. Because there exists ex post observable but ex ante non-contractible information in the model, the auditors could improve the measurement by exercising professional judgement. The off-setting cost is that the increased reliance on auditors' professional judgement induces the manager to influence the auditors. In this context, the design of the auditors' incentives and the optimal mix of rules and principles (professional judgement) could be examined.

Another limitation of the simple model is that it is not rich enough to distinguish the conservatism of the measurement rule from the "conservatism" of the incentive function. Leuz (1998) provides a nice discussion of using two ways to create contingencies in contracts: either through the performance measure or through the incentive function. Because the measurement process is a mechanical mapping from transaction characteristics to accounting recognition in the model, the effect of a conservative measurement rule on the contract can be replicated by a contract that discounts the good performance produced by a neutral measurement rule. However, the latter contract does not do better than the former. In a richer model with auditors' role, the accounting measurement process is not a mechanical process any more, which could make a contract with a conservative measurement rule strictly more efficient. More research is needed to shed lights on this issue.

# 8 Appendix

Some proofs are explained in the text. Here I provide more details of the proofs of Proposition 2, 3, and 5. Most of them are based on standard comparative statics.

**Proof.** of Proposition 2: At date $\frac{1}{2}$, the manager chooses $\beta$ to maximize $q_B\beta(1-c)X_B - hK(\beta)$. The first-order condition is

$$q_B(1-c)X_B - hK^{'}(\beta^*) = 0. \tag{8}$$

The second-order condition is $-hK^{''}(\beta^*) < 0$ because $K^{''} > 0$. Because $K^{'}(0) = 0$ and $K^{''} > 0$, $\beta^* > 0$. Differentiating the first-order condition with respect to $c$, we have

$$\frac{\partial\beta^*}{\partial c} = -\frac{q_B X_B}{hK''} = -\frac{K^{'}}{(1-c)K''} < 0. \tag{9}$$

For the proof of Proposition 5 later, we also differentiate the first-order condition with respect to $q_B$ and $h$ :

$$\frac{\partial\beta^*}{\partial q_B} = \frac{(1-c)X_B}{hK''} > 0; \frac{\partial\beta^*}{\partial h} = -\frac{K^{'}}{hK''} < 0.$$

We also differentiate $\frac{\partial \beta^*}{\partial c}$ with respect to $c, q_B$,and $h$ :

$$\frac{\partial^2 \beta^*}{\partial c^2} = -\frac{K'''}{K''}(\frac{\partial \beta^*}{\partial c})^2; \tag{10}$$

$$\frac{\partial^2 \beta^*}{\partial c \partial q_B} = -\frac{1}{(1-c)}\frac{(K'')^2 - K'K'''}{(K'')^2}\frac{\partial \beta^*}{\partial q_B} < 0;$$

$$\frac{\partial^2 \beta^*}{\partial c \partial h} = -\frac{1}{(1-c)}\frac{(K'')^2 - K'K'''}{(K'')^2}\frac{\partial \beta^*}{\partial h} > 0.$$

■

**Proof.** of Proposition 3:

$$\begin{aligned}
\Pr(\omega &= G|r = g) = \frac{\Pr(G)\Pr(g|G)}{\Pr(G)\Pr(g|G) + \Pr(B)\Pr(g|B)} \\
&= \frac{\frac{q_G}{q_G+q_B}(1-c)}{\frac{q_G}{q_G+q_B}(1-c) + \frac{q_B}{q_G+q_B}\beta^*(1-c)} \\
&= \frac{q_G}{q_G + q_B\beta^*}
\end{aligned}$$

Because $\frac{\partial \beta^*}{\partial c} < 0, \Pr(\omega = G|r = g)$ is increasing in $c$. Thus, the good news becomes more informative with a more conservative measurement rule.

$$\begin{aligned}
\Pr(\omega &= B|r = b) = \frac{\Pr(B)\Pr(b|B)}{\Pr(B)\Pr(b|B) + \Pr(G)\Pr(b|G)} \\
&= \frac{\frac{q_B}{q_G+q_B}(1-\beta^*(1-c))}{\frac{q_B}{q_G+q_B}(1-\beta^*(1-c)) + \frac{q_G}{q_G+q_B}c} \\
&= \frac{1}{1 + \frac{q_G}{q_B}\frac{c}{1-\beta^*(1-c)}}
\end{aligned}$$

Consider the effect of $c$ on $\frac{c}{1-\beta^*(1-c)}$ :

$$\frac{\partial}{\partial c}\frac{c}{1-\beta^*(1-c)} = \frac{1-\beta^*(1-c) + c(\frac{\partial \beta^*}{\partial c}(1-c) - \beta^*)}{(1-\beta^*(1-c))^2} = \frac{1-\beta^* + c(1-c)\frac{\partial \beta^*}{\partial c}}{(1-\beta^*(1-c))^2}$$

Denote the numerator as $N(c) \equiv 1 - \beta^* + c(1-c)\frac{\partial \beta^*}{\partial c}$.

$$\begin{aligned}
\frac{\partial N(c)}{\partial c} &= -2c\frac{\partial \beta^*}{\partial c} + c(1-c)\frac{\partial^2 \beta^*}{\partial c^2} \\
&= -c\frac{\partial \beta^*}{\partial c}(2 + (1-c)\frac{K'''}{K''}\frac{\partial \beta^*}{\partial c}) \\
&= -c\frac{\partial \beta^*}{\partial c}(2 - \frac{K'''}{K''}\frac{K'}{K''}) \\
&> 0
\end{aligned}$$

Because $\frac{\partial N(c)}{\partial c} > 0$ and $\underset{c \to 0}{Limit} N(c) = 1 - \beta^*(0) > 0$, $N(c) > 0$ for any $c$. Therefore, $\frac{\partial}{\partial c}\frac{c}{1-\beta^*(1-c)} > 0$ and $\Pr(\omega = B | r = b)$ decreases in $c$. ■

**Proof.** of Proposition 5: Following the steps in the text, we simplify Problem 1 to a problem of choosing $c$ to maximize $V(c)$ in equation 5, which is reproduced here:

$$V(c) = V^{FB} - q_B \beta^*(c)(1-c)\Delta^{Over} - q_G c \Delta^{Under} - hK(\beta^*(c)).$$

Differentiating $V(c)$ with respect to $c$,

$$\begin{aligned}
\frac{dV(c)}{dc} &= -q_B \frac{\partial \beta^*}{\partial c}(1-c)\Delta^{Over} + q_B \beta^* \Delta^{Over} - q_G \Delta^{Under} - hK' \frac{\partial \beta^*}{\partial c} \\
&= q_B \Delta^{Over} \beta^* - q_G \Delta^{Under} - q_B(\Delta^{Over} + X_B)(1-c)\frac{\partial \beta^*}{\partial c}.
\end{aligned}$$

The second equality uses equation 8. The second-order condition for a maximum is satisfied because

$$\begin{aligned}
\frac{d^2 V(c)}{dc^2} &= q_B \Delta^{Over}\frac{\partial \beta^*}{\partial c} + q_B(\Delta^{Over} + X_B)\frac{\partial \beta^*}{\partial c} - q_B(\Delta^{Over} + X_B)(1-c)\frac{\partial^2 \beta^*}{\partial c^2} \\
&= q_B \Delta^{Over}\frac{\partial \beta^*}{\partial c} + q_B(\Delta^{Over} + X_B)\frac{\partial \beta^*}{\partial c} + q_B(\Delta^{Over} + X_B)(1-c)\frac{K'''}{K''}(\frac{\partial \beta^*}{\partial c})^2 \\
&= (\Delta^{Over} + (\Delta^{Over} + X_B)(1 + (1-c)\frac{K'''}{K''}\frac{\partial \beta^*}{\partial c}))q_B \frac{\partial \beta^*}{\partial c} \\
&= (\Delta^{Over} + (\Delta^{Over} + X_B)(1 - (1-c)\frac{K'''}{K''}\frac{K'}{(1-c)K''}))q_B \frac{\partial \beta^*}{\partial c} \\
&= (\Delta^{Over} + (\Delta^{Over} + X_B)(1 - \frac{K' K'''}{(K'')^2}))q_B \frac{\partial \beta^*}{\partial c} \\
&< 0.
\end{aligned}$$

The second equality uses equation 10 and the last inequality results from Assumption 2 and $\frac{\partial \beta^*}{\partial c} < 0$. As analyzed in the text, when $q_B \Delta^{Over}(\beta^*(0) - \frac{\partial \beta^*}{\partial c}|_{c=0}) - hK' \frac{\partial \beta^*}{\partial c}|_{c=0} > q_G \Delta^{Under}$, there exists $c^* \in (0, 1)$ such that

$$\frac{dV(c^*)}{dc} = q_B\beta^*(c^*)\Delta^{Over} - q_B(1-c^*)\Delta^{Over}\frac{\partial\beta^*(c^*)}{\partial c} - q_G\Delta^{Under} - hK'\frac{\partial\beta^*(c^*)}{\partial c} = 0.$$

Differentiating it with respect to $h, q_B, q_G$, and the free parameters in $\Delta^{Over}$ $(F_B)$ and in $\Delta^{Under}$ ($F_G$ and $X_G$), we have

$$\begin{aligned}
\frac{dc^*}{dh} &= -\frac{1}{\frac{d^2V(c)}{dc^2}}(q_B\Delta^{Over}\frac{\partial\beta^*}{\partial h} - q_B(\Delta^{Over}+X_B)(1-c)\frac{\partial^2\beta^*}{\partial c\partial h}) < 0;\\
\frac{dc^*}{dq_B} &= -\frac{1}{\frac{d^2V(c)}{dc^2}}(\Delta^{Over}(\beta^* + q_B\frac{\partial\beta^*}{\partial q_B}) - (\Delta^{Over}+X_B)(1-c)\frac{\partial\beta^*}{\partial c} - q_B(\Delta^{Over}+X_B)(1-c)\frac{\partial^2\beta^*}{\partial c\partial q_B}) > 0;\\
\frac{dc^*}{dq_G} &= \frac{1}{\frac{d^2V(c)}{dc^2}}\Delta^{Under} < 0; \frac{dc^*}{dF_B} = \frac{1}{\frac{d^2V(c)}{dc^2}}(q_B\beta^* - q_B(1-c)\frac{\partial\beta^*}{\partial c}) < 0;\\
\frac{dc^*}{dF_G} &= \frac{1}{\frac{d^2V(c)}{dc^2}}q_G < 0; \frac{dc^*}{dX_G} = \frac{1}{\frac{d^2V(c)}{dc^2}}q_G < 0.
\end{aligned}$$

■

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