

Who Benefits from Fair Value Accounting?

An Equilibrium Analysis with Strategic Complementarities

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1. Introduction

The move to fair value accounting is arguably the most radical shift in accounting standards during the past decade. Under fair value accounting a firm's assets and liabilities are periodically marked to market rather than recorded at their historical cost, and gains and losses arising from such revaluations are reported as part of a firm's comprehensive income¹. The merits of fair value accounting seem obvious and compelling. Surely, fair values are much more descriptive of a firm's current financial position than the historical cost at which the firm's assets were originally acquired. Therefore, the reporting of fair values must facilitate more accurate assessments of a firm's net wealth resulting in better decisions by current and future stakeholders. Such reporting would also produce capital market valuations that are more consistent with the fundamentals of the firm. Most of the concerns that have been expressed are not about the principle of fair value accounting, but about the *measurement* of fair values, especially in cases where market prices for identical or similar assets do not exist.

But the above intuitive arguments supporting fair value accounting are not *equilibrium* arguments, in a sense that will be elaborated below. In fact, an equilibrium analysis of whether or how economic agents actually benefit from fair value accounting is missing in the literature. Lacking such an analysis, the case for fair value accounting remains somewhat speculative.

It is easy to see the case for fair value accounting in a statistical decision theory sense where a single decision maker interacts with the states of Nature. For such settings, more information about the state of Nature, in the Blackwell sense, is always preferred to less, and strictly so if the additional information is payoff relevant. Thus,

¹ We are ignoring the effect of incorporating conservatism and other imperfections into fair value measurements, in order to focus solely on the *principle* of fair value reporting.

since fair value accounting ostensibly provides incremental information about a firm's wealth, Blackwell's theorem would imply that fair value accounting is strictly preferred to historical cost accounting in any decision setting where the firm's wealth is payoff relevant to decision makers.

However, realistically, assessments of a firm's wealth are not analogous to assessments of the states of Nature because we do not live in a Robinson Crusoe economy. What firms do impacts their outside stakeholders and what these outside stakeholders do impacts the firm. Thus, a firm's wealth depends upon the endogenous actions of its inside managers and the endogenous actions of outside stakeholders, such as the firm's customers, suppliers of labor and suppliers of capital. When the actions of insiders and outsiders interact in the determination of a firm's wealth, the actions taken by corporate managers will depend at least partially upon their anticipation of outside stakeholders' actions in response to their own actions. Therefore, if outside stakeholders' actions are partly guided by their assessments of the firm's wealth, then information provided to help in the assessment of a firm's wealth will impact the decisions of both insiders and outsiders and will therefore change the wealth distribution that is being assessed. The purpose of this paper is to study an example of such realistically complex interactive settings in order to gain additional insights into the economic consequences of fair value accounting.

In our analysis, the outside stakeholders who affect the firm's wealth are customers who place orders for the single good that the firm produces. Customers ordering decisions depend partially upon assessments of the firm's wealth because the ability of the firm to service the future needs of customers could become limited if the firm became financially weak. The firm's wealth is affected not just by the decisions that customers make, but also by an asset allocation decision that is made by the firm's

managers at a date earlier to the date on which customer orders are placed. This asset allocation decision consists of allocating capital between a risk free asset and a risky asset whose expected return is larger than the risk free rate of return. The firm is risk averse. Investment in the risky asset increases the firm's expected wealth, but also increases the risk that the firm must bear. Fair value accounting for the risky asset provides incremental decision facilitating information about the firm's wealth to its customers.

The results we obtain are striking and quite contrary to popular belief. We find that, while the information provided by fair value accounting is uncertainty decreasing from the perspective of the firm's outside stakeholders, it is uncertainty increasing from the perspective of corporate managers. The more precise is the information provided by fair value accounting, the *greater* becomes the volatility of the firm's income and wealth due to variations in customer orders. This increased volatility is not cosmetic in the sense of being a mere *reporting* phenomenon. The volatility in real income goes up. Corporate managers respond to this situation by decreasing the firm's investment in the risky asset thus additionally altering the distribution of the firm's wealth. Thus, in our setting, the wealth distribution that is being assessed by outside stakeholders is itself affected by the information that is being provided to facilitate this assessment. We find that the net result of these actions and interactions is that fair value accounting makes the firm (i.e. its shareholders) unambiguously worse off. The firm's customers are better off only in a *sequential* sense, i.e. at the time they need to make their decisions they would exhibit a positive demand for fair value accounting and the more precise is the information provided by fair value accounting the more they would benefit. But, we find that *in equilibrium*, taking into account the actions and reactions of both the manager and the outside stakeholders, these outside stakeholders could actually

become worse off, especially if the information provided by fair value accounting is *too precise*.

Our results cast doubt on the desirability of fair value accounting. Plantin, Sapra and Shin (2008) and Allen and Carletti (2007) have also raised concerns about fair value accounting and have identified some of its negative consequences. However, in this previous research the concerns originate from a lack of liquidity in the market for the firm's assets, thus creating measurement problems. Our analysis is free from measurement and liquidity issues and questions the very *principle* on which fair value accounting is based.

2. The Economic Setting

We assume customers are atomistic, so no single customer by herself can impact the wealth of the firm. Specifically, there is a continuum of customers, uniformly distributed over the unit interval. Let:

q_i = order placed by customer i .

$$Q = \int_0^1 q_i di = \text{the aggregate of customer orders.}$$

There are 3 dates, 0, 1 and 2, with date 2 being the terminal date. The firm begins at date 0 with an endowment of m units of a riskless asset. One unit of the riskless asset held until the terminal date produces one unit of wealth at the terminal date. However, the firm has the opportunity to convert some or all of its endowment into a risky illiquid asset whose expected return at date 2 is greater than that of the riskless asset. Let z be the amount that the firm chooses to invest in the risky asset at date 0 and let $z\tilde{\theta}$ be the return at date 2. *Ex post*, at date 2, the wealth of the firm is:

$$w = m - z + z\theta + Q \quad (1)$$

Thus, the firm's wealth depends partly upon a decision made by the firm's inside manager and partly upon the aggregate of decisions made by a continuum of outside stakeholders (customers).

Customers place orders with the firm at date 1. We assume that the payoff to a customer for ordering from our incumbent firm depends partly upon the financial strength of the firm and partly upon a commonly known industry wide technological parameter η that describes how well the characteristics of the good produced by the firm match the needs of its customers. Customers are less willing to place orders with the incumbent firm if they perceive the firm as being financially weak. Let $A = \tau\eta + (1 - \tau)w$, where $0 < (1 - \tau) < 1$ describes the relative extent to which customers are affected by the financial strength of the firm that supplies them². The ex post payoff to a customer who places an order of size q_i is:

$$u_i = Aq_i - \frac{1}{2}q_i^2 \quad (2)$$

where $\frac{1}{2}q_i^2$ is the known cost of using the good in whatever manner the customer uses it.

Before the customers place their orders at date 1, the accounting system provides a fair value estimate of the value of the risky asset in which the firm has invested, and this estimate is incrementally informative about the terminal wealth of the firm. The fair value estimate is public information. We assume that this public information would not exist under historical cost accounting. Customers use the fair

² The model of customers used here is a variation on the model in Angeletos and Pavan (2004).

value estimate along with any other information, public or private, that is available to them to assess the firm's wealth before choosing their orders.

3. Customers' Ordering Decisions

Let $E_i(\tilde{A})$ be customer i 's expectation of $\tilde{A}$ conditional on the information she receives at date 1. Then, the order placed by customer i is the unique solution to:

$$\text{Max}_{q_i} E_i(\tilde{A})q_i - \frac{1}{2} q_i^2 \quad (3)$$

The first order condition to (3) yields:

$$q_i = \tau\eta + (1-\tau)(m-z) + (1-\tau)zE_i(\tilde{\theta}) + (1-\tau)E_i(\tilde{Q}) \quad (4)$$

Since the random variable $\tilde{\theta}$ is a state of Nature, expectations of $\tilde{\theta}$ are defined by Bayes' Theorem, but expectations about the aggregate order $\tilde{Q}$ is a much more complex object. These latter expectations depend upon what each customer expects other customers to do, and therefore on each customer's belief of the beliefs of other customers. We show below that $\tilde{Q}$ and $E_i(\tilde{Q})$ can be calculated iteratively, and are described by an infinite hierarchy of higher order beliefs of $\tilde{\theta}$.

Since $Q = \int_0^1 q_i di$, it follows from the first order condition (4) that:

$$Q = \tau\eta + (1-\tau)(m-z) + (1-\tau)z \int_0^1 E_i(\theta) di + (1-\tau) \int_0^1 E_i(Q) di \quad (5)$$

I refer to $E_i(\theta)$ as the first order belief of customer i , and $\int_0^1 E_i(\theta) di$ as the average first

order belief about θ in the population of customers. No customer knows what this

average belief is, but each customer can form a belief of this average belief which I

denote by $E_i \int_0^1 E_j(\theta) dj$. From (5),

$$E_i(Q) = \tau\eta + (1-\tau)(m-z) + (1-\tau)zE_i \int_0^1 E_j(\theta) dj + (1-\tau)E_i \int_0^1 E_j(Q) dj \quad (6)$$

In (6) the expression $E_i \int_0^1 E_j(Q) dj$ is *conceptually* well defined since it is customer i 's

belief of the average belief of Q in the customer population, but we don't yet know how to calculate it. Inserting (6) into the customer's first order condition yields:

$$q_i = \tau\eta + (1-\tau)(m-z) + (1-\tau)zE_i(\theta) + (1-\tau)\tau\eta + (1-\tau)^2(m-z) + (1-\tau)^2zE_i \int_0^1 E_j(\theta) dj + (1-\tau)^2E_i \int_0^1 E_j(Q) dj \quad (7)$$

Integrating the expression in (7) over the customer population yields:

$$Q = \tau\eta + (1-\tau)(m-z) + (1-\tau)z \int_0^1 E_i(\theta) di + (1-\tau)\tau\eta + (1-\tau)^2(m-z) + (1-\tau)^2z \int_0^1 \int_0^1 E_i \int_0^1 E_j(\theta) dj di + (1-\tau)^2 \int_0^1 E_i \int_0^1 E_j(Q) dj di \quad (8)$$

In (8) the expression $\int E_i \int E_j(\theta) dj di$ is the average expectation of the average expectation of θ in the customer population. We refer to it as the average second order expectation of θ . Now, (8) can be used to obtain an updated calculation of $E_i(Q)$ and this updated expression for $E_i(Q)$ can be inserted into the customer's first order

condition (4) to yield an updated expression for q_i . Integrating this updated expression for q_i yields the following updated expression for the aggregate order quantity Q .

$$\begin{aligned}
Q = & \tau\eta + (1-\tau)\tau\eta + (1-\tau)^2\tau\eta + (1-\tau)(m-z) + (1-\tau)^2(m-z) + (1-\tau)^3(m-z) + \\
& (1-\tau)z \int_0^1 E_i(\theta) di + (1-\tau)^2 z \int_0^1 E_i \int_0^1 E_j(\theta) dj di + \\
& (1-\tau)^3 z \int_0^1 E_i \int_0^1 E_k \int_0^1 E_j(\theta) dj dk di + (1-\tau)^3 \int_0^1 E_i \int_0^1 E_k \int_0^1 E_j(Q) dj dk di
\end{aligned} \tag{9}$$

Comparing (5), (8), and (9) it is clear that repeated iteration yields:

$$\begin{aligned}
Q = & \tau\eta[1 + (1-\tau) + (1-\tau)^2 + \dots] + \\
& (1-\tau)(m-z)[1 + (1-\tau) + (1-\tau)^2 + \dots] + \\
& (1-\tau)z[\theta^{(1)} + (1-\tau)\theta^{(2)} + (1-\tau)^2\theta^{(3)} + \dots]
\end{aligned} \tag{10}$$

where, $\theta^{(t)}$ denotes the average t th. order expectation of θ . Since $0 < (1-\tau) < 1$, each of the infinite series contained in (10) is convergent and well defined. Carrying out the summation yields the final expression:

$$Q = \frac{\tau\eta + (1-\tau)(m-z)}{\tau} + (1-\tau)z \sum_{t=0}^{\infty} (1-\tau)^t \theta^{(t+1)} \tag{11}$$

Notice in (11) the undefined expectations of Q have vanished and have been replaced by well defined higher order expectations of θ .

We assume that the information structure in the economy is as follows. The commonly known prior distribution of $\tilde{\theta}$ is Normal with mean μ and variance $\frac{1}{\alpha}$. Equivalently, $\tilde{\theta} = \mu + \tilde{\xi}$, $\tilde{\xi} \sim N(0, \frac{1}{\alpha})$. We assume $\mu > 1$ so that investment in the risky asset is *a priori* desirable. Both historical cost accounting and fair value accounting reveal the amount z of investment in the risky asset but, at date 1, fair value accounting provides an additional signal that is not provided by historical cost accounting. Fair value accounting provides an estimate of the date 1 value of the risky asset. Conceptually, such an estimate is equivalent to providing a noisy signal of the final return $\tilde{\theta}$ on the risky asset. Therefore, we model fair value accounting as providing the unbiased public signal:

$$\tilde{y} = \theta + \tilde{\varepsilon}, \quad \tilde{\varepsilon} \sim N(0, \frac{1}{\beta})$$

Higher values of β represent more precise measurement of fair values, and the lowest value of β , i.e. $\beta = 0$ is equivalent to historical cost accounting. Additionally, we assume that customers receive noisy idiosyncratic *private* signals of $\tilde{\theta}$:

$$x_i = \theta + \tilde{\omega}_i, \quad \tilde{\omega}_i \sim N(0, \frac{1}{\gamma})$$

An economy where fair value accounting is the only source of information about the value of the risky asset at date 1 is obtained by setting $\gamma = 0$, so the inclusion of private signals is without loss of generality. The existence of private signals captures the realistic idea that in the absence of a public source of information, individual customers will have entirely idiosyncratic beliefs of the return to the risky asset. We assume that all of the noise terms, $\tilde{\xi}$, $\tilde{\varepsilon}$, and $\tilde{\omega}_i$ are independent of each other and independent of $\tilde{\theta}$.

We now proceed to derive the aggregate order quantity Q for the specific information structure described above. The first order belief of customer i is:

$$E_i(\tilde{\theta}) = \frac{\alpha\mu + \beta y + \gamma x_i}{\alpha + \beta + \gamma} \quad (12)$$

It is convenient to rewrite the above expression in a different way. Let

$$\delta \equiv \frac{\gamma}{\alpha + \beta + \gamma}, \text{ and}$$

$$P \equiv \frac{\alpha\mu + \beta y}{\alpha + \beta}$$

Then (12) is equivalent to:

$$E_i(\tilde{\theta}) = \delta x_i + (1 - \delta)P, \quad (13)$$

where P can be thought of as the public information in the economy and x_i as the private information of customer i . Then, the average first order belief of $\tilde{\theta}$ is:

$$\theta^{(1)} \equiv \int E_i(\theta) di = \int (\delta x_i + (1 - \delta)P) di = \delta \theta + (1 - \delta)P,$$

from which it follows that i 's belief of the average first order belief is:

$$\begin{aligned} E_i \int E_j(\theta) dj &= \delta E_i(\theta) + (1 - \delta)P \\ &= \delta [\delta x_i + (1 - \delta)P] + (1 - \delta)P \\ &= \delta^2 x_i + (1 - \delta^2)P \end{aligned}$$

Therefore the average second order belief of θ is:

$$\theta^{(2)} = \int E_i \int E_j(\theta) dj di = \delta^2 \theta + (1 - \delta^2) P$$

Iterating in this way gives the average t th. order expectation of θ :

$$\theta^{(t)} = \delta^t \theta + (1 - \delta^t) P \quad (14)$$

Notice that the weight on the fundamental θ decreases and the weight on the public signal P increases in every successive iteration. This implies that the fundamentals will get underweighted and the public signal will get over-weighted in the determination of the aggregate outsider response Q . This is a well known result in settings with higher order beliefs (see Morris and Shin (2002), and Angeletos and Pavan (2004)). I will show that in the specific context of fair value accounting, what this implies is that the error contained in the accounting estimate of the fair value of the risky asset, will have a disproportionate influence on how outsiders respond to the firm's asset allocation decision z .

Insert (14) into the general expression for Q derived in (11) to obtain the value of Q specific to the information structure under consideration. Also, from this expression for Q the values of $E_i(Q)$ and the value of q_i can be calculated. This yields:

Proposition 1:

In a fair value accounting regime, the equilibrium response of the firm's customers to the firm's asset allocation decision z is:

$$q_i = \frac{1}{\tau} \left\{ \tau\eta + (1-\tau)(m-z) + (1-\tau)z \left[\left(\frac{\tau\delta}{1-(1-\tau)\delta} \right) x_i + \left(1 - \frac{\tau\delta}{1-(1-\tau)\delta} \right) P \right] \right\} \quad (15)$$

and,

$$Q = \frac{1}{\tau} \left\{ \tau\eta + (1-\tau)(m-z) + (1-\tau)z \left[\left(\frac{\tau\delta}{1-(1-\tau)\delta} \right) \theta + \left(1 - \frac{\tau\delta}{1-(1-\tau)\delta} \right) P \right] \right\} \quad (16)$$

Proof: See the Appendix.

Because $\left(\frac{\tau}{1-(1-\tau)\delta} \right) < 1, \forall \delta > 0$ and $\tau < 1$, the equilibrium weight on

x_i in (15) and on θ in (16) is strictly less than δ , which is the weight that would be used in Bayesian updating. This implies that, because of the need to assess the beliefs of others, each individual customer under-weights his private information about θ and over-weights the public information in deciding how much to order from the firm. In turn, this results in the equilibrium aggregate order quantity Q becoming less sensitive to fluctuations in the fundamentals θ and overfly sensitive to the public information provided by fair value accounting. The effect of this distortion on social welfare will be developed in a later section.

4. The Firm's Asset Allocation Decision:

We now turn to the firm's decision problem at date 0. The firm makes decisions to affect its date 2 wealth distribution. As specified earlier, the firm's terminal wealth is $w = m - z + z\theta + Q$. We assume the firm is risk averse with constant absolute risk aversion $\rho > 0$. If $\tilde{w}$ is distributed Normal, the firm's objective function is:

$$\text{Max}_z \left\{ E(\tilde{w}) - \frac{1}{2} \rho \text{Var}(\tilde{w}) \right\} \quad (17)$$

Now, the firm's wealth is strongly affected by customer orders, and since customer orders are sensitive to assessments of the firm's wealth, the firm must be mindful of how its investment z in the risky asset affects the size of the aggregate order Q from its customers. From the perspective of date 0, $\tilde{Q}$, as determined in (16), is a Normally distributed random variable since it depends linearly on the Normally distributed return $\tilde{\theta}$ as well as on the Normally distributed fair value report $\tilde{y}$ that is released later at date 1.

Using the facts that $E(\tilde{\theta}) = E(\tilde{P}) = \mu$, we obtain from (16):

$$E(\tilde{Q}) = \frac{\tau\eta + (1-\tau)[m + z(\mu-1)]}{\tau} \quad (18)$$

and,

$$E(\tilde{w}) = \frac{\tau\eta + m + z(\mu-1)}{\tau} \quad (19)$$

The effect of the firm's risky asset investment on its expected wealth is twofold. There is a direct effect and an indirect effect. Since $\mu > 1$, the direct effect is that the

expected return on the firm's investment is larger resulting in larger expected wealth. The indirect effect operates through the firm's customers. When customers perceive the firm as being more financially sound, (higher expected wealth), they are more willing to buy from the firm, so the aggregate order quantity Q is strictly increasing in z . This additionally augments the expected wealth of the firm.

We turn now to the uncertainty in the firm's wealth caused by investment in the risky asset.

$$\text{var}(\tilde{w}) = z^2 \text{var}(\tilde{\theta}) + \text{var}(\tilde{Q}) + 2z \text{cov}(\tilde{\theta}, \tilde{Q}) \quad (20)$$

The first term in (20) describes the direct effect of investment in the risky asset. The second and third terms capture the indirect effects caused by customer responses to the firm's wealth adjustment decisions. We assess the variance of the firm's wealth term by term. Hereafter,

$$\text{we use } \lambda \equiv \frac{\tau\delta}{1-(1-\tau)\delta}.$$

$$\text{var}(\tilde{\theta}) = \text{var}(\tilde{\xi}) = \frac{1}{\alpha}$$

From (16):

$$\begin{aligned} \text{var}(\tilde{Q}) &= \left(\frac{1-\tau}{\tau} \right)^2 z^2 \text{var}[\lambda \tilde{\theta} + (1-\lambda) \tilde{P}] \\ &= \left(\frac{1-\tau}{\tau} \right)^2 z^2 [\lambda^2 \text{var}(\tilde{\theta}) + (1-\lambda)^2 \text{var}(\tilde{P}) + 2\lambda(1-\lambda) \text{cov}(\tilde{\theta}, \tilde{P})] \end{aligned} \quad (21)$$

where,

$$\begin{aligned}\text{var}(\tilde{P}) &= \left(\frac{\beta}{\alpha + \beta} \right)^2 \text{var}(\tilde{y}) \\ &= \left(\frac{\beta}{\alpha + \beta} \right)^2 \left(\frac{1}{\alpha} + \frac{1}{\beta} \right) = \left(\frac{\beta}{\alpha + \beta} \right) \frac{1}{\alpha}\end{aligned}$$

and,

$$\begin{aligned}\text{cov}(\tilde{\theta}, \tilde{P}) &= \text{cov}\left(\tilde{\theta}, \left(\frac{\beta}{\alpha + \beta} \right) \tilde{y}\right) \\ &= \left(\frac{\beta}{\alpha + \beta} \right) \text{var}(\tilde{\theta}) = \left(\frac{\beta}{\alpha + \beta} \right) \frac{1}{\alpha}\end{aligned}$$

Inserting these last two calculations into (21) gives:

$$\text{var}(\tilde{Q}) = \left(\frac{1-\tau}{\tau} \right)^2 z^2 \frac{1}{\alpha} \left[\lambda^2 + (1-\lambda)^2 \left(\frac{\beta}{\alpha + \beta} \right) + 2\lambda(1-\lambda) \left(\frac{\beta}{\alpha + \beta} \right) \right]$$

which simplifies to:

$$\text{var}(\tilde{Q}) = \left(\frac{1-\tau}{\tau} \right)^2 z^2 \frac{1}{\alpha} \left[\lambda^2 + (1-\lambda^2) \left(\frac{\beta}{\alpha + \beta} \right) \right] \quad (22)$$

Taking into account that the coefficient λ also depends on β we show that the above expression is strictly increasing in β , providing an important new insight:

Lemma 1:

Increases in the precision of information provided by fair value accounting increases the uncertainty in the size of the aggregate order placed with the firm.

Proof: See the Appendix.

The result in Lemma1 is a special case of a quite general phenomenon. Information provided to a decision maker allows her to vary her decision to better fit the circumstances that exist at the time. But, from an *ex ante* perspective, such variability in the decision makes the world look more uncertain. The more precise is the information provided to the decision maker the greater will be the variability in the decision and the more uncertainty about the decision there will be from an *ex ante* perspective. A decision maker's action is *ex ante* most predictable if no new information can possibly arrive prior to making that decision. In the context of our model, no information arrival (public or private) prior to the decisions made by customers, is equivalent to $\beta = \gamma = 0$. But in this case,

$$\delta \equiv \frac{\gamma}{\alpha + \beta + \gamma} = 0, \text{ implying that } \lambda \equiv \frac{\tau\delta}{1 - (1 - \tau)\delta} = 0. \text{ Then, it is immediate from (22)}$$

that $\text{var}(\tilde{Q}) \rightarrow 0$ as $(\beta, \gamma) \rightarrow 0$.

The remaining term in the calculation of $\text{var}(\tilde{w})$ as specified in (20), is:

$$\begin{aligned} \text{cov}(\tilde{\theta}, \tilde{Q}) &= \text{cov}\left(\tilde{\theta}, \left(\frac{1-\tau}{\tau}\right)z(\lambda\theta + (1-\lambda)\tilde{P})\right) \\ &= \left(\frac{1-\tau}{\tau}\right)z[\lambda \text{var}(\tilde{\theta}) + (1-\lambda)\text{cov}(\tilde{\theta}, \tilde{P})] \\ &= \left(\frac{1-\tau}{\tau}\right)\frac{1}{\alpha}z\left[\lambda + (1-\lambda)\left(\frac{\beta}{\alpha + \beta}\right)\right] \end{aligned} \quad (23)$$

which is also strictly increasing in β .

Inserting (22) and (23) into (20) gives:

$$\begin{aligned} \text{var}(\tilde{w}) = & z^2 \frac{1}{\alpha} + z^2 \frac{1}{\alpha} \left(\frac{1-\tau}{\tau} \right)^2 \left[\lambda^2 + (1-\lambda^2) \frac{\beta}{\alpha + \beta} \right] + \\ & 2z^2 \frac{1}{\alpha} \left(\frac{1-\tau}{\tau} \right) \left[\lambda + (1-\lambda) \frac{\beta}{\alpha + \beta} \right] \end{aligned} \quad (24)$$

Proposition 2:

Keeping fixed the firm's investment in the risky asset, the more precise is the fair value information provided to outside stakeholders to assist in assessing the firm's wealth the more uncertain the wealth of the firm becomes from an ex ante perspective.

Proof: See the Appendix.

Proposition 2 is shocking! It is also a stark example of how misleading the conclusions from a study of accounting disclosure could be when those conclusions are derived from models that *assume* an exogenous distribution for the variable of interest. In such studies information *always* reduces uncertainty, since statistically a conditional variance is smaller than an unconditional variance. This kind of theorizing has lead to frequent claims by both academics and practitioners that higher “quality” accounting, or more precise disclosures, must decrease a firm's cost of capital. In our study too, if the wealth of the firm is an exogenously given random variable then information about wealth can only decrease the uncertainty in wealth. But such a scenario is an over-simplification of the real world. Realistically, a firm's wealth depends not just upon the state of Nature, but also on decisions made by both insiders and outsiders. If the disclosure of information alters the decisions of outsiders and if these decisions affect the distribution of the firm's wealth then it is not necessarily true that information is uncertainty reducing even on an *ex post* basis.

We can now characterize the firm's investment in the risky asset, made at date 0. Inserting (19) and (24) into the firm's objective function, as described in (17), and differentiating with respect to z gives the first order condition:

$$z = \frac{\mu - 1}{\tau \rho \frac{1}{\alpha} \left[1 + \left(\frac{1 - \tau}{\tau} \right)^2 \left(\lambda^2 + (1 - \lambda^2) \frac{\beta}{\alpha + \beta} \right) + 2 \left(\frac{1 - \tau}{\tau} \right) \left(\lambda + (1 - \lambda) \frac{\beta}{\alpha + \beta} \right) \right]} \quad (25)$$

How does the firm's investment in the risky asset vary with the precision of the asset's fair value information provided at date 1? From (25) it is clear that the effect of β on z is through the two factors $\lambda^2 + (1 - \lambda^2) \left(\frac{\beta}{\alpha + \beta} \right)$ and $\lambda + (1 - \lambda) \left(\frac{\beta}{\alpha + \beta} \right)$ contained in the denominator of (25). In the proofs of Lemma 1 and Proposition 2, we established that both factors are strictly increasing in β . Therefore, the denominator in (25) is strictly increasing in β , implying that $\frac{\partial z}{\partial \beta} < 0$. We have established:

Proposition 3

Increasing the precision of the fair value signal provided to outside stakeholders causes the firm's investment in the risky asset to decline.

The result described in Proposition 3 is an immediate consequence of the fact (established in Lemma 1) that greater precision in the information provided by fair value accounting increases the sensitivity of the customers decisions' to the information, thus increasing the ex ante variance in customer decisions. But because of customer concerns about the financial strength of the firm the sensitivity of customer decisions to new

information about the return to the risky asset depends also upon how much the firm has invested in the risky asset. The firm decreases its holdings of risky assets in order to decrease the uncertainty in customer orders.

5. Welfare Analysis

Having characterized the equilibrium decisions of both insiders and outsiders, we now turn to the main question of interest: In equilibrium, who benefits from fair value accounting? If the welfare of both parties (the firm and its customers) is uniformly declining in β , then fair value accounting unambiguously decreases social welfare. If the equilibrium payoff to the firm is declining in β , but the welfare of the firm's customers is increasing in β then there is a conflict of interest, and so on.

We answer the above questions in two settings. First, we examine social welfare when the only source of information is the public information provided by fair value accounting, i.e. if the private signal that we have modeled is suppressed. Next, we examine the setting in which there is both public and private information. The two settings are qualitatively different because of agents' needs to form beliefs of other agents' beliefs. In settings with only public information, all higher order beliefs are identical to first order beliefs. Therefore the overweighting of public information phenomenon cannot arise. However, when there is both public and private information, higher order beliefs are different from first order beliefs. In this case, public information is over-weighted and private information is underweighted relative to their information content thus causing the error in public information to exert undue influence on the aggregate decisions of outside stakeholders.

Only Public Information:

A setting with only public information is equivalent to making the precision of private information $\gamma = 0$. When $\gamma = 0$, $\delta \equiv \frac{\gamma}{\alpha + \beta + \gamma} = 0$, and $\lambda \equiv \frac{\tau\delta}{1 - (1 - \tau)\delta} = 0$.

We use these facts to derive the aggregate quantities of interest in the setting with only public information. From (15) and (16),

$$q_i = Q = \frac{1}{\tau} \left(\tau\eta + (1 - \tau)(m - z) + (1 - \tau)z \left[\frac{\alpha\mu + \beta y}{\alpha + \beta} \right] \right), \quad \forall i \quad (26)$$

The firm's expected wealth, conditional on z , remains unchanged from that described in (19).

However, inserting $\lambda = 0$ into (24), the variance of the firm's wealth becomes:

$$\text{var}(\tilde{w}) = z^2 \frac{1}{\alpha} \left[1 + \left(\frac{1 - \tau}{\tau} \right)^2 \left(\frac{\beta}{\alpha + \beta} \right) + 2 \left(\frac{1 - \tau}{\tau} \right) \left(\frac{\beta}{\alpha + \beta} \right) \right]$$

or equivalently, after simplification:

$$\text{var}(\tilde{w}) = z^2 \frac{1}{\alpha} \left[1 + \left(\frac{1 - \tau^2}{\tau^2} \right) \left(\frac{\beta}{\alpha + \beta} \right) \right] \quad (27)$$

Since the factor $\left(\frac{\beta}{\alpha + \beta} \right)$ is strictly increasing in β , Proposition 2 remains unchanged, i.e.

greater precision in the fair value signal increases the uncertainty in the firm's wealth.

The equilibrium value of the firm's investment in the risky asset is obtained by substituting $\lambda = 0$ into (25). This gives:

$$z = \frac{\mu - 1}{\tau \rho \frac{1}{\alpha} \left[1 + \left(\frac{1 - \tau}{\tau} \right)^2 \left(\frac{\beta}{\alpha + \beta} \right) + 2 \left(\frac{1 - \tau}{\tau} \right) \left(\frac{\beta}{\alpha + \beta} \right) \right]}$$

or equivalently, after simplification:

$$z = \frac{\mu - 1}{\tau \rho \frac{1}{\alpha} \left[1 + \left(\frac{1 - \tau^2}{\tau^2} \right) \left(\frac{\beta}{\alpha + \beta} \right) \right]} \quad (28)$$

From inspection of (28) it is obvious that the result described in Proposition 3 remains unchanged, i.e. the firm's equilibrium investment in the risky asset is strictly declining in the precision of the fair value signal.

We first consider the effect of fair value accounting on the firm. The firm's welfare is simply the maximized value of its objective function: $E(\tilde{w}) - \frac{1}{2} \rho \text{var}(\tilde{w})$. Inserting the equilibrium value of z , as described in (28) into (19) and (27) gives:

$$E(\tilde{w}) = \frac{\tau \eta + m}{\tau} + \frac{(\mu - 1)^2}{\tau^2 \rho \frac{1}{\alpha} \left[1 + \left(\frac{1 - \tau^2}{\tau^2} \right) \left(\frac{\beta}{\alpha + \beta} \right) \right]} \quad (29)$$

$$\text{var}(\tilde{w}) = \frac{(\mu - 1)^2}{\tau^2 \rho^2 \frac{1}{\alpha} \left[1 + \left(\frac{1 - \tau^2}{\tau^2} \right) \left(\frac{\beta}{\alpha + \beta} \right) \right]} \quad (30)$$

Therefore, in equilibrium, the firm's welfare is described by:

$$E(\tilde{w}) - \frac{1}{2}\rho \text{var}(\tilde{w}) = \frac{\tau\eta + m}{\tau} + \frac{1}{2} \frac{(\mu - 1)^2}{\tau^2 \rho \frac{1}{\alpha} \left[1 + \left(\frac{1 - \tau^2}{\tau^2} \right) \left(\frac{\beta}{\alpha + \beta} \right) \right]} \quad (31)$$

yielding,

Proposition 4

In equilibrium, the firm's welfare is strictly decreasing in the precision of the fair value signal.

Proposition 4 implies that, given a choice, firms would strictly prefer historical cost to fair value accounting. This result is consistent with the actual lobbying behavior of firms. The argument that was commonly used to lobby against fair value accounting was that marking-to-market would increase the volatility of the firm's reported income. This line of argument was dismissed by the FASB who argued that mark-to-market does not make reality, it only mirrors reality. The firm's *true* income is volatile to begin with and mark-to-market would simply make this volatility more transparent to its stakeholders, whereas the recording of assets at historical cost obscures this true volatility. Our analysis indicates that FASB's argument has merit only when the actions taken by a firm's stakeholders in response to accounting information has no impact at all on the wealth of the firm. We feel that such an assumption is inconsistent with reality. In the presence of *real effects*, fair value accounting does cause increased volatility in the firm's *true income*, not just its *reported* income, and this increased volatility does have negative economic consequences.

Now, consider the effect of fair value accounting on the social welfare of the firm's customers. We define the *ex post* social welfare Ω of the customer population as the aggregation of payoffs for individual customers, i.e.,

$$\Omega \equiv \int u_i di = A \int q_i di - \frac{1}{2} \int q_i^2 di$$

But, since in the absence of private information, $q_i = Q, \forall i$,

$$\Omega = AQ - \frac{1}{2} Q^2$$

Inserting $A = \tau\eta + (1-\tau)w$, gives:

$$\begin{aligned} \Omega(\theta, Q, z) &= [\tau\eta + (1-\tau)(m-z+z\theta+Q)]Q - \frac{1}{2} Q^2 \\ &= [\tau\eta + (1-\tau)(m-z+z\theta)]Q - \frac{1}{2} (2\tau-1)Q^2 \end{aligned} \quad (32)$$

We assume throughout our analysis that $\tau > \frac{1}{2}$, i.e. the financial strength of the supplier is of lesser concern to customers than the goodness of fit parameter η . The mathematical effect of $\tau > \frac{1}{2}$ is that *ex post* social welfare becomes a strictly concave function of Q thus ensuring that there is an *ex post* socially optimal value for the aggregate order quantity Q that is placed by the firm's customers.

Substituting the equilibrium value of Q , as described in (26), into (32) gives:

$$\begin{aligned}\Omega(\theta, y, z) = & \frac{1}{\tau} [\tau\eta + (1-\tau)(m-z) + (1-\tau)z\theta] * \\ & \left[\tau\eta + (1-\tau)(m-z) + (1-\tau)z \left(\frac{\alpha\mu + \beta y}{\alpha + \beta} \right) \right] - \\ & \frac{1}{2} (2\alpha - 1) \left[\tau\eta + (1-\tau)(m-z) + (1-\tau)z \left(\frac{\alpha\mu + \beta y}{\alpha + \beta} \right) \right]^2\end{aligned}$$

Customer welfare is measured by the *ex ante* quantity $E_{y,\theta}\{\Omega\}$. We first calculate this *ex ante* welfare for exogenously fixed values of z and then replace z by its equilibrium value to find the equilibrium welfare of the customer population.

Proposition 5

$$\begin{aligned}E_{y,\theta}\{\Omega(\theta, y; z)\} = & \frac{1}{2\tau^2} [\tau\eta + (1-\tau)m + (1-\tau)z(\mu-1)]^2 \\ & + \frac{(1-\tau)^2 z^2}{2\tau^2} \left(\frac{\beta}{\alpha + \beta} \right) \frac{1}{\alpha}\end{aligned}\tag{33}$$

If the amount z of the firm's risky investment is held fixed, customer welfare is strictly increasing in the precision of the information provided by fair value accounting.

Proof: See the Appendix.

The first term in (33) is the expected welfare of customers when no information is provided at all (i.e. in a historical cost regime), and the second term is the gain in customer expected welfare from providing fair value information with precision β . Clearly, the more precise is the information provided by fair value accounting the greater is the expected welfare of customers. The reason why customers gain from the information being provided is that they can better fit their ordering decisions to the actual wealth of the firm. This, of

course, is the standard reasoning underlying Blackwell's theorem, and it is the usual argument given in support of fair value accounting. The argument is valid if the wealth of the firm is an exogenous random variable. Since each customer takes the aggregate order Q that is contained in the firm's wealth as given, holding z fixed is tantamount to treating the firm's wealth as an exogenous random variable.

But, given that $\mu > 1$, customer welfare is also strictly increasing in z as can be seen from visual inspection of (33). In Proposition 3 we established that the amount z that the firm invests in the risky asset actually *declines* with the precision of the fair value signal. So the welfare result described in Proposition 5, while true in a partial equilibrium sense, may no longer be true when the decline in z is taken into account. An increase in the precision of the fair value signal results in two *opposing* forces. Better decisions increase customer welfare, but lower investment in the risky asset decreases customer welfare. Whether or not customers are better off, in equilibrium, depends on which of these two effects dominate. Below, we investigate the net effect on customer welfare.

Inserting the equilibrium value of z , as described in (28) into (33) gives:

$$E(\Omega) = \frac{1}{2\tau^2} \left[\tau\eta + (1-\tau)m + \frac{(1-\tau)(\mu-1)^2}{\tau\rho \frac{1}{\alpha} \left[1 + \left(\frac{1-\tau^2}{\tau^2} \right) \left(\frac{\beta}{\alpha+\beta} \right) \right]} \right]^2$$

$$+ \frac{(1-\tau)^2}{2\tau^2} (\mu-1)^2 \frac{\frac{1}{\alpha} \left(\frac{\beta}{\alpha+\beta} \right)}{\tau^2 \rho^2 \frac{1}{\alpha^2} \left[1 + \left(\frac{1-\tau^2}{\tau^2} \right) \left(\frac{\beta}{\alpha+\beta} \right) \right]^2}$$

The first expression above is unambiguously decreasing in β . How the second expression varies with respect to β depends upon the values of τ and α . In order to obtain insights into how customer welfare varies with the precision of the fair value signal, we develop necessary and sufficient conditions under which the second expression is also decreasing in β . Let:

$$L(\beta) \equiv \frac{\frac{1}{\alpha^2} \left[1 + \left(\frac{1-\tau^2}{\tau^2} \right) \left(\frac{\beta}{\alpha+\beta} \right) \right]^2}{\frac{1}{\alpha} \left(\frac{\beta}{\alpha+\beta} \right)}$$

If $L(\beta)$ is increasing in β then customer welfare is strictly decreasing in the precision of the fair value signal. If $L(\beta)$ is decreasing in β then the effect of the precision of information on customer welfare is ambiguous. Simplifying the expression for $L(\beta)$ gives:

$$L(\beta) = \frac{1}{\alpha} \left(\frac{\alpha+\beta}{\beta} \right) + \frac{2}{\alpha} \left(\frac{1-\tau^2}{\tau^2} \right) + \left(\frac{1-\tau^2}{\tau^2} \right)^2 \frac{1}{\alpha} \left(\frac{\beta}{\alpha+\beta} \right)$$

Differentiating gives:

$$\frac{\partial L}{\partial \beta} = -\frac{1}{\beta^2} + \left(\frac{1-\tau^2}{\tau^2} \right)^2 \frac{1}{(\alpha+\beta)^2}$$

Therefore,

$$\frac{\partial L}{\partial \beta} > 0 \text{ if and only if } \frac{1-\tau^2}{\tau^2} > \frac{\alpha+\beta}{\beta}$$

or, equivalently $\frac{\partial L}{\partial \beta} > 0$ if and only if :

$$\frac{\alpha}{\beta} < \frac{1}{\tau^2} - 2 \quad (34)$$

The quantity $\frac{1}{\tau^2} - 2$ must be positive for (34) to be satisfied, i.e. $\tau < 0.707$ is necessary

for $\frac{\partial L}{\partial \beta} > 0$. Recall that $(1 - \tau)$ is the weight that customers put on the firm's wealth in

assessing the marginal value of placing their orders with the incumbent firm. So (34) indicates that if the weight that the customers put on the firm's wealth is at least 30% then there is an *upper bound* to the precision of the information beyond which fair value accounting is guaranteed to decrease customer welfare. Additionally, (34) yields the following very non-intuitive result:

Proposition 6:

From the perspective of customers, the greater is the relevance of firm wealth to customer decisions (i.e. the greater is the value of $(1 - \tau)$) the less precise should be the information provided by fair value accounting.

Proposition 6 would make no sense at all if the wealth maximizing decisions of corporate managers were completely independent of the actions of the firm's outside stakeholders. It begins to make sense only if we take into account that greater precision in the information provided by fair value accounting induces greater variability in the actions of outside stakeholders, which induces the firm to become more cautious in its investment strategy which, in turn, damages the interests of the firm's outside stakeholders.

Welfare Analysis with Both Public and Private Information:

Authors' note: This section is currently under development.

6. Concluding Remarks

The results that we have obtained contradict popular wisdom to such an extent that it behoves us to ask why outside stakeholders did not lobby against the move to fair value accounting, and why they seem to demand even more precision in fair value estimates. These empirical facts look less mysterious if one takes into account the sequential nature of decisions made by corporate management and outside stakeholders. At the time that outside stakeholders need to make their choices, the actions of corporate managers are sunk, so to these outside stakeholders the firm's wealth *feels* very much like an exogenous random variable. Sequential rationality dictates that they will demand the most accurate information possible about the firm's wealth so that they can minimize the probability of their own decision errors. This fact is fully reflected in Proposition 4.

It is tempting for regulators to adopt the sequentially rational perspective of firms' outside stakeholders. Yet the larger wisdom that should prevail should be based on the *equilibrium* payoffs to the affected parties. In the equilibrium that we have described, and also (we think) in the real world, many of the actions taken by corporate managers are significantly influenced by the anticipation of future actions by outside stakeholders and, in turn, these outside stakeholders are affected by the earlier decisions made by corporate managers. In such an interactive world, our results cast doubt about the wisdom of mandating fair value accounting.

Appendix

Proof of Proposition 1:

First, we calculate the value of Q from (11). From (14) it follows that:

$$\begin{aligned}
 \sum_{t=0}^{\infty} (1-\tau)^t \theta^{(t+1)} &= \sum_{t=0}^{\infty} (1-\tau)^t [\delta^{t+1} \theta + (1-\delta^{t+1})P] \\
 &= \delta \theta \left[\sum_{t=0}^{\infty} (1-\tau)^t \delta^t \right] + P \sum_{t=0}^{\infty} (1-\tau)^t - \delta P \left[\sum_{t=0}^{\infty} (1-\tau)^t \delta^t \right] \\
 &= \frac{\delta \theta}{1-(1-\tau)\delta} + \frac{P}{\tau} - \frac{\delta P}{1-(1-\tau)\delta} \\
 &= \frac{1}{\tau} \left[\left(\frac{\tau \delta}{1-(1-\tau)\delta} \right) \theta + \left(1 - \frac{\tau \delta}{1-(1-\tau)\delta} \right) P \right]
 \end{aligned}$$

Inserting this expression into (11) yields the expression described in (16).

Now, from (16) it follows that:

$$E_i(Q) = \frac{1}{\tau} \left\{ \tau \eta + (1-\tau)(m-z) + (1-\tau)z \left[\left(\frac{\tau \delta}{1-(1-\tau)\delta} \right) E_i(\theta) + \left(1 - \frac{\tau \delta}{1-(1-\tau)\delta} \right) P \right] \right\} \quad (A1)$$

Substituting (A1) into (4) and using $E_i(\theta) = \delta x_i + (1-\delta)P$ gives:

$$\begin{aligned}
 q_i &= [\tau \eta + (1-\tau)(m-z)] \left[1 + \left(\frac{1-\tau}{\tau} \right) \right] + (1-\tau)z [\delta x_i + (1-\delta)P] + \\
 &\quad (1-\tau)z \left(\frac{1-\tau}{\tau} \right) \left[\left(\frac{\tau \delta}{1-(1-\tau)\delta} \right) \{\delta x_i + (1-\delta)P\} + \left(1 - \frac{\tau \delta}{1-(1-\tau)\delta} \right) P \right] \quad (A2)
 \end{aligned}$$

Collect the terms in (A2) that depend on x_i and the terms that depend on P . The term

that depends on x_i is:

$$(1-\tau)z\delta x_i \left[1 + \left(\frac{1-\tau}{\tau} \right) \left(\frac{\tau\delta}{1-(1-\tau)\delta} \right) \right] = \frac{(1-\tau)z\delta x_i}{1-(1-\tau)\delta}$$

which is convenient to write as:

$$= \left(\frac{1-\tau}{\tau} \right) \left(\frac{\tau\delta}{1-(1-\tau)\delta} \right) z x_i \quad (\text{A3})$$

Also in (A2) the terms that depend on P are:

$$\begin{aligned} & (1-\tau)zP \left[(1-\delta) \left\{ 1 + \left(\frac{1-\tau}{\tau} \right) \left(\frac{\tau\delta}{1-(1-\tau)\delta} \right) \right\} + \left(\frac{1-\tau}{\tau} \right) \left(1 - \frac{\tau\delta}{1-(1-\tau)\delta} \right) \right] \\ &= (1-\tau)zP \left[\left(\frac{1-\delta}{1-(1-\tau)\delta} \right) + \left(\frac{1-\tau}{\tau} \right) \left(\frac{1-\delta}{1-(1-\tau)\delta} \right) \right] \\ &= \left(\frac{1-\tau}{\tau} \right) \left(\frac{1-\delta}{1-(1-\tau)\delta} \right) zP \\ &= \left(\frac{1-\tau}{\tau} \right) \left(1 - \frac{\tau\delta}{1-(1-\tau)\delta} \right) zP \quad (\text{A4}) \end{aligned}$$

Inserting (A3) and (A4) into (A2) and simplifying gives:

$$q_i = \frac{1}{\tau} \left\{ \tau\eta + (1-\tau)(m-z) + (1-\tau)z \left[\left(\frac{\tau\delta}{1-(1-\tau)\delta} \right) x_i + \left(1 - \frac{\tau\delta}{1-(1-\tau)\delta} \right) P \right] \right\}$$

as claimed in Proposition 1.

Proof of Lemma 1:

The $\text{var}(\tilde{Q})$ is strictly increasing in β if the factor $\lambda^2 + (1 - \lambda^2) \left(\frac{\beta}{\alpha + \beta} \right)$ is strictly

increasing in β . Using $\lambda \equiv \frac{\tau\delta}{1 - (1 - \tau)\delta}$ and $\delta \equiv \frac{\gamma}{\alpha + \beta + \gamma}$ gives $\lambda = \frac{\tau\gamma}{\alpha + \beta + \tau\gamma}$.

Therefore the factor:

$$\begin{aligned} \lambda^2 + (1 - \lambda^2) \left(\frac{\beta}{\alpha + \beta} \right) &= \left(\frac{\tau\gamma}{\alpha + \beta + \tau\gamma} \right)^2 + \left(1 - \frac{\tau^2\gamma^2}{(\alpha + \beta + \tau\gamma)^2} \right) \left(\frac{\beta}{\alpha + \beta} \right) \\ &= \frac{1}{(\alpha + \beta + \tau\gamma)^2} \left[\tau^2\gamma^2 + [(\alpha + \beta + \tau\gamma)^2 - \tau^2\gamma^2] \left(\frac{\beta}{\alpha + \beta} \right) \right] \\ &= \frac{\tau^2\gamma^2 + \beta(\alpha + \beta) + 2\beta\tau\gamma}{(\alpha + \beta + \tau\gamma)^2} \end{aligned}$$

Therefore,

$$\begin{aligned} \text{sign} \frac{\partial}{\partial \beta} \left\{ \lambda^2 + (1 - \lambda^2) \left(\frac{\beta}{\alpha + \beta} \right) \right\} &= \\ \text{sign} \left\{ (\alpha + \beta + \tau\gamma)^2 (\alpha + 2\beta + 2\tau\gamma) - 2(\alpha + \beta + \tau\gamma) (\tau^2\gamma^2 + \beta(\alpha + \beta) + 2\beta\tau\gamma) \right\} &= \\ \text{sign} \left\{ (\alpha + \beta + \tau\gamma) [\alpha(\alpha + \beta + \tau\gamma) + 2\beta(\alpha + \beta) + 2\beta\tau\gamma + \right. & \\ \left. 2\tau\gamma(\alpha + \beta) + 2\tau^2\gamma^2 - 2\tau^2\gamma^2 - 2\beta(\alpha + \beta) - 4\beta\tau\gamma] \right\} &= \\ \text{sign} \left\{ (\alpha + \beta + \tau\gamma) [\alpha(\alpha + \beta + \tau\gamma) + 2\alpha\tau\gamma] \right\} &> 0 \end{aligned}$$

Q.E.D.

Proof of Proposition 2:

We have previously argued that from the perspective of date 0,

$var(\tilde{w}) = z^2 var(\tilde{\theta}) + var(\tilde{Q}) + 2z cov(\tilde{\theta}, \tilde{Q})$. In Proposition 2 we are holding z fixed

and $var(\tilde{\theta})$ is a prior variance that is unaffected by the precision of accounting

disclosure. We have shown in Lemma 1 that $var(\tilde{Q})$ is strictly increasing in the

precision of public disclosure. Therefore, it suffices to establish that $cov(\tilde{\theta}, \tilde{Q})$ is also

strictly increasing in the precision of public disclosure. But, from (20), $cov(\tilde{\theta}, \tilde{Q})$ is

strictly increasing in β if the factor $\lambda + (1 - \lambda) \left(\frac{\beta}{\alpha + \beta} \right)$ is strictly increasing in β .

Inserting $\lambda = \frac{\tau\gamma}{\alpha + \beta + \tau\gamma}$ gives,

$$\begin{aligned} \lambda + (1 - \lambda) \left(\frac{\beta}{\alpha + \beta} \right) &= \frac{\tau\gamma}{\alpha + \beta + \tau\gamma} + \left(1 - \frac{\tau\gamma}{\alpha + \beta + \tau\gamma} \right) \left(\frac{\beta}{\alpha + \beta} \right) \\ &= \frac{\beta + \tau\gamma}{\alpha + \beta + \tau\gamma} \end{aligned}$$

which is strictly increasing in β .

Q.E.D.

Proof of Proposition 5

Substituting $\frac{\alpha\mu + \beta y}{\alpha + \beta} = \frac{\alpha\mu + \beta(\mu + \xi + \varepsilon)}{\alpha + \beta} = \mu + \left(\frac{\beta}{\alpha + \beta} \right) (\xi + \varepsilon)$ in (26), gives:

$$Q = \frac{1}{\tau} [\tau\eta + (1 - \tau)(m - z) + (1 - \tau)z\mu] + \frac{1}{\tau} [(1 - \tau)z \left(\frac{\beta}{\alpha + \beta} \right) (\xi + \varepsilon)]$$

Substituting this expression for Q into (32) and using $\theta = \mu + \xi$ gives:

$$\begin{aligned}\Omega(\xi, \varepsilon, z) = & \frac{1}{\tau} [\tau\eta + (1-\tau)(m-z) + (1-\tau)z\mu]^2 + \\ & \frac{1}{\tau} [\tau\eta + (1-\tau)(m-z) + (1-\tau)z\mu] \left[(1-\tau)z \left(\frac{\beta}{\alpha + \beta} \right) (\xi + \varepsilon) + (1-\tau)z\xi \right] + \\ & \frac{1}{\tau} (1-\tau)^2 z^2 \left(\frac{\beta}{\alpha + \beta} \right) \xi (\xi + \varepsilon) - \frac{1}{2} (2\tau - 1) Q^2\end{aligned}$$

Therefore,

$$\begin{aligned}E_{y,\theta} \{ \Omega(\theta, y; z) \} = E_{\xi,\varepsilon} \{ \Omega(\xi, \varepsilon; z) \} = \\ \frac{1}{\tau} (\tau\eta + (1-\tau)(m-z) + (1-\tau)z\mu)^2 + \\ \frac{1}{\tau} (1-\tau)^2 z^2 \left(\frac{\beta}{\alpha + \beta} \right) \frac{1}{\alpha} - \frac{1}{2} (2\tau - 1) E_{\xi,\varepsilon} (Q^2)\end{aligned} \tag{A5}$$

But,

$$\begin{aligned}E_{\xi,\varepsilon} (Q^2) = & \frac{1}{\tau^2} (\tau\eta + (1-\tau)(m-z) + (1-\tau)z\mu)^2 + \\ & \frac{1}{\tau^2} (1-\tau)^2 z^2 \left(\frac{\beta}{\alpha + \beta} \right)^2 \left(\frac{1}{\alpha} + \frac{1}{\beta} \right)\end{aligned}$$

Substituting this expression into (A5) gives,

$$\begin{aligned}E_{y,\theta} \{ \Omega(\theta, y; z) \} = & (\tau\eta + (1-\tau)(m-z) + (1-\tau)z\mu)^2 \left(\frac{1}{\tau} - \frac{2\tau-1}{2\tau^2} \right) \\ & + \frac{1}{\tau} (1-\tau)^2 z^2 \left(\frac{\beta}{\alpha + \beta} \right) \frac{1}{\alpha} - \left(\frac{2\tau-1}{2\tau^2} \right) (1-\tau)^2 z^2 \left(\frac{\beta}{\alpha + \beta} \right) \frac{1}{\alpha}\end{aligned}$$

which implies:

$$\begin{aligned}
E_{y,\theta}\{\Omega(\theta, y; z)\} &= \frac{1}{2\tau^2}(\tau\eta + (1-\tau)(m-z) + (1-\tau)z\mu)^2 \\
&\quad + \frac{1}{2\tau^2}(1-\tau)^2 z^2 \left(\frac{\beta}{\alpha+\beta}\right) \frac{1}{\alpha}
\end{aligned}$$

which is strictly increasing in β .

Q.E.D.

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