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The Economic Consequences of Expanding Accounting Recognition

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Abstract

This article investigates the economic consequences of including more hard-to-measure future activities in a firm's accounting measurements. Using a simple model of endogenous investment in which payoffs are measured by either a restrictive or expanded recognition rule, we show that, in the process of expanding accounting recognition, firms' internal investment efficiency and external share-price risk premium may not necessarily be a trade-off. In particular, we show that the consequences of an accounting scope expansion depend on the investment environment (e.g., growth prospects) and the inherent measurement characteristics (e.g., measurement noise). For example, even with a higher measurement noise, an expanded accounting recognition may generate a lower risk premium in the share price. More surprisingly, it may lead to a higher investment efficiency and a lower risk premium at the same time. The underlying driving force is that different accounting regimes can affect the risk premium *indirectly* through their impacts on the investment level, beyond directly through the different measurement noise levels they bring.

Keywords

accounting measurement regimes, measurement scope, measurement noise

Introduction

Within the accounting measurement structure, a critical scope issue is whether accounting measurements exclude future economic activities that are relevant to firm value but inherently hard to measure. Over the past few decades, the scope of accounting recognition has been expanding to include more and more such hard-to-measure future activities. The Financial Accounting Standards Board's (FASB's) newly issued accounting standard for credit losses is a representative example of this scope expansion.[1] Under the previous ''incurred loss'' model, only expected losses over a specific time horizon that pass a ''probable'' threshold are recognized. The ''current expected credit loss'' (CECL) model

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specified by the new accounting standard, however, removes the ‘‘probable’’ threshold and requires the recognition of the *lifetime* expected losses of the loan, which are harder to measure. The new CECL model has been referred to by the American Bankers Association as ‘‘the biggest change ever to bank accounting.’’[2]

The expansion is generally justified to be a response to the increasing demand from investors for more value-relevant information about an entity, particularly when much of the firm value emanates from future hard-to-measure events. During the debate of the new accounting standard on credit losses, most investors and analysts expressed their preference for the new CECL model based on their significant concerns with the delayed loss recognition.[3] However, in addition to the relevant implementation and auditing costs, many preparers voiced their concerns over the large measurement uncertainty in the CECL’s long-term forecast of the expected credit losses. In their comment letters to the original exposure draft, preparers claim that it may be very difficult to accurately forecast the amount of losses beyond a certain point of time. For example, Morgan Stanley claims that ‘‘an expected credit loss measurement approach based on a life-of-loan estimate would increase substantially the level of estimation uncertainty . . .’’ In its letter, Ford Motor Company goes even further by saying that ‘‘the degree of accuracy or inaccuracy of the forecasts will always be the subject of debate with respect to whether it was an estimate or an error.’’ This debate on the new CECL model, to some extent, captures the general theme of controversy on most scope expansion issues. By including more hard-to-measure activities, accounting measurements become more useful on one hand. On the other hand, recognizing more hard-to-measure activities inevitably injects more noise into the resulting accounting measures. This apparent conflict between usefulness and noise appears to be a pervasive policy trade-off in designing modern accounting measurements.[4]

Our article examines this trade-off. Specifically, we consider two alternative accounting measurements designed to highlight the scope expansion and embed them into a standard investment model. Critical to the scope expansion is the simultaneous increase in both the measurement noise and the alignment between the accounting measure and the long-term investment return. Using this model, we investigate the scope expansion along two economic dimensions: investment efficiency and risk premium in the firm’s stock price.[5] We find that when equilibrium investment levels are taken into account, different accounting regimes can affect the risk premium *indirectly* through their impacts on the investment level, beyond directly through the different measurement noise levels they bring. Through this indirect mechanism, sometimes there is no trade-off at all: The scope expansion may simultaneously increase investment efficiency and decrease risk premium.

Specifically, we consider a risk-neutral entrepreneur selecting the amount of an initial investment, which determines both the mean and variance of the resulting future cash flows. Along the measurement dimension, some cash flows are easy to measure (or pass an evidential threshold), while other cash flows are hard to measure. Before the realization of the cash flows, the firm must report an accounting signal to risk-averse equity investors who competitively determine the share price of the firm. The accounting signal is noisy, and thus resolves some but not all the uncertainty of the future cash flows. The unresolved uncertainty determines the risk premium required by investors. The firm intends to maximize a weighted average of the short-term share price and the expected future cash flows. We interpret the weight on the share price as the managerial myopia. The larger the weight, the more myopic the firm.

There are two alternative accounting regimes: *Partial accounting* measures only the easy-to-measure future cash flows with low noise, whereas *Full accounting* measures all the anticipated future cash flows (i.e., both the easy-to-measure and hard-to-measure cash flows) with high noise. The key feature of the model is the fundamental difference in the informational properties of the two accounting regimes. This difference is especially large for (a) firms with higher growth prospects, which, in our model, are characterized by higher expected hard-to-measure future cash flows; and (b) firms with higher future profitability risks, which are characterized by higher volatility of the same hard-to-measure cash flows. Investors fully understand this structural difference and make rational inferences based on the accounting signal.

Our model delivers the following results: First, regarding investment efficiency, Full accounting, albeit noisier, better aligns the accounting signal with the investment return. Therefore, it induces more efficient investment than Partial accounting for firms with high growth prospects, because for these firms most of the cash flows from the investment are hard to measure and excluded from the recognition of Partial accounting.

Second, regarding risk premium, we find that it may be lower under Full accounting *regardless of* its measurement noise. The reason is that while the accounting measurements directly change the risk premium by resolving some cash flow uncertainty (i.e., direct effect), they also change the firm's investment level, which determines the ex ante cash flow uncertainty to begin with (i.e., indirect effect). This indirect effect opens another channel through which the accounting measurements can affect the risk premium.[6] Under either accounting regime, this *indirect* effect may dominate the direct effect, causing the risk premium to be, counterintuitively, decreasing in the accounting noise. When the managerial myopia is not low, the indirect effect makes the risk premium generally elevated under Partial accounting, because the hard-to-measure cash flow uncertainty magnified by the investment is left unchecked by the Partial accounting signal. As a result, regardless of the noise level, Full accounting may lead to a lower risk premium in the presence of indirect effect. Furthermore, higher uncertainty in the hard-to-measure cash flows (i.e., higher future profitability risk) could strengthen this distinction by increasing the chance this case happens.

Last, combining the above investment efficiency and risk-premium results, a firm with high growth prospects and high future profitability risks could find Full accounting preferable on both fronts even with a high measurement noise. To these firms, the process of expanding accounting recognition does not necessarily generate a trade-off between investment efficiency and risk premium, as one normally expects.

Two assumptions in our main model require more discussion: First, we do not consider managerial manipulation of the accounting signal in our main model. However, we believe that accounting scope expansion could make accounting measurements more prone to such manipulation. In Section ''Accounting Manipulation,'' we provide a detailed analysis of a setting that allows managerial manipulation under Full accounting. We find that allowing manipulation does not qualitatively change the main results of the article. Second, similar to Beyer (2009), we assume that a risk-neutral entrepreneur faces a risk-averse pricing of her firm in our main setting. This assumption on the risk preference is consistent with prior empirical findings.[7] In Section ''The Risk-Averse Entrepreneur,'' we provide additional analysis in a setting where both the entrepreneur and investors are risk averse and how our results could be affected by a higher risk aversion of the entrepreneur.

In our article, the cash flow characteristics (easy to measure vs. hard to measure) present a challenge to measuring an entity's activities because accounting must deal with the scope issue (i.e., inclusion or exclusion of certain cash flows as a measurement object) in addition to other measurement issues (e.g., measurement noise). As such, our article makes an attempt to explicitly model the expanding recognition scope in accounting measurements. Our article's central accounting concern follows a broad theme in the modeling work on the accounting measurement structure. In recent strands of this theme that are closely related to our article, Dye (2002) views classification as a foundational accounting measurement function, and its possible manipulation has implications in the equilibrium accounting standards, which he terms ''Nash'' standards. Dye and Sridhar (2004) focus on accounting aggregation and the resulting trade-off between relevance and reliability. Along a similar line, Liang and Wen (2007) focus on input- vs. output-based accounting measures and their differential effects on equilibrium investment. Among other studies highlighting the importance of accounting structure, Arya, Fellingham, Glover, Schroeder, and Strang (2000) revive the earlier linear algebra work on the double-entry bookkeeping structure into a modern light. Ohlson (1995) and Feltham and Ohlson (1995) bring valuation theory to clean-surplus accounting. Liang and Zhang (2006) study the effects of flexible and rigid accounting regimes when firms face inherent or incentive uncertainties. Bertomeu and Magee (2015) model accounting standard setters in a strategic setting, and study how political pressures may affect the accounting regulation. Some other studies focus on the financial reporting quality choice (e.g., Bertomeu & Magee, 2011; Dye & Sridhar, 2007). Finally, the real-effect literature develops the notion that the disclosure of accounting information has an impact not only upon market prices but also upon corporate production/investment decisions (e.g., Beyer & Guttman, 2012; Kanodia, 1980; Kanodia & Lee, 1998).

The results in our article also have implications for empirical work on the relation between accounting quality and cost of capital. Prior literature has documented mixed evidence on the association between earnings quality and cost of capital (e.g., Beyer, Cohen, Lys, & Walther, 2010; Botosan, 1997; Botosan & Plumlee, 2002; Francis, LaFond, Olsson, & Schipper, 2004). The comparative statics results of our model indicate that factors such as managerial myopia, future profitability risk, intensity of the use of present value estimates (i.e., proxy for Partial accounting vs. Full accounting), and firms' growth prospects may help explain the mixed empirical findings. For example, our results imply that if managerial myopia is low, the cost of capital decreases in the accounting quality. However, if managerial myopia is at an intermediate level and the accounting quality is not too high, the cost of capital increases in the accounting quality, contrary to our common intuition.

The rest of the article proceeds as follows: Section ''Model'' describes the model. Section ''Main Analysis'' presents the main analyses and results of the model, and Section ''Extensions'' provides discussions on accounting manipulation, model assumption, and the relation to cost of capital studies. Section ''Conclusion'' concludes the article.

Model

A risk-neutral entrepreneur owns a technology, which requires an initial investment. Before making the investment, on date-0, an accounting regime—either *Partial accounting* or *Full accounting*—is in place and known to all. On date-1, the entrepreneur chooses her private investment $I \in \mathbb{R}^+$ to establish the firm. The known accounting system then generates a public signal y on date-2^-. On date-2, the entrepreneur sells a fixed portion, $\beta \in (0, 1)$, of her ownership in the firm to outside investors, and the market price P is determined based on all publicly available information. All cash flows are realized on date-3. We denote the total cash flows on date-3 by x. Figure 1 summarizes the sequence of events.

We next provide more details on the model.

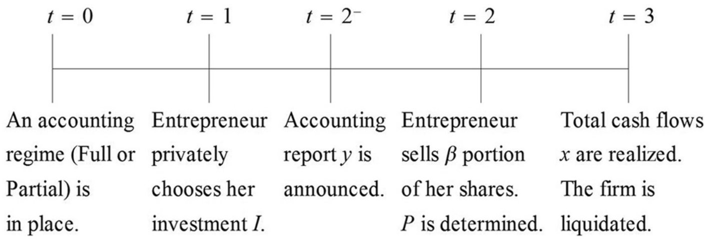

Figure 1. The time line of events.

Cash Flows

Following previous literature (e.g., Dye, 2002; Dye & Sridhar, 2004), the date-1 investment I is assumed to be privately chosen by the entrepreneur and is not observable to outside investors.[8] The investment generates stochastic future cash flows x, determined by the investment I and the state of nature θ. For tractability, we assume the cash flows x are

$$x(I, \theta) = \theta I.$$

We interpret θ as the underlying profitability of the investment, and assume that the entrepreneur does not observe θ before making the investment I. The prior distribution of θ is commonly known to all. The details of the prior distribution are specified below.

Two Accounting Regimes

On date-0, two accounting regimes are possible: Partial accounting and Full accounting. The selection of the accounting regime is a choice problem which, in practice, involves many relevant parties with conflicting incentives such as regulators, reporting firms, auditors, and other capital market users. While we do not explicitly model this complex choice problem and take the accounting regime in place as given, we do provide an analysis of the firm welfare under each regime in Section ''Main Analysis.''

Partial accounting. The scope of the Partial accounting system is limited: It excludes, from its measurement, cash flows with hard-to-measure characteristics such as high noise, lack of evidence, and/or being associated with future activities. We capture the measurement dimension distinction as follows: Suppose there are two components of the profitability variable θ:

$$\theta \equiv \theta^e + \theta^h,$$

where θ^e (θ^h) is the profitability variable underlying the cash flows that are easy to measure (hard to measure), and

$$\begin{bmatrix} \theta^e \\ \theta^h \end{bmatrix} \sim N\left(\begin{bmatrix} \theta_0 \\ k\theta_0 \end{bmatrix}, \begin{bmatrix} V_e & 0 \\ 0 & V_h \end{bmatrix} \right). \tag{1}$$

Therefore, the prior distribution of θ is normal with mean $(1+k)\theta_0$ and variance $V_\theta \equiv V_e + V_h$. The parameter θ_0 is the expected profitability underlying the easy-to-measure cash flows, which we label as the base profitability of the investment. The cash flow specification in (1) is designed to capture several important features.

- Growth prospect: We use $k \in \mathbb{R}^+$, a commonly known parameter, to capture the relative size of the expected future cash flows that are hard to measure and excluded from the measurement consideration under Partial accounting. Because the hard-to-measure property can be caused by the association with future events, we will interpret the parameter k as the firm's growth prospect, although k may capture more.[9]
- Future profitability risk: We use V_h to capture the volatility of the hard-to-measure cash flows' profitability. For ease of exposition, we interpret this parameter V_h as the firm's future profitability risk.
- Independence: We assume that the correlation between the two types of cash flows is 0, which reflects the underlying economic logic. One important reason that certain cash flows are hard to measure is that they are subject to future economy-wide or industry-wide shocks, which should be less correlated with the firm-specific factors underlying the easy-to-measure cash flows.[10]

Based on the above cash flow structure, the Partial accounting signal, denoted by y^p, is a noisy measure of the easy-to-measure cash flows, where the superscript p stands for Partial accounting. That is,

$$y^p = \theta^e I + \varepsilon_p,$$

where the accounting measurement noise $\varepsilon_p \sim N[0, V_p]$ is independent of the profitability parameter θ. Because accountants are not asked to measure $\theta^h I$, the Partial accounting measurement can be quite precise. This modeling choice is designed to be a reduced-form representation of many existing accounting recognition rules that focus on assets in place and ignore any future activities. In many accounting standards, future economic events are excluded from accounting measurement when they fail the "probable," "reasonably estimable," or "more than likely" recognition tests. Recall the loan loss example from the introduction. Partial accounting shares the spirit of the previous incurred loss model for credit losses, which deliberately ignores measuring the expected losses beyond the short-term and below the "probable" threshold.

The potential problem of Partial accounting is, of course, that the measurement is less comprehensive and less aligned with the entire economic return of the investment. This problem is more pronounced when the portion of cash flows excluded from the measurement is large (i.e., a large k in our model). It is important to note that on date-2 when the firm price is determined, even though Partial accounting does not recognize the hard-to-measure cash flows captured by the variable θ^h, market participants still take such anticipated future cash flows into consideration in pricing the firm.

Full accounting. Under Full accounting, the accounting signal, denoted by y^f, is a noisy measure of the total cash flows x, where the superscript f stands for Full accounting. That is,

$$y^f = x + \varepsilon_f = \theta I + \varepsilon_f = \left(\theta^e + \theta^h\right) I + \varepsilon_f,$$

where the accounting measurement noise $\varepsilon_f \sim N[0, V_f]$ is independent of the profitability parameter θ and the Partial accounting noise ε_p. The expression for y^f is meant to represent, in a reduced form, the informational property of a comprehensive accounting signal but not the measurement process per se. The Full accounting signal provides ''comprehensive'' information about both the easy-to-measure and hard-to-measure cash flows. However, due to aggregation, the Full accounting signal may not share the same noise level as the Partial accounting signal ($V_f \neq V_p$).[11]

Returning to the same loan loss example, the total expected ''lifetime'' losses under the new CECL model include the expected losses from the added time horizon and below the ''probable'' threshold in addition to those obtained under the previous incurred loss model. Naturally, the resulting estimated loan losses would contain more noise than those from the previous incurred loss model. While our model abstracts away from the underlying detailed measurement process, the properties of any such summary accounting measures would be fairly represented by the y^f specification.

The Entrepreneur's Objective Function and Interim Share Price

Following previous literature (e.g., Einhorn & Ziv, 2007; Liang & Wen, 2007; Stein, 1989), we assume that the entrepreneur is interested in both the firm's current market price and the future cash flows. Accordingly, the entrepreneur's objective is to maximize a weighted average of the expected date-2 market price and the expected total future cash flows, net of the initial private investment cost $I^2/2$. That is, the entrepreneur's objective function on date-1 is (assuming a 0 discount rate)

$$E[\beta P + (1-\beta)x] - \frac{I^2}{2}. \tag{2}$$

Here, β measures the extent to which the entrepreneur's investment is share-price motivated. Accordingly, we can interpret β as the managerial myopia. The larger the β, the more myopic the entrepreneur.

The firm shares are priced in a competitive rational capital market. Investors in the market are risk averse and have a constant absolute risk aversion (CARA) utility function with risk-averse coefficient τ; that is,

$$U(W_i) = -\exp(-\tau W_i),$$

where W_i denotes the investor's wealth or consumption. Given the CARA utility function, following standard results in the literature, the market price P is equal to the expected future cash flows minus a risk premium that is determined by the investors' perceived cash flow volatility. We can express the market price in the following mean–variance form:

$$P = E[x|\Omega] - \beta\tau Var[x|\Omega], \tag{3}$$

where Ω is the information set publicly available to investors on date-2.[12] The first term in (3) represents the market's expected total future cash flows conditional on all available information, and the second term is the risk premium, which depends on the conditional variance (i.e., the unresolved cash flow uncertainty), the risk-averse coefficient (τ), and the managerial myopia (β). Similar to Beyer (2009), a risk-neutral entrepreneur faces a risk-averse pricing of her firm. In Section ''Extensions,'' we provide more discussion on a setting where both the entrepreneur and investors are risk averse.

Main Analysis

Equilibrium Characterization

Before proceeding to the detailed analysis, we first define the equilibrium:

Definition 1: Under the known accounting regime (Partial or Full accounting), an equilibrium relative to Ω consists of an investment decision $I(\cdot)$ and a perfectly competitive market pricing function $P(\cdot)$ such that

1. given the pricing function $P(\cdot)$, the optimal investment $I(\cdot)$ maximizes $E[\beta P + (1-\beta)x] - (I^2/2)$;
2. given the market's conjecture $\hat{I}(\cdot)$ on the entrepreneur's investment, the market pricing function $P(\cdot)$ satisfies $P = E[x|\Omega, \hat{I}(\cdot)] - \beta\tau Var[x|\Omega, \hat{I}(\cdot)]$;
3. the market's conjecture is correct. That is, $\hat{I}(\cdot) = I(\cdot)$.

As a benchmark, we label $I^* = (1+k)\theta_0$ as the first best investment, because this would have been the optimal investment if the entrepreneur had no short-term share-price incentive. More efficient investment, in our context, means the equilibrium investment is closer to I^*.

The following proposition characterizes a linear equilibrium for both Partial accounting and Full accounting. We denote the equilibrium investment under Partial accounting and Full accounting by I_p and I_f, respectively.

Proposition 1: There exists a linear equilibrium relative to $y \in \{y^p, y^f\}$, which is given as follows:

1. Under Partial accounting, the linear pricing function $P = E[x|y^p] - \beta\tau Var[x|y^p]$, where

$$E[x|y^p] = b_p \cdot y^p + a_p \text{ and } Var[x|y^p] = I_p^2 V_h + \frac{I_p^2 V_e V_p}{I_p^2 V_e + V_p}, \tag{4}$$

with $b_p = I_p^2 V_e/(I_p^2 V_e + V_p)$ and $a_p = (V_p/(I_p^2 V_e + V_p) + k)\theta_0 I_p$, and the equilibrium investment

$$I_p = \left[\beta b_p + (1-\beta)(1+k)\right]\theta_0; \tag{5}$$

and

2. under Full accounting, the linear pricing function $P = E[x|y^f] - \beta\tau Var[x|y^f]$, where

$$E\left[x|y^f\right] = b_f \cdot y^f + a_f \text{ and } Var\left[x|y^f\right] = \frac{I_f^2 V_\theta V_f}{I_f^2 V_\theta + V_f} \tag{6}$$

with $b_f = I_f^2 V_\theta / (I_f^2 V_\theta + V_f)$ and $a_f = (V_f / (I_f^2 V_\theta + V_f))(1+k))\theta_0 I_f$, and the equilibrium investment

$$I_f = \left[\beta b_f + (1-\beta)\right](1+k)\theta_0.^{13} \tag{7}$$

Proof. All proofs are provided in the appendix.

The entrepreneur's ex ante payoff or welfare on date-1, denoted by W as a function of her equilibrium investment $I \in \{I_p, I_f\}$, can be expressed as

$$\begin{aligned} W(I) &= E[\beta P + (1-\beta)x] - \frac{I^2}{2} \\ &= E\left[x - \frac{I^2}{2}\right] - \beta^2 \tau Var[x|y]. \end{aligned} \tag{8}$$

The first term in Equation 8 is the expected total future cash flows net of the investment cost, which depend on the efficiency of the equilibrium investment. The second term in (8) measures the risk premium to compensate outside investors for bearing the risk. The entrepreneur's welfare depends on both the investment efficiency and the risk premium induced by the existing accounting regime. Proposition 1 shows that the equilibrium investment (I_p in (5) or I_f in (7)) depends on the managerial myopia β, the market response coefficient b_p or b_f, and the growth prospect k. In addition, this proposition characterizes the conditional variances or risk premiums under the two accounting regimes, as shown in (4) and (6).

In the following, we first analyze how the accounting measures affect the equilibrium investment or investment efficiency. We then analyze how they affect the conditional variance or risk premium. In particular, we show that they affect the conditional variance both directly through uncertainty resolution and indirectly through the endogenous investment. Counterintuitive results arise when the indirect effect dominates the direct effect.

Investment Analysis

In this section, we focus on the investment decision and analyze the induced investment efficiency under the two accounting regimes. Given the equilibrium in Proposition 1, the following corollary presents some comparative statics results regarding the equilibrium investment:

Corollary 1

1. The equilibrium investment under both accounting regimes approaches $(1-\beta)(1+k)\theta_0$ as the accounting signal becomes infinitely noisy.
2. The equilibrium investment I_p approaches $[1+(1-\beta)k]\theta_0$ as V_p approaches 0, and I_f approaches the first best investment $(1+k)\theta_0$ as V_f approaches 0.
3. Under both accounting regimes, the equilibrium investment is higher when the accounting signal is less noisy and when the entrepreneur is less myopic.

Under both accounting regimes, the equilibrium investment is lower than the first best. The underinvestment equilibrium is a standard result in the literature.[14] Due to the noise in the accounting signal, investors discount the accounting signal in pricing the firm, leading to the underinvestment result. The underinvestment problem is alleviated as the accounting signal becomes less noisy. Similarly, a lower β indicates that, when making the investment decision, the entrepreneur focuses less on the interim stock price and more on the future cash flows, also reducing the underinvestment incentive.

The structural differences between the two accounting regimes lead to the different equilibrium investments. Under Partial accounting, the accounting signal is only a noisy measure of the easy-to-measure cash flows and does not measure the hard-to-measure cash flows. The price does not respond to the incremental hard-to-measure cash flows caused by a marginal change in the investment. As a result, the hard-to-measure cash flows do not provide any investment incentives through the price. Accordingly, even with no measurement noise, the investment under Partial accounting is still lower than the first best. When the growth prospect k increases, this structural disadvantage of Partial accounting becomes more severe, which further reduces the investment efficiency.

In contrast, under Full accounting, the accounting signal measures both the easy-to-measure and hard-to-measure cash flows, which makes the signal more ''congruent'' with the entire investment return. Therefore, Full accounting provides more incentives for the investment all else equal. When there is no measurement noise, the investment under Full accounting achieves the first best. Furthermore, when the growth prospect k increases, this structural advantage of Full accounting becomes stronger, because the higher k makes it more important to measure the hard-to-measure cash flows. The formal comparison is provided by the following proposition:

Proposition 2: There exists a cutoff point k^* independent of V_p, such that Full accounting induces more efficient investment than Partial accounting for firms with $k \geq k^*$ (i.e., $I_f \geq I_p$ if $k \geq k^*$). Furthermore, when τ is sufficiently smaller than θ_0, the entrepreneur prefers Full accounting for any $k > k^*$.

Given the above discussion on the structural differences between the two accounting regimes, when the growth prospect k increases, Partial accounting generally induces less efficient investment, whereas Full accounting induces more efficient investment. As a result, if k is high enough, Full accounting would induce more efficient investment than Partial accounting despite the higher measurement noise in the Full accounting signal.

Note that the parameter θ_0 determines how important the investment efficiency is to the entrepreneur because it reflects the base profitability of the investment. However, the investors' risk-aversion coefficient τ determines how important the risk premium is to the entrepreneur, because it determines the size of the risk premium but does not affect the equilibrium investment under either accounting regime. When τ is sufficiently smaller than θ_0, the impact of risk premium on the entrepreneur's welfare is negligible. As a result, the entrepreneur prefers Full accounting if the growth prospect k is high, because Full accounting induces more efficient investment.

Risk Premium and the Entrepreneur's Welfare Analysis

In this section, we first focus on the risk-premium concern. According to Proposition 1, the conditional variance consists of two components as shown in (4) under Partial accounting. The first component is the unconditional variance of the hard-to-measure cash flows, and the second component is the conditional variance of the easy-to-measure cash flows. Notice that only the second component is lowered by the accounting signal y^p. Under Full accounting, the accounting signal y^f provides information about both the easy-to-measure and hard-to-measure cash flows, and thus helps resolve certain uncertainty from both, as shown in (6).

If the investment is exogenously given, our model delivers a common intuition: under either accounting regime, the noisier the accounting signal, the less cash flow uncertainty is resolved, and the higher the conditional variance. However, with endogenous investment, our model casts a challenge to this common intuition. The relationship between the accounting noise and the conditional variance becomes more subtle. In particular, the accounting noise has two effects:

- Direct effect: Higher noise increases the conditional variance due to less uncertainty resolution, and
- Indirect effect: Higher noise leads to lower equilibrium investment, which reduces the conditional variance because it reduces the total (ex ante) cash flow uncertainty.

As a result, this indirect effect through the endogenous investment works against the direct effect. Given such countervailing direct and indirect effects, the net impact of the accounting noise on the conditional variance is not unambiguous, and depends on the dominant effect.

Corollary 2: With endogenous investment, we have the following relationship between the conditional variance and the accounting noise:

1. Under the Partial accounting regime,
   i. if the managerial myopia is small ($\beta \leq (1+k)/(3+k+2V_h/V_e)$), the conditional variance increases in the accounting noise V_p;
   ii. if the managerial myopia is at an intermediate level ($(1+k)/(3+k+2V_h/V_e)<\beta<(1+k)/(k+2V_h/V_e)$), the conditional variance first increases, and then decreases in V_p as V_p increases; and
   iii. if the managerial myopia is large ($\beta \geq (1+k)/(k+2V_h/V_e)$), the conditional variance decreases in the accounting noise V_p.
2. Under the Full accounting regime,
   i. if the managerial myopia is small ($\beta \leq 1/3$), the conditional variance increases in V_f; and
   ii. if the managerial myopia is large ($\beta>1/3$), the conditional variance first increases, and then decreases in V_f as V_f increases.

Figures 2 and 3 visualize the results in Corollary 2 for Partial accounting and Full accounting, respectively.

Under Partial accounting, Figure 2 shows that the conditional variance may increase or decrease in the accounting noise depending on the managerial myopia β and the accounting noise V_p. This is driven by the relatively strong (weak) indirect effect when the equilibrium investment is small (large). For example, in Figure 2, P3, the entrepreneur is significantly myopic. Therefore, the equilibrium investment is small enough that the indirect effect is always dominant, leading to the conditional variance monotonically decreasing in the accounting noise. However, in Figure 2, P2, the entrepreneur is less myopic. The indirect effect is dominant only when the accounting noise is relatively large. The reason is that the large accounting noise further reduces the investment and leads to a dominant indirect

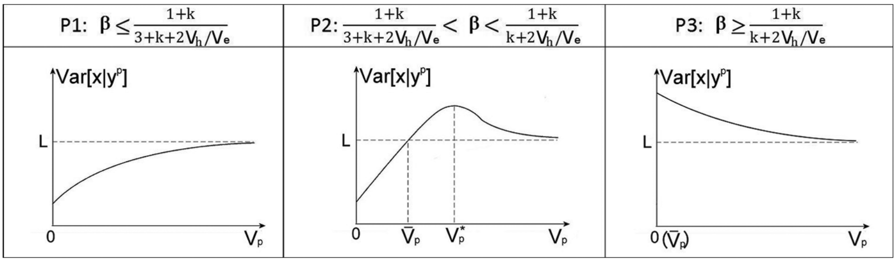

Figure 2. The impact of the accounting noise on the conditional variance under Partial accounting.
Note. L is the unconditional variance, and $L=(1-\beta)^2(1+k)^2\theta_0^2V_\theta$.

effect. Therefore, the conditional variance first increases, and then decreases in V_p as V_p increases. When the entrepreneur is the least myopic as in Figure 2, P1, the direct effect is always dominant and the conditional variance always increases in V_p. Similar arguments also apply to the Full accounting regime (as shown in Figure 3).

From Figure 2, one can also see that the cutoff points for the different cases depend on V_h/V_e, the "relative future profitability risk." In particular, the indirect effect is more likely to be dominant with a higher relative future profitability risk. The reason is that, under Partial accounting, the entire volatility from the future hard-to-measure cash flows adds to the conditional variance. The higher the relative future profitability risk, the larger the magnifying (indirect) effect on the conditional variance from any incremental investment. In contrast, under Full accounting, the cutoff points are not related to the relative future profitability risk because the Full accounting signal measures the total cash flows, and thus the relative volatility between the two cash flow components has no impact on the trade-off between the direct and indirect effects.[15]

Risk premium may be smaller under Full accounting even with a high noise. Using the results in Corollary 2, we now compare the conditional variances under the two accounting regimes. To focus our analysis on interesting parameter regions to highlight the key economic results, we assume, for the following analysis, that the profitability of the hard-to-measure cash flows is relatively volatile: $V_h>(3/2+k)V_e$.[16] The following proposition presents the relevant results on the conditional variance comparison:

Proposition 3: If $\beta \in ((1+k)/(3+k+2V_h/V_e), 1/3]$, there exists a $\bar{V}_p \geq 0$, such that the conditional variance is smaller under Full accounting than under Partial accounting for any V_f and $V_p \geq \bar{V}_p$.

Proof. The formal proof is omitted. See below for intuition.

The result in Proposition 3 comes directly from the comparison of the related graphs in Figures 2 and 3. By comparing Figure 2, P3 with Figure 3, F1, one can see that for *any* noise levels under the two accounting regimes, the conditional variance is always higher than the unconditional variance L under Partial accounting, whereas it is always lower than L under Full accounting. Therefore, Full accounting *always* produces a lower conditional variance than Partial accounting (i.e., $\bar{V}_p=0$). Similarly, by comparing Figure 2, P2 with Figure 3, F1, one can also see that for any given V_f and $V_p \geq \bar{V}_p$, the conditional variance

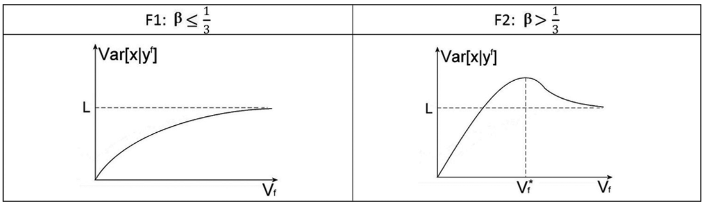

Figure 3. The impact of the accounting noise on the conditional variance under Full accounting.

under Partial accounting is larger than that under Full accounting. The intuition is as follows: Under Partial accounting, the entire uncertainty from the hard-to-measure cash flows adds to the conditional variance, while under Full accounting, only a reduced portion adds to the conditional variance due to the comprehensive Full accounting signal. As a result, when the volatility from the hard-to-measure cash flows is relatively high, Full accounting, even with a high noise, could lead to a lower conditional variance. Furthermore, the higher the relative future profitability risk, the more likely it is for this case to happen.

A couple of other observations also emerge from the proposition. First, Proposition 3 is a robust result in the sense that it does not rely on any specific (functional) relationship between the accounting noises under the two accounting regimes (i.e., the proposition is valid for any pair of V_f and $V_p \geq \bar{V}_p$). Second, Proposition 3 is also a strong result in the sense that it holds for any noise levels under Full accounting, including any large noise levels.

Full accounting may benefit both investment efficiency and risk premium. The results in Propositions 2 and 3 only focus on the sole impact of the investment efficiency and risk premium on the entrepreneur's welfare, respectively. The following proposition combines the impacts from both on the entrepreneur's welfare:

> **Proposition 4:** For any θ_0, τ, and V_f, if $k \geq k^*(\beta = 1/3)$ and $\beta \in ((1+k)/(3+k+2V_h/V_e), \frac{1}{3}]$, then the entrepreneur prefers Full accounting for any $V_p > \bar{V}_p$ because both the investment is more efficient and the conditional variance is smaller under Full accounting.

Proposition 4 presents a strong result that Full accounting could perform better on both welfare components even if it contains a large noise, as long as the given conditions are satisfied. The intuition is as follows: First, as Proposition 2 shows, for any given other parameters, when the growth prospect is relatively large (i.e., $k \geq k^*$), the initial investment is more efficient under Full accounting.[17] Second, as Proposition 3 implies, if the entrepreneur's myopia is at an intermediate level, then for any V_f and $V_p > \bar{V}_p$, the conditional variance under Full accounting is smaller. Combining both results, one can see that the entrepreneur would prefer Full accounting if the growth prospect k is relatively large and the entrepreneur's myopia is within an intermediate range, because Full accounting is better on both fronts.

Extensions

Accounting Manipulation

Another major concern associated with the expansion of accounting recognition is that the measurement of hard-to-measure cash flows is less reliable and easier to manipulate. To explore the potential impact of this concern on the main results of the article, we allow for managerial manipulation in this section.[18] By measuring the hard-to-measure cash flows, the Full accounting signal is more susceptible to managerial manipulation than the Partial accounting signal. For simplicity, we assume that only the Full accounting signal is subject to manipulation.[19] In particular, under Full accounting, the entrepreneur could report an accounting signal z^f different from the unmanaged signal y^f at a cost of

$$\psi\left(z^f\right) = \frac{c}{2}\left(z^f - y^f - \varepsilon_z\right)^2,$$

where $\varepsilon_z \sim N[0, V_z]$ is privately observed by the entrepreneur but not by investors and is independent of all other random variables, and $c>0$ is a commonly known cost parameter. The noise term ε_z reflects the uncertainty (to investors) in the cost of manipulation, and prevents investors from fully unraveling the unmanaged accounting signal from the reported signal z^f in equilibrium (see Dye & Sridhar, 2004; Liang & Wen, 2007 for similar setups). The cost parameter c reflects the ease of manipulation: The less reliable the measure, the easier to manipulate and thus the smaller the c. We note that while not explicitly modeled, the cost parameter c is determined, in part, by the strength of the legal and auditing system.

We first characterize the equilibrium under Full accounting with manipulation.

Proposition 5: If the manipulation cost under Full accounting is $\psi\left(z^f\right) = \frac{c}{2}\left(z^f - y^f - \varepsilon_z\right)^2$, there exists a linear equilibrium relative to z^f, which is given by the linear pricing function $P = E[x|z^f] - \beta\tau Var[x|z^f]$, where

$$E\left[x|z^f\right] = b'_f \cdot z^f + a'_f \text{ and } Var\left[x|z^f\right] = \frac{\left(I'_f\right)^2 V_\theta V'_f}{\left(I'_f\right)^2 V_\theta + V'_f}, \tag{9}$$

with $V'_f \equiv V_f + V_z$, $b'_f = ((I'_f)^2 V_\theta)/((I'_f)^2 V_\theta + V'_f)$ and $a'_f = (1 - b'_f)(1+k)\theta_0 I'_f - (\beta(b'_f)^2/c)$, the equilibrium investment

$$I'_f = \left[\beta b'_f + (1-\beta)\right](1+k)\theta_0, \tag{10}$$

and the equilibrium reporting strategy

$$z^f = y^f + \varepsilon_z + \frac{\beta b'_f}{c}. \tag{11}$$

According to (11), the equilibrium accounting report z^f is different from the unmanaged signal y^f by two terms: ε_z and $\beta b'_f/c$. The term $\beta b'_f/c$ reflects the entrepreneur's equilibrium manipulation that is perfectly inferred by investors in equilibrium. The intercept a'_f of the pricing function is adjusted accordingly to undo the manipulation. The noise term ε_z reflects the unknown manipulation and prevents investors from fully unraveling the unmanaged signal. This unknown manipulation ε_z injects additional noise into the accounting signal z^f (i.e., $V'_f \equiv V_f + V_z$).

By comparing Propositions 1 and 5, one can see how the introduction of manipulation affects our main results on investment efficiency and risk premium. From (7) and (10) as well as the expressions for b_f and b'_f, the equilibrium investments with and without manipulation are different only due to the different variances of the (reported) signal noise: V_f for I_f and V'_f for I'_f. In other words, the net impact on the investment from introducing manipulation is that the accounting signal under Full accounting becomes noisier. Therefore, the introduction of manipulation will not qualitatively change the comparison of the investment efficiency under the two accounting regimes (as shown in Proposition 2), except that the cutoff point k^* becomes larger with manipulation because a larger growth is needed to counter the larger variance in z^f.[20]

Similarly, from (6) and (9), the difference between the conditional variances with and without manipulation also comes from the different variances of the signal noise. The introduction of manipulation is equivalent to increasing the variance of the signal noise from V_f to V'_f. Therefore, the results in Corollary 2 regarding how the conditional variance changes with V_f still hold qualitatively. The result in Proposition 3 regarding the comparison of the conditional variances under the two accounting regimes holds as well because the result is valid for any value of V_f. In summary, the introduction of manipulation does not qualitatively affect our main results regarding investment efficiency and risk premium.

Anticipating the ex post manipulation, the entrepreneur's ex ante welfare under Full accounting, denoted by W', can be expressed as

$$\begin{aligned} W' &= E[\beta P + (1-\beta)x] - \frac{I^2}{2} - \psi\left(z^f\right) \\ &= E\left[x - \frac{I^2}{2}\right] - \beta^2 \tau Var\left[x|z^f\right] - \frac{\beta^2\left(b'_f\right)^2}{2c}. \end{aligned}$$

Compared with the welfare W in the main setting as shown in (8), the welfare W' is subject to an additional dead-weight loss from the manipulation. As the dead-weight loss does not exist under Partial accounting, Full accounting is less likely to be preferred by the entrepreneur when manipulation is allowed than when it is not. However, if the dead-weight loss is sufficiently small, it would have negligible impact on the entrepreneur's welfare. Accordingly, the related result in Proposition 4 would remain unchanged because, as argued above, the previous comparison results on investment efficiency and risk premium still hold qualitatively with manipulation.

Note that if there is a strong legal and auditing system in place, the manipulation cost c could be large and the dead-weight loss from the manipulation could be sufficiently small. Similarly, if the investment is sufficiently profitable (i.e., θ_0 is sufficiently large), the dead-weight loss could become relatively small as well. Therefore, we have the following corollary:

Corollary 3: When θ_0 or c is sufficiently large, for any V_f, if $k \geq k^*(\beta = 1/3)$ and $\beta \in ((1+k)/(3+k+2V_h/V_e), \frac{1}{3}]$, the entrepreneur prefers Full accounting for any $V_p > \bar{V}_p$ because both the investment is more efficient and the conditional variance is smaller under Full accounting.

Proof. The proof is sketched above and omitted.

In summary, allowing manipulation does not qualitatively change the positive impacts on the entrepreneur's welfare from the scope expansion as shown in the main setting. Admittedly, the manipulation generates a dead-weight loss that does not exist in the main setting. However, if the positive impacts are dominant, for example, when a strong legal and auditing system is in place, the expansion is still preferable.

The Risk-Averse Entrepreneur

In our main setting, as the entrepreneur is risk neutral, her welfare only depends on the investment efficiency and investors' risk premium. However, if the entrepreneur is risk averse, she has to further consider her own risk premium. Suppose the entrepreneur has a CARA utility function with risk-averse coefficient τ_e. We can express the entrepreneur's certainty equivalent on date-1, denoted by CE_s, as follows:

$$\begin{aligned} CE_s &= E\left[\beta P + (1-\beta)x - \frac{I^2}{2}\right] - \frac{\tau_e}{2} Var\left[\beta P + (1-\beta)x - \frac{I^2}{2}\right] \\ &= E\left[x - \frac{I^2}{2}\right] - \beta^2 \tau Var[x|y] - \frac{\tau_e}{2} Var[\beta P + (1-\beta)x] \\ &= W - \frac{\tau_e}{2} Var[\beta \cdot b \cdot y + (1-\beta)x], \end{aligned} \tag{12}$$

where $(s, b, y) \in \{(p, b_p, y^p), (f, b_f, y^f)\}$. From (12), one can see that the entrepreneur's certainty equivalent equals her corresponding welfare W in the risk-neutral setting net of her own risk premium. The entrepreneur's risk premium depends on the volatility of the accounting signal, the volatility of the total cash flows, and the covariance between them, all of which increase in the investment. As a result, the equilibrium investment level is lowered in the risk-averse setting.

If the entrepreneur's risk-averse coefficient τ_e is sufficiently small relative to the investor's risk-averse coefficient τ, all previous comparison results in the main setting would still qualitatively hold here because the investors' risk premium will be the dominant factor (i.e., $CE_s \approx W$). However, if τ_e is sufficiently large relative to τ, the entrepreneur's risk premium will be the dominant factor, and some results from the risk-neutral setting may change. For example, as shown in (12), part of the entrepreneur's risk premium arises from the volatility in the accounting signal y that consists of the cash flows the accounting signal measures and the accounting noise. Because the Full accounting signal measures both the easy-to-measure and hard-to-measure cash flows—whereas the Partial accounting signal measures only the easy-to-measure cash flows—the accounting signal is more volatile and the entrepreneur's risk premium is larger under Full accounting (holding everything else the same). The entrepreneur's own risk aversion induces a lower equilibrium investment under Full accounting. When the volatility from the hard-to-measure cash flows V_h is relatively large, the equilibrium investment could become sufficiently lower under Full accounting, such that the lower investment becomes the dominant factor in the welfare (certainty equivalent) comparison. Therefore, it is possible that the entrepreneur would prefer Partial accounting to Full accounting when V_h is relatively large. The following numerical example is consistent with this conjecture.[21]

Let $\beta = 0.2$, $\theta_0 = 2$, $\tau = 0$, $k = 2$, $V_e = V_p = 1$, and $V_f = 200$. Figure 4 depicts how the difference between the entrepreneur's certainty equivalents under Full accounting and under

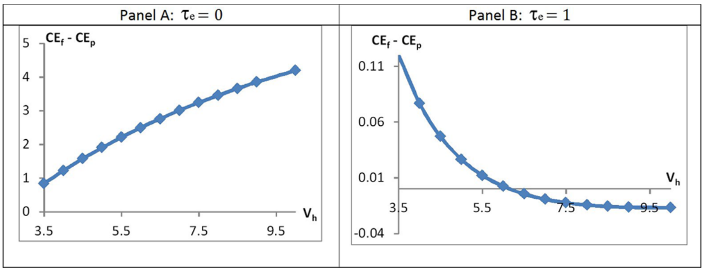

Figure 4. The comparison of the certainty equivalents under Full accounting and Partial accounting.
Note. $CE_f(CE_p)$ is the entrepreneur's certainty equivalent under Full (Partial) accounting.

Partial accounting, $CE_f - CE_p$, changes with V_h when the entrepreneur is risk neutral (i.e., Panel A: $\tau_e = 0$) and risk averse (i.e., Panel B: $\tau_e = 1$).

In Panel A where $\tau_e = 0$, the certainty equivalent is always larger under Full accounting than under Partial accounting, indicating that the entrepreneur always prefers Full accounting. In contrast, Panel B where $\tau_e = 1$ shows that when V_h is relatively small, the entrepreneur prefers Full accounting (i.e., $CE_f - CE_p > 0$), whereas when V_h is relatively large, the entrepreneur prefers Partial accounting to Full accounting (i.e., $CE_f - CE_p < 0$), which is consistent with our conjecture.

Link to the Empirical Cost-of-Capital Studies

Our results on the relation between accounting noise and conditional variance have empirical implications on studies regarding the relation between accounting information quality and (firm-equity) cost of capital. We define the cost of capital of the firm as follows[22]:

Definition 2: The ex post cost of capital of the firm on date-2 is defined as

$$COC_s = \frac{E[x|y] - P}{E[x]} = \frac{\beta\tau Var[x|y]}{(1+k)\theta_0 I}, \text{ where } (s, y, I) \in \{(p, y^p, I_p), (f, y^f, I_f)\}. \tag{13}$$

The simplification in definition (13) results from Equation 3. The numerator, $E[x|y] - P$, is the expected stock return on date-2 after the accounting report $y \in \{y^p, y^f\}$ is released. We further deflate this return by the ex ante expected total cash flows $E[x]$ to express the cost of capital as a percentage, which neutralizes the impact of different investment levels on the cost of capital. The following corollary characterizes the relationship between the cost of capital and accounting noise for both accounting regimes.

Corollary 4: We have the following relationship between the cost of capital and accounting noise:

1. Under the Partial accounting regime,
   i. if $\beta \leq (1+k)/(2+k+V_h/V_e)$, then COC_p increases in V_p;
   ii. if $(1+k)/(2+k+V_h/V_e) < \beta < (1+k)/(k+V_h/V_e)$, COC_p first increases and then decreases in V_p as V_p increases; and
   iii. if $\beta \geq (1+k)/(k+V_h/V_e)$, then COC_p decreases in V_p.

2. Under the Full accounting regime,
   i. if $\beta \leq 1/2$, then COC_f increases in V_f; and
   ii. if $\beta > 1/2$, COC_f first increases and then decreases in V_f as V_f increases.

Proof. The proof is similar to that of Corollary 2 and thus omitted.

The results in this corollary are similar to those of Corollary 2, which presents the relation between the conditional variance and accounting noise. Therefore, Figures 2 and 3 also graph the relation between the cost of capital and accounting noise. The results indicate that the nature and direction of the relation between the cost of capital and accounting information quality depend on factors such as the managerial myopia in investment decisions (β), the relative future profitability risk (V_h/V_e), and the firms' growth prospects (k), which seem to be less explored in the empirical literature on cost of capital.

Empirical work has documented mixed evidence on the association between earnings quality and cost of capital, which Beyer et al. (2010) attribute to some empirical challenges, such as the self-selection problem, the existence of a possible mechanical relationship, and the measurement errors in the proxies of cost of capital and disclosure quality. Given the nonmonotonic relation shown in Figures 2 and 3, our study provides potential factors that may help explain the mixed evidence. For example, based on both Figures 2 and 3, we can see that, if the entrepreneur's myopia is at an intermediate level and the accounting information quality is not too high (see Figures 2, P2 and 3, F2), the cost of capital *increases* in the accounting quality, contrary to our common intuition. Also, if the firm extensively relies on Partial accounting measures and the manager is very myopic (i.e., Figures 2, P3), the cost of capital *increases* in the accounting quality regardless of the accounting quality. In other cases, the relation between the cost of capital and accounting quality could be negative, as normally expected.

Conclusion

In this article, we provide an economic model in which the conceptual scope issue with every accounting measurement has an economic meaning. In particular, we build an accounting model to highlight one important scope dimension: inclusion or exclusion of hard-to-measure future events. We embed the accounting model into a standard economic model in which the accounting measurement affects both distributional and allocational efficiency. We conclude that the scope expansion in accounting measurements may affect both real variables such as investment efficiency and financial variables such as risk premium in share prices. Specifically, we show that in the process of expanding accounting recognition, firms' internal investment efficiency and external share-price risk premium may *not* necessarily be a trade-off in that an expanded recognition may lead to both a higher investment efficiency and a lower risk premium at the same time.

While we believe that our study opens the question on a key scope issue in accounting measurement, we view the article as limited on a few fronts. We have limited our attention to the formal accounting measurement and abstracted away from other forms of disclosure such as corporate voluntary disclosure and information disclosed by other market participants. These other forms of disclosure also have an impact on investment efficiency and risk premium. Similarly, outside investors are also silent in collecting their own information in our model. These topics are all fruitful avenues to explore in future studies.

Appendix

Proof (of Proposition 1 and Corollary 1)

Given the market's conjecture $\hat{I}_p$ on the investment decision under Partial accounting, we have

$$\begin{bmatrix} \theta\hat{I}_p \\ \theta^e\hat{I}_p + \varepsilon_p \end{bmatrix} \sim N\left(\begin{bmatrix} (1+k)\theta_0\hat{I}_p \\ \theta_0\hat{I}_p \end{bmatrix}, \begin{bmatrix} \hat{I}_p^2(V_e+V_h) & \hat{I}_p^2 V_e \\ \hat{I}_p^2 V_e & \hat{I}_p^2 V_e + V_p \end{bmatrix} \right).$$

From the pricing function (3),

$$\begin{aligned} P &= E[x|y^p] - \tau\beta VAR[x|y^p] \\ &= E\left[\theta\hat{I}_p|\theta^e\hat{I}_p+\varepsilon_p\right] - \tau\beta\cdot VAR\left[\theta\hat{I}_p|\theta^e\hat{I}_p+\varepsilon_p\right] \\ &= \left(\frac{V_p}{\hat{I}_p^2 V_e + V_p} + k \right)\theta_0\hat{I}_p + \frac{\hat{I}_p^2 V_e}{\hat{I}_p^2 V_e + V_p} y^p - \tau\beta\left(V_h + \frac{V_p}{\hat{I}_p^2 V_e + V_p} V_e \right)\hat{I}_p^2. \end{aligned}$$

The entrepreneur's ex ante expected payoff is $E\left[-\frac{1}{2}I^2 + \beta P + (1-\beta)x\right]$. Given the above linear pricing conjecture, the entrepreneur selects the optimal investment I_p to maximize her expected payoff. Thus, the first order condition (FOC) gives

$$I_p = \left[\beta b_p + (1-\beta)(1+k)\right]\theta_0,$$

$$\text{where } b_p = \frac{\hat{I}_p^2 V_e}{\hat{I}_p^2 V_e + V_p}.$$

Because the market's conjecture is correct in equilibrium $\hat{I}_p = I_p$, we have

$$b_p = \frac{I_p^2 V_e}{I_p^2 V_e + V_p} = \frac{\frac{I_p}{\theta_0} - (1-\beta)(1+k)}{\beta}, \text{ or}$$

$$f(I_p) \equiv I_p^2 V_e\left[I_p - (1+(1-\beta)k)\theta_0\right] + V_p\left[I_p - (1-\beta)(1+k)\theta_0\right] = 0.$$

It is easy to see that

$$f(I_p) < 0 \text{ if } I_p \leq (1-\beta)(1+k)\theta_0, \text{ and}$$

$$f(I_p) > 0 \text{ if } I_p \geq (1+(1-\beta)k)\theta_0.$$

From the property of continuity, there exists at least one root of I_p between $(1-\beta)(1+k)\theta_0$ and $(1+(1-\beta)k)\theta_0$. We always pick the root closest to $(1+(1-\beta)k)\theta_0$ if there are multiple roots.

We show the comparative statics below. From the expression of $f(I_p)$, it is easy to see that the root $I_p \to (1+(1-\beta)k)\theta_0$ as $V_p \to 0$, $I_p \to (1-\beta)(1+k)\theta_0$ as $V_p \to +\infty$, and V_h has no impact on I_p. By implicit function theorem, we have $(\partial I_p/\partial V_p) = (((1-\beta)(1+k)\theta_0 - I_p)/(f'(I_p)))$, where $f'(I_p) = 3I_p^2 V_e - 2I_p V_e(1+(1-\beta)k)\theta_0 + V_p$. Now, we show

$f'(I_p)>0$, where I_p is the root closest to $(1+(1-\beta)k)\theta_0$. If $f'(I_p)<0$, as $f(I_p)=0$, there exists an $I_p^* \in (I_p, (1+(1-\beta)k)\theta_0)$, such that $f(I_p^*)<0$. Given $f(I_p=(1+(1-\beta)k)\theta_0)>0$, there exists an $I_p^{**} \in (I_p^*, (1+(1-\beta)k)\theta_0)$, such that $f(I_p^{**})=0$, which is a contradiction with the assumption that I_p is the root closest to $(1+(1-\beta)k)\theta_0$. Thus, $f'(I_p)>0$. Therefore, $(\partial I_p/\partial V_p)=(((1-\beta)(1+k)\theta_0 - I_p)/(f'(I_p)))<0$. Similarly, $(\partial I_p/\partial\beta)=-((I_p^2 V_e k\theta_0 + V_p\theta_0 (1+k))/(f'(I_p)))<0$, and $(\partial I_p/\partial V_e)=-((I_p^2[I_p-(1+(1-\beta)k)\theta_0])/(f'(I_p)))>0$.

With similar arguments, given the market's conjecture $\hat{I}_f$ on the investment decision under Full accounting, we have

$$\begin{bmatrix} \theta\hat{I}_f \\ \theta\hat{I}_f+\varepsilon_f \end{bmatrix} \sim N\left(\begin{bmatrix} (1+k)\theta_0\hat{I}_f \\ (1+k)\theta_0\hat{I}_f \end{bmatrix}, \begin{bmatrix} \hat{I}_f^2 V_\theta & \hat{I}_f^2 V_\theta \\ \hat{I}_f^2 V_\theta & \hat{I}_f^2 V_\theta + V_f \end{bmatrix} \right).$$

From the pricing function (3),

$$\begin{aligned} P &= E[x|y^f] - \tau\beta VAR[x|y^f] \\ &= E[\theta\hat{I}_f|\theta\hat{I}_f+\varepsilon_f] - \tau\beta \cdot VAR[\theta\hat{I}_f|\theta\hat{I}_f+\varepsilon_f] \\ &= \frac{V_f}{\hat{I}_f^2 V_\theta + V_f}(1+k)\theta_0\hat{I}_f + \frac{\hat{I}_f^2 V_\theta}{\hat{I}_f^2 V_\theta + V_f} y^f - \tau\beta\frac{\hat{I}_f^2 V_\theta V_f}{\hat{I}_f^2 V_\theta + V_f}. \end{aligned}$$

The entrepreneur's ex ante expected payoff is $E[-\frac{1}{2}I^2+\beta P+(1-\beta)x]$. Given the above linear pricing conjecture, the entrepreneur selects the optimal investment I_f to maximize her expected payoff. Thus, the FOC gives

$$I_f = [\beta b_f + (1-\beta)](1+k)\theta_0,$$

$$\text{where } b_f = \frac{\hat{I}_f^2 V_\theta}{\hat{I}_f^2 V_\theta + V_f}.$$

Because the market's conjecture is correct in equilibrium $\hat{I}_f = I_f$, we have

$$b_f = \frac{I_f^2 V_\theta}{I_f^2 V_\theta + V_f} = \frac{\frac{I_f}{(1+k)\theta_0} - (1-\beta)}{\beta}, \text{or}$$

$$h(I_f) \equiv I_f^2 V_\theta[I_f - (1+k)\theta_0] + V_f(I_f - (1-\beta)(1+k)\theta_0) = 0.$$

It is easy to see that

$$h(I_f) < 0 \text{ if } I_f \le (1-\beta)(1+k)\theta_0, \text{ and}$$

$$h(I_f) > 0 \text{ if } I_f \ge (1+k)\theta_0.$$

From the property of continuity, there exists at least one root of I_f between $(1-\beta)(1+k)\theta_0$ and $(1+k)\theta_0$. We always pick the root closest to $(1+k)\theta_0$ if there are multiple roots.

Similarly, from the expression of $h(I_f)$, it is easy to see that the root $I_f \rightarrow (1+k)\theta_0$ as $V_f \rightarrow 0$, $I_f \rightarrow (1-\beta)(1+k)\theta_0$ as $V_f \rightarrow +\infty$. Now, we show $h'(I_f)>0$, where I_f is the root closest to $(1+k)\theta_0$. If $h'(I_f)<0$, as $h(I_f)=0$, there exists an $I_f^* \in (I_f, (1+k)\theta_0)$, such that $h(I_f^*)<0$. Given $h(I_f=(1+k)\theta_0)>0$, there exists an $I_f^{**} \in (I_f^*, (1+k)\theta_0)$, such that $h(I_f^{**})=0$, which is a contradiction with the assumption that I_f is the root closest to $(1+k)\theta_0$. Thus, $h'(I_f)>0$. By implicit function theorem, we have $\partial I_f/\partial V_f = ((1-\beta)(1+k)\theta_0 - I_f)/\ (h'(I_f))<0$, $\partial I_f/\partial V_\theta = I_f^2[(1+k)\theta_0 - I_f]/h'(I_f)>0$, and $\partial I_f/\partial\beta = -V_f(1+k)\ \theta_0/h'(I_f)<0$.

Proof (of Proposition 2)

From the proof of Proposition 1, we have $I_p \in ((1-\beta)(1+k)\theta_0, (1+(1-\beta)k)\theta_0)$ and $I_f \in ((1-\beta)(1+k)\theta_0, (1+k)\theta_0)$. That is, $I_p/((1+k)\theta_0) \in (1-\beta, (1+(1-\beta)k)/(1+k))$ and $I_f/((1+k)\theta_0) \in (1-\beta, 1)$. One can easily see that the upper bound of $I_p/((1+k)\theta_0)$ decreases in k (i.e., $\partial((1+(1-\beta)k)/(1+k))/\partial k = -\beta/(1+k)^2<0$) and approaches $(1-\beta)$ as $k \rightarrow +\infty$ and 1 as $k \rightarrow 0$. Furthermore, as β increases, the upper bound decreases faster in k (i.e., the magnitude of $\partial((1+(1-\beta)k)/(1+k))/\partial k$ increases in β).

Under Full accounting, $I_f/((1+k)\theta_0) \in (1-\beta, 1)$, where I_f solves $h(I_f) \equiv I_f^2 V_\theta [I_f - (1+k)\theta_0] + V_f(I_f - (1-\beta)(1+k)\theta_0) = 0$. Then, we have

$$H\left(I_f^0\right) \equiv \left(I_f^0\right)^2 (1+k)^2\theta_0^2 V_\theta \left[I_f^0 - 1\right] + V_f\left[I_f^0 - (1-\beta)\right] = 0, \tag{14}$$

where $I_f^0 = (I_f/((1+k)\theta_0))$. Taking the derivative of $H(I_f^0)$ defined in (14) with respect to k, we have

$$\frac{\partial H\left(I_f^0\right)}{\partial I_f^0}\frac{\partial I_f^0}{\partial k} + 2(1+k)\left(I_f^0\right)^2\theta_0^2 V_\theta\left[I_f^0 - 1\right] + \frac{\partial V_h}{\partial k}\left(I_f^0\right)^2(1+k)^2\theta_0^2\left[I_f^0 - 1\right] = 0. \tag{15}$$

Note that $(\partial H(I_f^0)/\partial I_f^0)>0$ because we have shown $h'(I_f) = (1+k)\theta_0((\partial H(I_f^0))/\partial I_f^0)(\partial I_f^0/\partial I_f)>0$, where I_f is the root closest to $(1+k)\theta_0$. Thus, from (15), given $I_f^0<1$, we have $(\partial I_f^0/\partial k)>0$. One can also see from (14) that I_f^0 approaches 1 as $k \rightarrow +\infty$.

In summary, as k increases from 0 to $+\infty$, the upper bound of $I_p/((1+k)\theta_0)$ (i.e., $(1+(1-\beta)k)/(1+k)$) decreases from 1 to $(1-\beta)$, while $I_f^0 = (I_f/((1+k)\theta_0))$ increases from a value between 1 and $(1-\beta)$ (note $I_f^0 \in (1-\beta, 1)$) to 1. Therefore, there must exist a k^*, such that $(I_f/((1+k^*)\theta_0)) = ((1+(1-\beta)k^*)/(1+k^*)) > (I_p/(1+k^*)\theta_0)$. Accordingly, for any $k \geq k^*$, Full accounting induces more efficient investment than Partial accounting, that is, $I_f \geq I_p$. Note that k^* is the solution to the equation $[1+(1-\beta)k]^2 k - V_f/(V_\theta\theta_0^2) = 0$. Therefore, we have $\partial k^*/\partial\beta>0$.

Proof (of Corollary 2)

For Partial accounting, differentiating $Var[x|y^p]$ with respect to V_p, we have

$$\frac{dVar[x|y^p]}{dV_p} = \frac{\partial Var[x|y^p]}{\partial V_p} + \frac{\partial Var[x|y^p]}{\partial I_p}\frac{\partial I_p}{\partial V_p}$$
$$= \frac{I_p^4 V_e^2}{\left(I_p^2 V_e + V_p\right)^2} + \left(\frac{2I_p V_e V_p^2}{\left(I_p^2 V_e + V_p\right)^2} + 2I_p V_h\right)\frac{-\left(I_p - (1-\beta)(1+k)\theta_0\right)}{f'\left(I_p\right)},$$

where $f'(I_p) = 3V_e I_p^2 - 2V_e(1+(1-\beta)k)\theta_0 I_p + V_p > 0$ as shown before. From $f(I_p) = 0$, we have $-(I_p - (1-\beta)(1+k)\theta_0) = V_e I_p^2(I_p - r)/V_p$, where $r \equiv (1+(1-\beta)k)\theta_0$. By substitution and simplification, we have

$$\frac{dVar[x|y^p]}{dV_p} = \frac{I_p^3 V_e^2\left(3I_p - 2(1+(1-\beta)k)\theta_0\right)}{\left(I_p^2 V_e + V_p\right) f'\left(I_p\right)} + \frac{2I_p^3 V_h V_e\left(I_p - r\right)}{f'\left(I_p\right) V_p}$$
$$= \frac{I_p^3 V_e\left[\left[3V_e V_p I_p - 2V_e V_p r + 2V_h V_p\left(I_p - r\right) + 2V_h \cdot V_e I_p^2\left(I_p - r\right)\right]\right.}{\left(I_p^2 V_e + V_p\right) f'\left(I_p\right) V_p}$$
$$= \frac{3I_p^3 V_e^2\left[I_p - \frac{2}{3}\left(r + \beta\theta_0\frac{V_h}{V_e}\right)\right]}{\left(I_p^2 V_e + V_p\right) f'\left(I_p\right)}.$$

The third equality results from the substitution $V_e I_p^2(I_p - r) = -(I_p - (1-\beta)(1+k)\theta_0)V_p$ (from $f(I_p) = 0$) and simplification. Therefore, if $(1-\beta)(1+k)\theta_0 \geq (2/3)(r + \beta\theta_0(V_h/V_e))$ or $\beta \leq ((1+k)/(3+k+2V_h/V_e))$, then $I_p > (1-\beta)(1+k)\theta_0 \geq (2/3)(r + \beta\theta_0(V_h/V_e))$ and $(dVar[x|y^p]/dV_p) > 0$.

However, when $(1-\beta)(1+k)\theta_0 < (2/3)(r + \beta\theta_0(V_h/V_e))$ or $\beta > (1+k)/(3+k+2V_h/V_e)$, given $I_p < r$, I_p decreases in V_p, and $I_p \to r$ as $V_p \to 0$, then if $(2/3)(r + \beta\theta_0(V_h/V_e)) < r$ or $\beta < ((1+k)/(k+2V_h/V_e))$, there exists a $V_p^* = (-V_e I_p^2(I_p - r))/(I_p - (1-\beta)(1+k)\theta_0)|_{I_p = \frac{2}{3}(r + \beta\theta_0\frac{V_h}{V_e})}$, such that when $V_p \gtreqless V_p^*$, $I_p \gtreqless (2/3)(r + \beta\theta_0(V_h/V_e))$ and $(dVar[x|y^p]/dV_p) \gtreqless 0$. On the contrary, if $(2/3)(r + \beta\theta_0(V_h/V_e)) \geq r$ or $\beta \geq ((1+k)/(k+2V_h/V_e))$, then $I_p < (2/3)(r + \beta\theta_0(V_h/V_e))$ and $(dVar[x|y^p]/dV_p) < 0$.

Given $I_p \to r$ $((1-\beta)(1+k)\theta_0)$ as $V_p \to 0$ $(+\infty)$ from Corollary 1, we can see $Var[x|y^p] \to (1+(1-\beta)k)^2\theta_0^2 V_h$ as $V_p \to 0$ and $\to L \equiv (1-\beta)^2(1+k)^2\theta_0^2(V_e + V_h) = (1-\beta)^2(1+k)^2\theta_0^2 V_\theta$ as $V_p \to +\infty$.

For Full accounting, differentiating $Var[x|y^f]$ with respect to V_f, we have

$$\frac{dVar\left[x|y^f\right]}{dV_f} = \frac{\partial Var\left[x|y^f\right]}{\partial V_f} + \frac{\partial Var\left[x|y^f\right]}{\partial I_f}\frac{\partial I_f}{\partial V_f}$$
$$= \frac{I_f^4 V_\theta^2}{\left(I_f^2 V_\theta + V_f\right)^2} + \frac{2I_f V_\theta V_f^2}{\left(I_f^2 V_\theta + V_f\right)^2} \cdot \frac{-\left(I_f - (1-\beta)(1+k)\theta_0\right)}{h'\left(I_f\right)}$$
$$= \frac{3I_f^3 V_\theta^2\left(I_f - \frac{2}{3}(1+k)\theta_0\right)}{\left(I_f^2 V_\theta + V_f\right) h'\left(I_f\right)},$$

where $h'(I_f) = 3V_\theta I_f^2 - 2V_\theta(1+k)\theta_0 I_f + V_f > 0$ as shown before. The third equality results from the substitution $-(I_f - (1-\beta)(1+k)\theta_0) = I_f^2 V_\theta(I_f - (1+k)\theta_0)/V_f$ (from $h(I_f) = 0$)

and simplification. Therefore, if $(1-\beta)(1+k)\theta_0 \geq (2/3)(1+k)\theta_0$ or $\beta \leq (1/3)$, then $I_f > (1-\beta)(1+k)\theta_0 \geq (2/3)(1+k)\theta_0$ and $(dVar[x|y^f]/dV_f) > 0$.

Below, consider the other case where $(1-\beta)(1+k)\theta_0 < (2/3)(1+k)\theta_0$ or $\beta > (1/3)$. Note that I_f decreases in V_f as shown before. Because $I_f(V_f=0) = (1+k)\theta_0 > (2/3)(1+k)\theta_0$, there exists a $V_f^* > 0$ such that when $V_f \gtreqless V_f^*$, $I_f \gtreqless \frac{2}{3}(1+k)\theta_0$ and $(dVar[x|y^f]/dV_f) \gtreqless 0$, where $V_f^* = ((-V_\theta I_f^2(I_f-(1+k)\theta_0))/(I_f-(1-\beta)(1+k)\theta_0))|_{I_f=\frac{2}{3}(1+k)\theta_0}$.

Given $I_f \rightarrow (1-\beta)(1+k)\theta_0$ as $V_f \rightarrow +\infty$ from Corollary 1, we can see $Var[x|y^f] \rightarrow L \equiv (1-\beta)^2(1+k)^2\theta_0^2 V_\theta$ as $V_f \rightarrow +\infty$.

Proof (of Proposition 4)

This result directly follows from Proposition 2 and Proposition 3. The reason we have $k^*(\beta=(1/3))$ is that, as shown in the proof of Proposition 2, $\partial k^*/\partial\beta > 0$. Thus, for any $\beta \in ((1+k)/(3+k+2V_h/V_e), \frac{1}{3}]$, if $k \geq k^*(\beta=(1/3))$, we have $I_f \geq I_p$.

Proof (of Proposition 5)

Given the market's conjecture $\hat{I}'_f$ on the investment and the manipulation strategy $\hat{m}$ (i.e., $z^f = y^f + \varepsilon_z + \hat{m}$), we have

$$\begin{bmatrix} x = \theta\hat{I}'_f \\ z^f = \theta\hat{I}'_f + \varepsilon_f + \varepsilon_z + \hat{m} \end{bmatrix} \sim N\left(\begin{bmatrix} (1+k)\theta_0\hat{I}'_f \\ (1+k)\theta_0\hat{I}'_f + \hat{m} \end{bmatrix}, \begin{bmatrix} \left(\hat{I}'_f\right)^2 V_\theta & \left(\hat{I}'_f\right)^2 V_\theta \\ \left(\hat{I}'_f\right)^2 V_\theta & \left(\hat{I}'_f\right)^2 V_\theta + V'_f \end{bmatrix}\right),$$

where $V'_f \equiv V_f + V_z$. Then, the pricing function is

$$\begin{aligned} P &= E\left[x|z^f\right] - \beta\tau Var\left[x|z^f\right] \\ &= E\left[\theta\hat{I}'_f|z^f\right] - \tau\beta \cdot VAR\left[\theta\hat{I}'_f|z^f\right] \\ &= \frac{\left(\hat{I}'_f\right)^2 V_\theta}{\left(\hat{I}'_f\right)^2 V_\theta + V'_f} z^f + \frac{V'_f}{\left(\hat{I}'_f\right)^2 V_\theta + V'_f}(1+k)\theta_0\hat{I}'_f - \frac{\left(\hat{I}'_f\right)^2 V_\theta}{\left(\hat{I}'_f\right)^2 V_\theta + V'_f}\hat{m} - \tau\beta\frac{\left(\hat{I}'_f\right)^2 V_\theta V'_f}{\left(\hat{I}'_f\right)^2 V_\theta + V'_f} \\ &= b'_f z^f + a'_f - \tau\beta\frac{\left(\hat{I}'_f\right)^2 V_\theta V'_f}{\left(\hat{I}'_f\right)^2 V_\theta + V'_f}, \end{aligned}$$

where $a'_f = (1-b'_f)(1+k)\theta_0\hat{I}'_f - b'_f\hat{m}$ and $b'_f = ((\hat{I}'_f)^2 V_\theta)/((\hat{I}'_f)^2 V_\theta + V'_f)$.

Taking the above pricing function as given, the entrepreneur privately chooses the investment level I'_f and the manipulation m (i.e., $z^f = y^f + \varepsilon_z + m$) to maximize

$$\begin{aligned} &\max_{I'_f, m} E[\beta P + (1-\beta)x] - \frac{\left(I'_f\right)^2}{2} - \frac{c}{2}m^2 \\ &= \beta a'_f + \left[\beta b'_f + (1-\beta)\right](1+k)\theta_0 I'_f + \beta b'_f m - \beta^2\tau\frac{\left(\hat{I}'_f\right)^2 V_\theta V'_f}{\left(\hat{I}'_f\right)^2 V_\theta + V'_f} - \frac{\left(I'_f\right)^2}{2} - \frac{c}{2}m^2. \end{aligned}$$

The first-order condition shows that

$$I'_f = \left[\beta b'_f + (1-\beta)\right](1+k)\theta_0,$$

$$m = \frac{\beta b'_f}{c} \text{ or } z^f = y^f + \varepsilon_z + \frac{\beta b'_f}{c}.$$

Because the market's conjectures are correct in equilibrium, the rest of the proof is similar to the proof of Proposition 1 and thus omitted.

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Notes

1. See Financial Accounting Standards Board (FASB) Accounting Standards Updates (ASU), "Financial Instruments—Credit Losses (Topic 326)," issued on June 16, 2016, which will become effective in 2020.
2. See the letter from the American Bankers Association to FASB Chairman Russell Golden, dated January 13, 2016, available at http://www.aba.com/Advocacy/LetterstoCongress/Documents/RussellGolden-FASB-011316.pdf.
3. See the summary of feedback on the FASB's original exposure draft on credit losses available at http://www.fasb.org/jsp/FASB/FASBContent_C/ProjectUpdatePage&cid=1176159268094#next_steps.
4. The change in goodwill accounting from the amortization model to the impairment model is another representative example. The amortization model is based on the originally capitalized value of the goodwill and, thus, the amortization amounts are easy to measure. However, the impairment model requires the firm to determine the acquired unit's current value, which depends on the estimation of future cash flows and is hard to measure. Another example of this trade-off is the accounting for stock option compensation.
5. In our model, risk premium is defined as the difference between the expected future cash flows and the share price.
6. To give an analogy here, think of the ex ante cash flow uncertainty as a pie consisting of two pieces—one representing the resolved uncertainty by the accounting measurement and the other representing the unresolved/remaining uncertainty (i.e., the risk premium). For a fixed size of

pie, a higher measurement noise would increase the size of the risk-premium piece. However, at the same time, the higher measurement noise would also decrease the size of the entire pie by reducing the investment. As a result, the net impact of the higher measurement noise on the size of the risk-premium piece is unclear and depends on the dominant effect.

7. For example, Puri and Robinson (2013) find that typical entrepreneurs are less risk averse and more willing to embrace risk than the rest of the population because their risk bearing is tempered by longer planning horizons.
8. This can be a scenario in which the entrepreneur makes her personal efforts to develop the project.
9. For example, two firms from different industries can have the same growth prospect but one firm has more hard-to-measure cash flows, resulting in different k's in our model. Nevertheless, we use the growth prospect interpretation for ease of exposition.
10. Furthermore, a strong correlation between the two types of cash flows would defeat the modeling purpose of differentiating the hard-to-measure cash flows from the easy-to-measure cash flows. This is because a strong correlation would make an accounting signal informative about θ^e become highly informative about θ^h, and thus the hard-to-measure cash flows would become the easy-to-measure cash flows. While there are strong reasons supporting a model specification of zero correlation, some correlation between the cash flows to be measured (θ^e) and the cash flows excluded from the measurement (θ^h) may exist in practice (e.g., there are some foreseeable future events). Technically, our results are robust to a generalization to a nonzero but small correlation between θ^e and θ^h.
11. Here, the variance of the measurement noise in the Full accounting signal, V_f, does not necessarily change with the growth potential k. For robustness, we also consider an alternative specification in which the variance depends on the size of the growth prospect k and a generic parameter v, which can be thought of as the ''per capita'' measurement noise of the hard-to-measure cash flows. For example, we can construct $V_f(k, v)$ as follows: Imagine the firm has an easy-to-measure project whose future cash flows are easy to measure and equal $\theta^e I$. The Partial accounting would measure this project with y^p. In addition, the firm has k hard-to-measure projects whose future cash flows are hard to measure and equal $\theta_i^h I$ ($i \in \{1, 2, ..., k\}$) with $E[\theta_i^h] = \theta_0$. Each of the k projects may be measured with an accounting signal y_i: $y_i = \theta_i^h I + \varepsilon_i$, $i \in \{1, 2, ..., k\}$, with $\varepsilon_i \sim N(0, v)$. Hence, if we can think of the Full accounting signal as an aggregate measure of the easy-to-measure project and the k hard-to-measure projects: $y^f = y^p + \sum y_i$, then the variance of ε_f would become a function of k and v (i.e., $V_f(k, v)$). If ε_p and all $\varepsilon_i's$ are independent of each other, then $V_f(k, v) = V_p + kv$. This alternative setup neither qualitatively alters the main results of the article nor introduces significant new insights. Therefore, we use the simpler specification in the main text.
12. Consider a perfectly competitive market. The wealth of a typical investor i is $W_i = (x - P)D_i$, where D_i is the investor's demand of the firm's shares given the price P. With the CARA utility function, the investor maximizes $E[W_i|\Omega] - (\tau/2)Var[W_i|\Omega] = (E[x|\Omega] - P)D_i - (\tau/2)D_i^2 Var[x|\Omega]$. From the first-order condition, we have $D_i = (E[x|\Omega] - P)/(\tau Var[x|\Omega])$. As β portion of the firm's shares is available for sale, the market clearing condition gives $\beta = \int_0^1 D_i di = (E[x|\Omega] - P)/(\tau Var[x|\Omega])$. Thus, we have the market price $P = E[x|\Omega] - \beta\tau Var[x|\Omega]$.
13. Note that the equilibrium investments I_p and I_f are implicitly determined through Equations 5 and 7, respectively. If there are multiples solutions, we always pick the most efficient one (i.e., the one closest to the first best investment). See the proof for details.
14. For example, in Dye and Sridhar (2004), the equilibrium investment level is always below the first best. Liang and Wen (2007) find a similar result that output-based accounting (similar to the two accounting measures in our article) always induces underinvestment by the firm.
15. Under both accounting regimes, when the accounting noise goes to infinity, the accounting signal is no longer informative about the cash flows, and therefore the conditional variance

becomes the unconditional variance $L \equiv (1-\beta)^2(1+k)^2\theta_0^2 V_\theta$. The fact that the conditional variance sometimes exceeds the unconditional variance under both accounting regimes (e.g., Figures 2, P3 and 3, F2) is due to the indirect effect. That is, when the noise reduces from infinity to a finite value, the equilibrium investment increases, and the conditional variance increases as well if the indirect effect is dominant.

16. Given this assumption, the cutoff point in Figure 2, P3 does not exceed $1/3$, indicating that there is a common β region for any graph in Figure 2 and the one in Figure 3, F1.
17. As shown in the proof of Proposition 2, the cutoff point k^* increases in β. Therefore, for any $\beta \in ((1+k)/(3+k+2V_h/V_e), 1/3]$, $k^*(\beta) \leq k^*(\beta = 1/3)$, which is independent of β. This is the reason we use $k^*(\beta = 1/3)$ as the cutoff point in Proposition 4.
18. We wish to thank an anonymous referee for suggesting that we pursue this extension.
19. Alternatively, one can assume that both Partial and Full accounting signals are subject to manipulation but the unit manipulation cost is higher for Partial accounting than for Full accounting (i.e., manipulation is more difficult under Partial accounting). This alternative setup will not qualitatively change the relevant results.
20. In the extreme case where there is no uncertainty in the cost of manipulation (i.e., $V_z = 0$), the equilibrium investment remains the same and the cutoff point would not change because investors can fully unravel the unmanaged accounting signal in equilibrium.
21. Note that in the main setting, although the analysis is tractable, the equilibrium investment is expressed implicitly (i.e., not in closed form). With a risk-averse entrepreneur, the implicit investment makes the analysis on certainty equivalent intractable due to the entrepreneur's own risk premium (i.e., the second term in Equation 12). Given the added complexity, we resort to a numerical example to illustrate our conjecture.
22. The definition of the cost of capital is for analytic ease. Our qualitative results remain the same if we define the cost of capital as $(E[x|y] - P)/(E[P])$, following previous literature (e.g., Gao, 2010; Lambert, Leuz, & Verrecchia, 2007).

References

Arya, A., Fellingham, J. C., Glover, J. C., Schroeder, D. A., & Strang, G. (2000). Inferring transactions from financial statements. *Contemporary Accounting Research*, *17*, 366-385.

Bertomeu, J., & Magee, R. (2011). From low-quality reporting to financial crises: Politics of disclosure regulation along the economic cycle. *Journal of Accounting & Economics*, *52*, 209-227.

Bertomeu, J., & Magee, R. (2015). Political pressures and the evolution of disclosure regulation. *Review of Accounting Studies*, *20*, 775-802.

Beyer, A. (2009). Capital market prices, management forecasts, and earnings management. *The Accounting Review*, *64*, 1713-1747.

Beyer, A., Cohen, D., Lys, T., & Walther, B. (2010). The financial reporting environment: Review of the recent literature. *Journal of Accounting & Economics*, *50*, 296-343.

Beyer, A., & Guttman, I. (2012). Voluntary disclosure, manipulation and real effects. *Journal of Accounting Research*, *50*, 1141-1177.

Botosan, C. (1997). Disclosure Level and the Cost of Equity Capital. *The Accounting Review*, *72*, 323-349.

Botosan, C., & Plumlee, M. (2002). A re-examination of disclosure level and the expected cost of equity capital. *Journal of Accounting Research*, *40*, 21-40.

Dye, R. A. (2002). Classifications manipulation and Nash accounting standards. *Journal of Accounting Research*, *40*, 1125-1162.

Dye, R. A., & Sridhar, S. S. (2004). Reliability-relevance trade-offs and the efficiency of aggregation. *Journal of Accounting Research*, *42*, 51-87.

Dye, R. A., & Sridhar, S. S. (2007). The allocational effects of the precision of accounting estimates. *Journal of Accounting Research*, *45*, 731-769.

Einhorn, E., & Ziv, A. (2007). Unbalanced information and the interaction between information acquisition, operating activities, and voluntary disclosure. *The Accounting Review*, *82*, 1171-1194.

Feltham, G., & Ohlson, J. A. (1995). Valuation and clean surplus accounting for operating and financial activities. *Contemporary Accounting Research*, *11*, 689-731.

Francis, J., LaFond, R., Olsson, P., & Schipper, K. (2004). Costs of equity and earnings attributes. *The Accounting Review*, *79*, 967-1010.

Gao, P. (2010). Disclosure quality, cost of capital, and investor welfare. *The Accounting Review*, *85*, 1-29.

Kanodia, C. (1980). Effects of shareholder information on corporate decisions and capital market equilibrium. *Econometrica*, *48*, 923-953.

Kanodia, C., & Lee, D. (1998). Investment and disclosure: The disciplinary role of periodic performance reports. *Journal of Accounting Research*, *36*, 33-55.

Lambert, R., Leuz, C., & Verrecchia, R. E. (2007). Accounting information, disclosure and the cost of capital. *Journal of Accounting Research*, *45*, 385-420.

Liang, P. J., & Wen, X. (2007). Accounting measurement basis, market mispricing, and firm investment efficiency. *Journal of Accounting Research*, *45*, 155-197.

Liang, P. J., & Zhang, X. (2006). Accounting treatment of inherent versus incentive uncertainties and the capital structure of the firm. *Journal of Accounting Research*, *44*, 145-176.

Ohlson, J. A. (1995). Earnings, book values, and dividends in equity valuation. *Contemporary Accounting Research*, *11*, 661-687.

Puri, M., & Robinson, D. T. (2013). The economic psychology of entrepreneurship and family business. *Journal of Economics & Management Strategy*, *22*, 423-444.

Stein, J. (1989). Efficient capital markets, inefficient firms: A model of myopic corporate behavior. *The Quarterly Journal of Economics*, *104*, 655-670.