A Real Effects Perspective to Accounting Measurement and Disclosure:
Implications and Insights for Future Research

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1. Introduction

The accounting literature on real effects postulates that how we measure and report firms’ business transactions to financial markets will significantly alter firms’ business strategies. Firms could become myopic in their investment strategies, forego prudent risk management, alter their loan portfolios, change how they obtain financing, and so on. Such a perspective stands in strong contrast to the popular belief that accounting provides information on an objective reality that is independent of accounting measurements and disclosure. The presence of real effects has far reaching implications for standard setting and for future accounting research. If how accountants measure and disclose a firm’s economic transactions changes those transactions, then it may no longer be true that any disclosure that is incrementally informative to the capital market improves resource allocation. It cannot be presumed that greater price efficiency translates into greater economic efficiency. We must evaluate accounting standards differently: Providing useful information to investors is an insufficient guide to standard setting because the real effects that could be triggered need to be taken into account. The research implication is that it is insufficient and perhaps misleading to merely look for price effects of new disclosure requirements or to examine whether correlations between accounting numbers and security returns are improved. We believe the focus should shift to the identification and empirical detection of real effects. Understanding what these real effects are, and how they come about, provides important new insights into how to identify and test for the economic consequences of alternative accounting standards and disclosure mandates.

In the accounting literature, it is commonplace to think of the link from financial markets to corporate decisions in terms of a firm’s cost of capital. Accounting measurements matter because “higher quality” accounting, and greater, more precise, or more transparent disclosures reduce a firm’s cost of capital. Such reductions in cost of capital occur because public information reduces the assessed uncertainty in a firm’s cash flows and reduces the adverse selection in capital markets that is caused by information asymmetry among traders (e.g.
Diamond and Verrecchia [1991], Leuz and Verrecchia [2000], Lambert, Leuz and Verrecchia [2007]). But, cost of capital cannot be directly measured, and studies that rely on proxies such as the expected rate of return predicted by the Capital Asset Pricing Model (CAPM), bid-ask spreads and trading volume provide only generic insights into the effect of accounting information. Although useful, they do little to resolve debates about the specific measurement and reporting issues that accounting regulators grapple with, such as: What is the appropriate accounting treatment of hedges and other executory transactions; should intangible investments be measured and capitalized; should the loan portfolios of financial institutions be fair valued, etc. There is no theory that relates cost of capital to alternative accounting treatments of such specific transactions.

There are two other perspectives on how financial markets affect corporate decisions. One view stresses the information transmission properties of market prices resulting in feedback effects from financial markets to the real economy (See Bond, Edmans and Goldstein (BEG) [2012] for a comprehensive survey of this literature, and Dye and Sridhar [2002]). In this view, individual investors and speculators in the market discover information that is relevant to the firm’s decisions and trade on that information. The information signals received by individual traders gets aggregated and impounded in equilibrium security prices in the process of trading. Thus, equilibrium security prices become a statistic of all the relevant information that is dispersed among private individuals. Corporate managers extract information from prices and use that information to guide the firm’s decisions. BEG argue that even though each individual speculator may be less informed than the firm’s manager, speculators collectively may be better informed. Additionally, there is much information external to the firm such as the state of the economy, product demand, etc. that is relevant to the firm’s decisions, but which may be better known collectively by outsiders than by the firm’s manager. Although there is merit and empirical support for this perspective (see the citations in BEG), this feedback role of financial markets does not identify a need for accounting disclosure.
The other perspective, that is more relevant to accounting, and therefore commonly used in the accounting literature, is that there is much firm specific information that is either consciously collected and analyzed by managers or is learned by managers from daily conduct of the firm’s internal operations and decisions; information that individual investors cannot directly access.² This kind of information asymmetry between internal managers and investors in the capital market is what gives rise to the need for accounting measurement and disclosure to outsiders. We think that most, if not all, FASB standards of measurement and disclosure are concerned with this kind of information, and in this paper we will focus exclusively on it.

How does the measurement and disclosure of information that is already known to corporate managers affect the decisions that these managers make on behalf of the firm? In Section 3, we provide a detailed illustration of how this happens in a simple specific setting. A general answer to this question was first formalized in Kanodia [1980] who showed how corporate decisions and capital market valuations are simultaneously affected, in dynamic general equilibrium, by the information in the capital market. Subsequently, Myers and Majluf [1984] and Stein [1989] also studied settings where the market’s information affects corporate decisions. None of these studies rely on cost of capital effects. Instead, market valuations are derived more directly as market clearing prices with information used to update investors’ beliefs about the future cash flows of the firm. The Kanodia [1980] general framework can be specialized to study the real effects of very specific accounting measurements and disclosure mandates. Recent studies have done so by constructing and analyzing precisely specified settings in which the corporate decisions that could be affected by the accounting measurements under study are explicitly modeled and allowed to interact with capital market pricing.

In this paper, we synthesize the methodology of real effects studies and illustrate the kind of insights and findings that are obtained from the consideration of very specific accounting measurements. Our intent is not that of providing a comprehensive survey of the literature on

² See Dye [1985, 1986], Verrecchia [1983].
real effects, but rather on distilling a unifying framework and identifying leads that could stimulate additional work in the future. Accordingly, we focus the paper on three broad accounting policy issues that have been difficult to resolve and remain controversial in the practitioner and academic community. In each case we elaborate on the new insights provided by a real effects perspective, insights that have hitherto been missing from policy debates. The three broad issues are:

i. Why is it important to separate a firm’s investment from its operating expenditures? What are the real effects of noise in such measurements? Is there a relevance-reliability tradeoff that should be considered in determining whether investment in intangible assets should be measured?

ii. Could marking-to-market the loan portfolios of financial institutions trigger pro-cyclical real effects?

iii. How does measurement and disclosure of firms’ derivative transactions affect firms’ choice of intrinsic risk exposures, risk management strategy, and the incentive to speculate?

In the absence of empirical data, the credibility of results obtained in an analytical study depends upon the intuition of readers that important features that are salient to the phenomena being studied are captured in the model. Therefore, it is useful to construct a unifying framework that underlies real effects studies and identify some of the more important assumptions that occur repeatedly in the models that have been used. We construct such a framework below and argue why these common assumptions are realistic and essential to study the real effects of accounting

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3 Kanodia [2006] provides a more comprehensive and detailed survey.
measurements. We contrast our framework to models of disclosure in pure exchange settings, where most of the literature is currently focused.

2. A Unifying Framework for the Study of Real Effects

Prior to the advent of modern capital markets, most group businesses were constituted to engage in specific ventures of short duration. At the end of the business venture, the proceeds from the business were distributed to the participants in the form of liquidating dividends. Such dividends constituted the returns to ownership. The main purpose of accounting was record keeping. Accurate records of assets, obligations, and cash flows helped to insure that the resources of the firm were not misappropriated by those who were actively engaged in the management of the venture. This role of accounting came to be known as the stewardship role. The stewardship role was subsequently enlarged to include reports that were useful in assessing managerial performance, specifying debt covenants, and making contingent payments.

With the advent of modern capital markets these joint ventures of limited duration and scope were replaced by publicly traded firms with indefinite duration and scope. Rather than paying out periodic or terminal dividends, firms retained most of their profits to finance new investment and growth. The owners of firms were no longer a well identified stable group of shareholders as a shifting and faceless crowd in the capital market could, and did, move readily in and out of ownership in the firm by buying and selling their shares in liquid capital markets. The paradigm of a firm’s shareholders providing capital to the firm and holding their ownership shares until the firm liquidates became obsolete. The economic benefits produced by the firm were no longer distributed to the firm’s owners via periodic or liquidating dividends. These benefits were transferred to owners via the pricing of the firm in the capital market. The time path of security prices determined the rewards to ownership. In the face of this radical shift, the principal role of accounting changed from that of stewardship to financial reporting to capital markets.
However, it is misleading to study financial reporting to capital markets in pure exchange economies where corporate activities and decisions are suppressed. In such an exchange economy, financial reports are necessarily viewed as providing information on exogenously specified true distributions of future prices or terminal payoffs. The effect of such information is merely to move prices, generate trading volume and reduce information asymmetry between less informed and more informed traders. Since for any given distribution of terminal payoffs the Capital Asset Pricing Model (CAPM), predicts the expected rate of return that determines a securities current price, it is believed that the effect of disclosure can be captured entirely in terms of the CAPM required rate of return. A lower required rate of return is then interpreted as a reduction in the firm’s cost of capital. Changes in cost of capital are proxied by changes in firms’ systematic risk (the beta coefficient in CAPM), bid-ask spreads and trading volume. Even though corporate decisions are not explicitly modeled, it is assumed that reductions in cost of capital can only improve corporate decisions. This view of the world has led to the belief that more information is always preferred to less and that price efficiency is synonymous with economic efficiency.

In the real effects paradigm, that we wish to portray, we should think of periodic releases of accounting information as affecting the evolution of the firm’s value over time where values are determined by trades among investors and speculators in the capital market who hold the firm only for short periods of time. The firm is not a passive entity to such valuation. The evolution of value over time is accompanied by the evolution of corporate decisions over time. Valuation and corporate decisions are intertwined because when shareholders derive their payoffs from the evolving time path of security prices, firm’s must necessarily be concerned with how their decisions are perceived and priced over time in the capital market. This represents a fundamental shift in how information affects corporate decisions. In a world where a firm’s

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owners contribute capital to the firm in exchange for ownership claims and simply hold these claims long enough to get their rewards by way of terminal dividends, the firm’s decisions are governed solely by the information possessed by its manager. Benevolent managers would evaluate alternative actions by assessing the risks and expected values of terminal cash flows associated with each action. That assessment would be based solely on the information the managers possess. The better is the manager’s information the better would be the decisions made on behalf of the firm’s shareholders and the higher would be the expected payoff to shareholders. But, when the time path of security prices determines the rewards to ownership, the same benevolent manager’s decisions must necessarily be affected by the information in the capital market. The price response at any given date to any decision that the firm makes and to any economic event depends only upon what traders in the market observe and upon the inferences they make, and not upon what managers know. In this sense, it is the market’s information, no matter how determined, that is the key factor affecting the firm’s decisions.\footnote{See Brandenburger and Polak [1996] for a complete model of this type.} This is not to say that managers cannot influence the information that is in the capital market, nor do we claim that there is no role for managerial judgment and managerial assessments of future events. The real effects, that we study, arise from the interaction between what managers know and what markets infer from accounting measurements and disclosure.

To get a sense of this interaction, consider the following setting. Suppose that some decision $d \in D$ that a manager needs to make on behalf of a publicly traded firm will affect the firm’s cash flows over three periods into the future. Call these future cash flows $\bar{x}_1$, $\bar{x}_2$, and $\bar{x}_3$. Assume the manager makes his decision at date zero and there are no later decisions to be made. Let $Y^f$ describe the information available to the manager at the time she chooses the decision on behalf of the firm. The firm is priced $P_1$ in the capital market at date 1 after realization and observation of the first period cash flow and $P_2$ at date 2 after realization and observation of the
first and second period cash flows. Let $Y_1^m$ and $Y_2^m$ be the information in the capital market at
dates 1 and 2. The information set $Y_1^m$ includes the first period cash flow and any knowledge of
the decision that the manager made at date zero, and the information set $Y_2^m$ includes $Y_1^m$ and
any additional information that arrives in the capital market between periods one and two. Now,
suppose that the firm’s objective function is to choose $d \in D$ to maximize a weighted average of
the expected period 1 and period 2 capital market prices, i.e.
\[
\text{Max } \alpha E(\tilde{P}_1 | Y^f) + (1-\alpha)E(\tilde{P}_2 | Y^f)
\]
for some $\alpha \in (0,1)$.

Assuming risk neutral pricing and assuming that the firm does not pay interim dividends,
the equilibrium price in the capital market at date 1 will be: $P_1 = x_1 + E(\tilde{x}_2 + \tilde{x}_3 | Y_1^m)$, and the
date 2 capital market price is $P_2 = x_1 + x_2 + E(\tilde{x}_3 | Y_2^m)$. These prices do not depend upon what
the manager knows and do not depend upon whether individual traders intend to hold the firm for
only one period or until the terminal date. The information available in the capital market at dates
1 and 2 is all that matters to the pricing of the firm at these two dates. Now, suppose that all of
the information available to the firm’s manager is also available to traders in the capital market,
i.e. $Y_2^m \supset Y_1^m \supset Y^f$. Then by the law of iterated expectations,
\[
E[E(\tilde{x}_2 + \tilde{x}_3 | Y_1^m) | Y^f] = E(\tilde{x}_2 + \tilde{x}_3 | Y^f)
\]
and
\[
E[E(\tilde{x}_3 | Y_2^m) | Y^f] = E(\tilde{x}_3 | Y^f).
\]
Therefore $E(\tilde{P}_1 | Y^f) = E(\tilde{P}_2 | Y^f)$
and the firm’s decision problem is equivalent to $\text{Max } E(\tilde{x}_1 + \tilde{x}_2 + \tilde{x}_3 | Y^f)$ for every value of $\alpha$.

Thus if everything the manager knows is also known to the capital market, the evolution of prices
in the capital market is irrelevant to the manager’s decisions and the weights assigned to each
price is also irrelevant. Maximizing a weighted average of prices is equivalent to maximizing
the expectation of terminal cash flows conditional on the information set of the manager at the
time the decision is made.
But, if some elements of the manager’s information is hidden from the capital market, i.e. if, in the Blackwell sense, the information set of the market $Y'^m_1$ is not finer than the information set of the manager $Y^f$, then the law of iterated expectations does not apply and

$$\alpha E(\tilde{P}_1 | Y^f) + (1 - \alpha)E(\tilde{P}_2 | Y^f) \neq E(\tilde{x}_1 + \tilde{x}_2 + \tilde{x}_3 | Y^f).$$

In this case the time path of market prices does matter and maximizing some weighted average of expected future prices is not equivalent to maximizing the expected terminal cash flow of the firm. The firm’s manager will need to assess the distribution of capital market prices at each future date conditional on each feasible decision. This assessment must depend upon what information arrives in the capital market at each date and how market prices respond to that information, as well as upon the information possessed by the firm’s manager. The decision made by the manager will depend in some complex way upon what the manager knows as well as on what the market observes and infers at each date. If the information that arrives in the market at future dates is even partially dependent on accounting measurements and reports, then accounting will have real effects on corporate decisions.

The assumption that accounting measurements inform stock prices is not without controversy in accounting. In the empirical literature in accounting it is often asserted that capital market prices are independent of accounting because the relevant information arrives in the market much earlier from alternative sources. For example, voluntary disclosures, earnings guidance, and forecasts provided by managers and financial analysts provide more timely and more forward looking information (See Ball and Shivakumar [2008], and Ball [2013]). The assertion rests on the empirical finding that the information contained in accounting statements is impounded in stock prices much earlier than the date on which these statements are formally released to the public. We do not dispute such empirical results, but we feel that the measurement rules that are mandated by FASB color all of the disclosures to the capital market regardless of who is actually doing the disclosing and regardless of when the information enters...
the market. For example, it is difficult to see how information about sales, manufacturing costs, marketing costs, profits, R&D expenditures, investment expenditures etc. can be provided by any source without relying on some systematic recording and aggregation process that operates in accordance with pre-specified and well understood measurement rules. Different measurement rules (and therefore different accounting standards) have different information content and will, therefore, differently affect the time path of security prices.

Managerial decisions are typically modeled as driven by incentive arrangements and compensation contracts. Yet, it is commonly assumed in the real effects literature that corporate decisions are driven by how prices in the capital market respond to those decisions. Managerial compensation contracts are not explicitly modeled and it is assumed that managers benevolently adopt whatever preferences shareholders have over the time path of security prices. This is not a fatal flaw because surely managerial compensation contracts will be structured in such a way that managers become focused on whatever price performance shareholders demand. So, ultimately it is the preferences of shareholders, not the preferences of managers that determine managerial actions.

3. Real Effects of Measuring a Firm’s Investment

3.1 A Canonical Model of How Measurement Noise Affects a Firm’s Investment.

The measurement and reporting of a firm’s periodic earnings is central to accounting, but the separation of investment expenditures from operating expenditures is essential to such measurement. Investment expenditures are recorded on the Balance Sheet as assets and expensed against future revenues, while operating expenses are believed to have “expired” and are matched with current revenues to determine a firm’s current period earnings. A firm’s investment cannot be directly observed by outsiders and, in practice, it is difficult to measure. What is readily observable to the accountant is the firm’s cash outflows, but how much of this outflow is investment and how much is operating expenditure is not obvious. The distinction between the
two requires difficult judgments of how the future will unfold. Thus accounting measurements of investment are inevitably noisy and contentious. Managers are much better informed than outsiders regarding a firm’s investment outlays, but their opinion cannot be readily accepted because managers are strongly tempted to disguise operating expenses as investments and so report both higher assets and higher earnings. In recognition of these facts, the measurement of various kinds of investment is governed by numerous accounting conventions and standards, but these standards do not perfectly fit the facts and usually require judgment in their application.

Understanding the real effects of measuring a firm’s investment provides rich insights into how accounting measurement and disclosure affect corporate decisions generally. Therefore we construct a somewhat detailed model of how measurement noise affects a firm’s choice of investment. The foundations of the model presented here is due to Stein [1989] and its augmentation in Kanodia and Mukherji [1996]. New insights are derived here that are not present in the earlier work.

Consider a three date model of a publicly traded firm that is choosing how much to invest. The firm chooses its investment at date zero and the uncertain returns to investment, in the form of operating profits, are realized at dates one and two. The firm’s accounting system produces a report at date one after the first period operating profit has been realized. Let \( \tilde{x}_1, \tilde{x}_2 \) be the operating profits at dates one and two that result from the investment. We assume that \( \text{cov}(\tilde{x}_1, \tilde{x}_2) > 0 \), so that knowledge of the first period’s operating profit is useful for predicting the next period’s operating profit. More specifically, \( \tilde{x}_1 \) is distributed Normal with mean \( \mu \) and precision \( \alpha \) and \( \tilde{x}_2 = g\tilde{x}_1 + \tilde{\omega} \) where \( \tilde{\omega} \) is independent of \( \tilde{x}_1 \) and distributed Normal with mean zero and precision \( \tau \), and \( g > 0 \) is a growth or persistence factor. Thus, from the perspective of...
date zero, $E(\tilde{x}_i) = \mu$, $E(\tilde{x}_2) = g\mu$ and $\text{cov}(\tilde{x}_1, \tilde{x}_2) = g\text{var}(\tilde{x}_1) = \frac{g}{\alpha} > 0$. We assume that these expected returns are strictly increasing in the scale of the investment project, so the firm effectively chooses $\mu$ by choosing how much to invest. Let $c(\mu)$ be the intended investment expenditure required to produce these expected returns. The actual investment expenditure of the firm deviates from the intended expenditure by a non-controllable random component so that the firm’s actual investment expenditure is $c(\mu) + \tilde{\gamma}$. We assume that $c(.)$ is increasing and strictly convex with $c'(0) = 0$ and $\tilde{\gamma}$ is distributed Normal with zero mean and precision $\delta$.

The firm’s realized net cash flow, at the end of the first period is:

$$z_i = x_i - c(\mu) - \gamma$$  \hspace{1cm} (3.1)

We assume that none of the variables that are typically measured by accounting systems, such as realized cash flows, operating profits, or investment expenditures is directly observed by outsiders in the capital market. Information about these quantities is provided by the firm’s accounting system. Since cash can be counted with perfect precision, we assume that the accounting system reports $z_i$ without error. However, as specified in (3.1), net cash flow confounds investment expenditures and operating profits. The accounting system measures the firm’s investment by trying to separate these two components but cannot do so perfectly. So measured investment, reported by the accounting system is:

$$K = c(\mu) + \gamma + \tilde{\epsilon},$$  \hspace{1cm} (3.2)

where $\tilde{\epsilon}$ is measurement error, independent of $\tilde{\gamma}$, and is distributed Normal with mean zero and precision $\beta$. The firm’s measured income in the first period is its cash flow adjusted for accruals. The only accrual here is the firm’s measured investment. Therefore, the firm’s income as measured by the accounting system is $y_1 = z_i + K$. Substituting from (3.1) and (3.2), yields:

$$y_1 = x_i - c(\mu) - \gamma + [c(\mu) + \gamma + \epsilon] = x_i + \tilde{\epsilon}$$  \hspace{1cm} (3.3)
The firm’s accounting system reports \( \{z_1, y_1, K\} \) at date 1.

What information is contained in the accounting report? Even though the accounting system seeks to measure and report the firm’s investment, the reported amount \( K \) cannot be used to make any Bayesian inference about the firm’s true investment. This is because the firm’s true investment \( c(\mu) \) is not a random variable and has no prior distribution\(^7\). The scale of investment implied by \( \mu \) is a choice variable for the firm and this fact, together with the structure of the firm’s decision problem, is common knowledge. Therefore, investors in the capital market will rationally conjecture \( \hat{\mu} \) from their understanding of the firm’s decision problem. Let \( \hat{\mu} \) be this conjectured value of \( \mu \). Given this conjecture, the capital market must perceive the firm’s reported cash flow \( z_1 \) as being generated by the equation:

\[
z_1 = x_1 - c(\hat{\mu}) - \gamma \tag{3.4}
\]

Thus the quantity \( z_1 + c(\hat{\mu}) \), where \( c(\hat{\mu}) \) is a known constant, is perceived as representing the quantity \( x_1 - \gamma \). This implies that the first period reported cash flow conveys information about the first period operating profit and because \( \text{cov}(z_1, x_1) = \text{var}(x_1) > 0 \) higher cash flow will be interpreted as good news.

The above analysis does not mean that imprecise measurements of investment are completely ignored. Measured investment feeds into the income report: \( y_1 = z_1 + K \). As shown in (3.3) the income report also conveys information about the first period operating profit of the firm and, given that \( \tilde{\gamma} \) and \( \tilde{e} \) are uncorrelated, the two reports contain information that is incremental to each other. The noise in measuring investment translates into noise in the income

\(^7\) In general, noisy measurements of endogenous choices contain no information about that choice. This subtle truism was first pointed out by Bebchuk and Stole (1993) and Bagwell (1995).
report. The less precise is the measurement of investment, the less informative is the firm’s income report.

The above description of the information contained in accounting measurements of net cash flow, investment, and income is quite general. Cash flow is free of accrual noise, so will acquire information content whenever accruals are noisy. Similarly, accruals acquire information content when cash flows are noisy and accruals filter out the noise in cash flows. This implies that both reports; cash flow and accounting income will be used to update investor assessments of firms’ future cash flows. This claim is consistent with the empirical findings in Bowen, Burgstahler and Daley [1987], Rayburn [1986], and Wilson [1986, 1987].

We now turn to the decision problem faced by the firm. As argued in Section 2, a firm’s objective function is determined by the preferences of its shareholders, not by the preferences of its manager. This being the case, we do not explicitly model managerial incentive contracts but simply assume that the manager is benevolent and does whatever shareholders would want her to do. We also assume that all agents in the economy are risk neutral and future cash flows are not discounted. Now, if the firm’s shareholders held the firm until liquidation (i.e. until the end of period two) the shareholders would want the manager to maximize the manager’s expectation of cumulative net cash flows:

\[
\max_{\mu} E_f [x_1 + x_2 - c(\mu) - \tilde{\gamma}]
\]  

(3.5)

where \( E_f (.) \) denotes the expectation conditional on the firm’s or its manager’s information.

Since the manager knows the precise \( \mu \) that she chooses, (3.5) is equivalent to:

\[
\max_{\mu} [\mu + g \mu - c(\mu)],
\]

which yields the first order condition:

\[
c'(\mu) = 1 + g
\]  

(3.6)

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8 Adding risk aversion and discounting produces no new insights into the phenomena we are seeking to study.
Equation (3.6) describes the firm’s first best level of investment. Notice that when shareholders hold the firm until the terminal date there is no role for accounting measurements and disclosure even though the shareholders are missing some information that the manager possesses. There is not even any reason for the market to price the firm. The economy functions perfectly well without accounting.\(^9\)

However, we argued in Section 2 that a model where the firm’s shareholders hold the firm till liquidation is unrealistic and the concept of liquidating dividends is obsolete. Firms continue their operations indefinitely and shareholders derive their return from the valuation of the firm in the capital market. We capture the spirit of these realistic features in our model by simply assuming that the firm’s current shareholders sell their holdings in the capital market at the end of period one after the release of accounting reports. The price in the capital market at date 1 depends upon the information in the market at that date and therefore upon the information contained in accounting measurements and reports. Given risk neutrality and the absence of discounting, in equilibrium this price must equal the observed cash accumulation in the firm at date 1 plus the conditional expectation of future cash flows:

\[
P(z_1, y_1) = z_1 + E(x_2 | z_1, y_1)
\]  

(3.7)

The objective function of a benevolent manager would then be:

\[
Max_{\mu} E_{\mu} [P(z_1, y_1)]
\]  

(3.8)

\(^9\) As indicated in the Framework described in Section 2, a role for accounting would emerge if there are conflicts between managers and shareholders thus creating a need for stewardship reports and contingent managerial compensation.
i.e., the manager would seek to maximize her expectation of the equilibrium price that will prevail in the capital market at the date that current shareholders liquidate their share holdings.

Now, $E(x_2 \mid z_1, y_1) = gE(x_1 \mid z_1, y_1)$, and from Bayes Theorem for Normally distributed random variables $E(x_1 \mid z_1, y_1)$ is a precision weighted average of the three estimates of $x_1$ that are available to the capital market, the prior conjectured mean $\hat{\mu}$, $z_1 + c(\hat{\mu})$, and $y_1$.

Specifically:

$$E(x_2 \mid z_1, y_1) = g \left( \frac{\alpha \hat{\mu} + \delta(z_1 + c(\hat{\mu})) + \beta y_1}{\alpha + \beta + \delta} \right)$$  \hspace{1cm} (3.9)

Inserting (3.9) into (3.7) yields the capital market’s pricing rule as a function of accounting reports:

$$P(z_1, y_1) = z_1 + \left( \frac{\delta g}{\alpha + \beta + \delta} \right) z_1 + \left( \frac{\beta g}{\alpha + \beta + \delta} \right) y_1 + \frac{\alpha g \hat{\mu} + \delta g c(\hat{\mu})}{\alpha + \beta + \delta}$$  \hspace{1cm} (3.10)

From the firm’s perspective $\hat{\mu}$ is a constant that it must accept as a given. The firm’s decisions affect its price in the capital market, but not the pricing rule, and the market’s conjecture $\hat{\mu}$ is a parameter in this pricing rule. Inserting (3.10) into (3.8) and eliminating constants over which the firm has no control, yields the objective function as perceived by the firm’s manager:

$$\text{Max}_{\mu} \ E_{f} \left[ z_1 + b_z z_1 + b_y y_1 \right]$$  \hspace{1cm} (3.11)

where, the coefficients $b_z$ and $b_y$ are pricing parameters defined by:
Remarkably, the firm’s objective function reduces to maximizing an expectation of a weighted sum of the date 1 accounting reports. But, this focus on accounting reports is not due to the functional fixation described by Ijiri, Jaedicke and Knight [1966] or the projected earnings fixation described by Verrecchia [2013]. The firm’s objective function is entirely consistent with Bayesian updating and rational inferences made by traders in the capital market. Using $E_f(z_1) = \mu - c(\mu)$ and $E_f(y_1) = \mu$ yields the first order condition that characterizes the equilibrium investment of the firm:

$$c'(\mu) = 1 + \frac{b_y}{1 + b_z}$$

(3.14)

Because everything in (3.14) is known by traders in the capital market, the market can correctly conjecture the firm’s equilibrium investment. Thus, if traders form their beliefs rationally the conjectured level of investment $c(\hat{\mu})$ that is used to price the firm will coincide with the firm’s true investment described by (3.14). Notice that, regardless of the precision with which the firm’s investment is measured, in equilibrium, the firm is always priced consistent with its fundamentals. It is not the case that accounting information makes markets more efficient. The effect of accounting measurement is to change the firm’s fundamentals. The equilibrium price in the capital market adjusts to fit the new fundamentals. Additionally, price efficiency and economic efficiency are not synonymous. Even when market prices are efficient in the sense that

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

(3.12)

$$b_y \equiv \frac{\beta g}{\alpha + \beta + \delta}$$

(3.13)
they reflect the true fundamentals of the firm, the firm underinvests. This can be seen by comparing (3.14) to (3.6) and from the fact that:

$$\frac{b_y}{1+b_z} = \frac{\beta g}{\alpha + \beta + \delta(1+g)} < g$$

Let us examine how the precision of accounting reports affects the equilibrium investment of the firm. The optimality condition (3.14) indicates that the firm’s investment strictly increases in the weight \(b_y\) on the income report and strictly decreases in the weight \(b_z\) on the cash flow report. Thus, market inferences based on a firm’s earnings report have a beneficial effect on the firm’s investment while market inferences based on a firm’s net cash flow detract from investment efficiency. The weight \(b_y\) on the earnings report is strictly increasing in the precision \(\beta\) with which the firm’s investment is measured as can be seen from (3.13), and the weight \(b_z\) on the cash flow report is strictly decreasing in \(\beta\) as can be seen from (3.12). So, the more precise is the measurement of investment the closer is the firm’s investment to first best. It is interesting to examine two extremes, one where there is no attempt at all to separate investment from operating expenditures and the second where the separation is perfect. The former case is described by \(\beta = 0\) and the latter case is equivalent to \(\beta = \infty\). When \(\beta = 0\) it can be seen from (3.13) that \(b_y = 0\), in which case (3.14) indicates that the firm’s equilibrium investment shrinks to the level described by \(c'(\mu) = 1\). This implies that the non-measurement of investment results in extreme myopia in the sense that investment is determined solely by its effect on short term returns and all effects of investment on future cash flows are ignored. This explains why it is so important to separate a firm’s investment expenditures from its operating expenditures. The importance of this accounting procedure is not due to concerns about market

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efficiency, but due to the result that in the absence of such measurement, efficient market prices cannot sustain anything better than myopic investment policies.

At the other extreme, infinitely precise measurement of investment results in first best investment since:

$$\frac{b_y}{1+b_z} = \frac{\beta g}{\alpha + \beta + \delta(1+g)} \to g \text{ as } \beta \to \infty$$

When the firm’s investment is perfectly measured, the maximization of the expected short-term price in the capital market is equivalent to the maximization of the expected long-term accumulation of cash flows. Thus, the short-termism forced on the firm by short-term shareholders does nothing to detract from economic efficiency. But this happy result is not automatically true. It cannot be achieved without perfect accounting measurement.

The information content of the cash flow report strictly increases in $\delta$ which describes both the precision of cash flow and the degree of uncertainty in the firm’s capital expenditure. What happens when the uncertainty in the firm’s capital expenditure vanishes, so that $\delta$ becomes arbitrarily large. It can be seen from (3.13) and (3.12) that as $\delta \to \infty$, $b_y \to 0$ and (3.14) becomes $c'(\mu) = 1$. Once again there is extreme myopia. The reason for this strange behavior is that as the variance of $\hat{\gamma}$ vanishes, the market perceives the firm’s cash flows as $z_i = x_i - c(\mu)$, so the market believes it can perfectly infer the firm’s operating income from the firm’s reported cash flow. Given such a belief, the information content of any noisy measure of income vanishes causing $b_y = 0$. Since higher values of cash flow lead to the inference that the firm’s operating income is higher the firm reduces its investment to increase its reported cash flow. The firm is not penalized for such actions because its actual investment is unobservable and therefore, off equilibrium, the market’s belief $c(\hat{\mu})$ does not vary with the firm’s actual investment. At the
other extreme, as the uncertainty in cash flow becomes arbitrarily large (i.e., \( \text{var}(\hat{y}) \to \infty \)) the firm’s cash flow report becomes completely uninformative. So \( \delta \to 0 \) and \( b_z \to 0 \). The firm’s investment is then described by \( c'(\mu) = 1 + \frac{\beta g}{\alpha + \beta} \). Investment remains below first best as long as there is noise in the measurement of investment, even though the negative effect of cash flow information is no longer present.

3.2 Insights from the Noisy Measurement of Investment

The simple model of investment that we have studied provides a rich array of insights into accounting issues. We develop these insights below.

(i) **Price efficiency versus economic efficiency:**

If we think of signals as providing information about the state of Nature, then it is certainly true that more precise signals will enhance economic efficiency and result in decisions that are more consistent with the true state of Nature. The study of accounting information in exchange economies treats the firm as if it were a state of Nature. Such a perspective leads naturally to the view that information increases price efficiency in the sense that prices become more consistent with the true fundamentals of the firm. In turn, greater price efficiency results in greater economic efficiency because prices guide the allocation of capital in the economy. Such thinking would be correct if the firm’s fundamentals are independent of the information in the capital market.

However, our simple model of the firm’s investment decision indicates that the firm’s fundamentals are not independent of what investors in the capital market know. The more imprecise is the measurement and reporting of investment the lower is the firm’s investment. When investment is not measured at all, the firm invests in an extremely myopic fashion. *But, in all cases the price in the capital market is fully consistent with the equilibrium investment of the*
firm, so price efficiency is always attained. What suffers due to lack of information is the sustainability of the investment that should occur given the long-term prospects of the firm. Thus, economic efficiency is affected even though price efficiency is not. This is the central message in Stein [1989] and is also argued in Bond, et al [2012]. We should be studying economic efficiency rather than price efficiency and the two concepts are not equivalent.

(ii) Measures of the total information content of accounting reports are misleading:

The previous literature has only identified the empirical regularity that both cash flows and earnings are priced by the capital market without any insight into whether this is good or bad for economic efficiency. In fact, if we theorize about accounting in the context of a pure exchange economy, only the total information content of accounting reports matters; how much of the information is contained in cash flow and how much is contained in reported earnings is of no consequence. But, a real effects perspective indicates that the source of the information is highly relevant. When investors in the capital market condition their beliefs strongly on the cash flows produced by the firm, economic efficiency suffers. Because higher cash flows are rationally interpreted as good news, a relatively greater weight on cash flow incrementally penalizes any unobservable action that decreases cash flows in the short-term regardless of how beneficial that action may be in the long-term. Greater reliance on the earnings report promotes economic efficiency.

(iii) A new measure of accounting quality:

Our results provide a distinctly different perspective on the concept of accounting quality and its measurement, a perspective that is based on real effects. We have argued that it is the noise in accruals that gives cash flow its information content. Additionally, we have shown that greater weight on cash flow decreases economic efficiency. If accruals were noise free, observed cash flows would have no information content and prices in the capital market would sustain full
economic efficiency. Therefore, our results indicate that the observed relative weight on cash flow in regressions of stock price on cash flow and earnings can be used as a proxy for the quality of accounting. The higher the relative weight on cash flow, the lower is the quality of accounting. It would be interesting to empirically determine how this measure of accounting quality has varied over time and how it varies cross-sectionally across industries.

(iv) An important benefit to accrual accounting is that it deters corporate myopia:

Our analysis provides new insight into the rationale for accrual accounting. A well functioning system of accruals deters the corporate myopia that would otherwise be induced by short-term traders in the capital market. An accounting system without accruals is equivalent to merely reporting a firm’s cash flows. We have shown that such accounting induces extreme myopia. On the other hand, perfectly precise measurement of investment, and therefore a perfect accrual system, makes a focus on short-term prices equivalent to a focus on long-term cash flows and therefore eliminates the myopia.

The principle that guides the design of accruals is the matching of costs and benefits. Such matching does not require accounting reports to be forward looking in the sense of pulling future benefits into current period performance reports. Our analysis indicates that an appropriate deferral of cash expenditures achieves the same goal. When the reporting of costs is deferred to the periods in which the corresponding benefits are realized and recorded, those actions that produce greater value in the long-term do not look like inferior actions in the short-term, thus decreasing the incentive for myopic actions. Rogerson [1997] and Reichelstein [1997] study inter-temporal allocations of capital expenditures in order to align the incentives of managers with the preferences of shareholders and show that a depreciation schedule based on relative benefits provides robust incentives.

None of these insights hold in exchange economies where real effects are suppressed. FASB has consistently argued that accrual accounting provides a better measure of a firm’s
performance than a mere listing of cash inflows and outflows. But FASB has not indicated how this better performance measure provides better resource allocation or otherwise provides benefits to any agent in the economy. In empirical research “better performance measure” and “higher accounting quality” have been operationalized as better prediction of the firm’s future cash flows. A real effects perspective indicates that higher accounting quality not only leads to better prediction of firms’ future cash flows but also favorably alters those cash flows.

3.3 Should Investment in Intangibles be Measured?

A firm’s investment in intangible assets such as research and development, human capital, information technology, brand equity, etc. are currently not treated as assets and are not capitalized on the firm’s balance sheet. R&D expenditures are measured and line itemized in the earnings report, but all other kinds of intangible investments are unmeasured and remain commingled with operating expenditures. During the 1990’s there was much debate about the accounting treatment of intangible investments. Advocates for the measurement and capitalization of intangible investments argued that intangible assets are highly relevant to a firm’s value in the new economy and that such disclosures can only increase the amount of information in the capital market, thus enhancing price efficiency and improving resource allocation. The value relevance studies of Aboody and Lev [1988], Lev and Sougiannis [1996] and Healy, Myers and Howe [2002] seemed to support such claims. But, FASB opposed the capitalization of intangibles arguing that intangibles cannot be measured with sufficient precision and that attempts to do so would decrease the reliability of financial statements and open the door to earnings management.

FASB’s argument stems directly from the difficulty of separating operating expenditures from investment expenditures. Although FASB expresses its concerns solely in terms of the reliability of accounting numbers, we have shown in the investment model of section 3.1 that non-measurement is worse than noisy measurement, when real effects are taken into account.
This would suggest unambiguously that intangible investments should always be measured regardless of reliability concerns. Kanodia, Sapra and Venugopalan (KSV) [2004] showed that when the firm invests in both tangible and intangible investments and there is a need to measure and report each separately, there is actually a relevance-reliability tradeoff that determines whether intangibles should be measured or left commingled with operating expenses.\textsuperscript{10} The tradeoff depends upon an assumed complementarity between the two kinds of investment and the assumption that measurement of intangible assets is much noisier than the measurement of tangible assets. Both assumptions seem realistic.

KSV use a Cobb Douglas like production technology to capture the complementarity between tangible and intangible assets:

\[ Q = K^\alpha N^\beta, \quad \alpha > 0, \beta > 0, \alpha + \beta < 1 \]  \hspace{1cm} (3.15)

where \( Q \) is the firm’s aggregate capital stock, and \( K \) and \( N \) are its investments in tangible and intangible assets, respectively. Investments are made at date 0 and the returns to investment, \( \tilde{x}_1, \tilde{x}_2 \), occur at dates 1 and 2. KSV assume that the mean returns to investment are strictly increasing in the firm’s capital stock:

\[ E(\tilde{x}_1) = E(\tilde{x}_2) = Q\mu, \]

where \( \mu > 0 \) captures the known profitability of investment. Also \( \text{cov}(\tilde{x}_1, \tilde{x}_2) = \rho > 0 \), and the prior variance of \( \tilde{x}_1 = \sigma^2_x \). As in our canonical model of investment described in section 3.1, the actual expenditure on intangibles is \( N + \tilde{\gamma} \) where \( \tilde{\gamma} \) is a random non-controllable perturbation of intended investment and is distributed Normal with mean zero and variance \( \sigma^2_\gamma \) while the actual and intended expenditure on tangibles is \( K \).

\textsuperscript{10} Dye and Sridhar [2004] also study a relevance-reliability tradeoff, but the context and the nature of the tradeoff is quite different from that developed by us.
KSV contrast two accounting regimes, one where intangibles are not measured and are
left commingled with operating expenditures (the expensing regime) and the second where
intangibles are measured (the capitalization regime), but the measurement gives rise to several
kinds of noise. Additionally, both regimes measure and report the firm’s investment in tangible
assets, the firm’s net cash balance at date 1, and the firm’s earnings at date 1. When intangibles
are measured there are random classification errors between tangible and intangible assets and
also between intangible assets and operating expenditures. These sources of noise are absent
when intangibles are left commingled with operating expenses. The date 1 accounting reports
that are produced in the two regimes are.

Expensing regime:

\[ I^e_K = K \] measured tangible assets,
\[ z = \tilde{x}_1 - K - N - \tilde{y} \] measured cash balance, and
\[ y^e = z + I^e_K = \tilde{x}_1 - N - \tilde{y} \] measured earnings.

Capitalization regime:

\[ I^m_K = K + \tilde{\eta}, \] measured tangible assets,
\[ I^m_N = N + \tilde{y} - \tilde{\eta} + \tilde{\omega}, \] measured intangible assets,
\[ z = \tilde{x}_1 - K - N - \tilde{y}, \] measured cash balance, and
\[ y^m = z + I^m_K + I^m_N = \tilde{x}_1 + \tilde{\omega} \] measured earnings.

The random variables \( \tilde{y}, \tilde{\eta}, \) and \( \tilde{\omega} \) are independently distributed and Normal with zero means
and variances \( \sigma^2_y, \sigma^2_\eta \) and \( \sigma^2_\omega \) respectively. The random variable \( \tilde{\eta} \) represents classification
error between tangible and intangible assets while \( \tilde{\omega} \) represents classification error between

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intangible assets and operating expenditures. Notice that the misclassification between tangible and intangible assets is offsetting and so does not affect measured earnings, but the misclassification between intangible assets and operating expenditures lingers and introduces noise in the earnings report.

The key informational difference between the two regimes is as follows. The capitalization of intangibles results in strictly greater information about the firm’s first period operating profits because reported cash flow communicates $\tilde{x}_1 - \tilde{y}$ and reported earnings provide an additional conditionally independent signal $\tilde{x}_1 + \tilde{\omega}$. When intangible investments are expensed the latter signal is lost and the only information about the firm’s first period operating earnings is $\tilde{x}_1 - \tilde{y}$. However, in the capitalization regime information about the firm’s tangible investment is lost because of the presence of random misclassifications between tangible and intangible investments. As in our canonical model of investment, the objective function of the firm is to maximize the manager’s date zero expectation of the date one price that prevails in the capital market.

KSV establish that in both regimes the firm underinvests in both tangible and intangible assets, but for different reasons. The underinvestment in the capitalization regime is due to forces similar to that in our canonical model of investment with measurement noise. Since, in this regime, both cash flows and earnings are informative about future cash flows, the date 1 price in the capital market prices both variables. The weight on cash flow is a deterrent to both kinds of investment. In the expensing regime, there is no noise in the measurement of tangible investments, but because of the complementarity between tangible and intangible assets, the underinvestment in intangible assets drags down the investment in tangible assets also. In the capitalization regime, the two kinds of assets are combined in an efficient manner to produce the firm’s capital stock, but in the expensing regime the firm increases its reliance on tangible assets and decreases its reliance on intangible assets resulting in an inefficient mix of the two kinds of
The degree of underinvestment in the capitalization regime depends only on the measurement noise caused by misclassifications between intangible investments and operating expenditures, while the degree of underinvestment in the expensing regime depends only upon the technological parameters $\alpha$ and $\beta$.

It is not immediately apparent which regime, the expensing regime or the capitalization regime, is socially preferred, since both regimes have their own problems. KSV show that social welfare depends critically upon the size of the aggregate capital stock that the firm builds through its investment in tangible and intangible assets. It turns out that the aggregate capital stock is larger in the capitalization regime than the expensing regime if and only if:

$$\left(1 + \frac{b_2}{1 + b_1}\right) > \left(1 + \frac{1}{1 - \beta}\right)^{\alpha/\alpha + \beta}$$  \hspace{1cm} (3.17)

The coefficient $b_2$ in the left hand side of (3.17) is the Bayesian weight that the equilibrium date 1 capital market price assigns to the firm’s reported earnings in the capitalization regime and the coefficient $b_1$ is the Bayesian weight on cash flow. These weights depend critically on the noise introduced into accounting reports by the measurement of intangible assets:

$$b_1 = \frac{\rho \sigma^2_\omega}{\sigma^2_x [\sigma^2_\omega + \sigma^2_\gamma] + \sigma^2_\omega \sigma^2_\gamma}$$  \hspace{1cm} (3.18)

$$b_2 = \frac{\rho \sigma^2_\gamma}{\sigma^2_x [\sigma^2_\omega + \sigma^2_\gamma] + \sigma^2_\omega \sigma^2_\gamma}$$  \hspace{1cm} (3.19)

It is readily apparent from (3.18) and (3.19) that an increase in $\sigma^2_\omega$ increases the weight on cash flow and decreases the weight on reported earnings, thus decreasing the left hand side of (3.17). Therefore, our analysis indicates that FASB’s concern for the imprecision in measuring intangible assets...
assets and the consequent noise introduced into the earnings report is a valid concern. It has a major role in damaging the case for the measurement of intangible assets.

The right hand side of (3.17) depends entirely on the technological coefficients $\alpha$ and $\beta$ and can be interpreted in terms of the relative importance of intangible assets in building the firm’s capital stock. The Cobb Douglas like production technology used in KSV implies that the efficient mix of tangible and intangible assets is described by: $\frac{N}{K} = \frac{\beta}{\alpha}$, so the bigger is the technological parameter $\beta$ relative to $\alpha$, the greater will be the proportion of intangible assets in the firm’s capital stock if tangible and intangible assets are combined efficiently. In order to capture the relevance side of the argument, as articulated by Lev and Zarowin [1999], KSV make the following transformation: Let $r \equiv \alpha + \beta$. Now consider increases in $\beta$ and decreases in $\alpha$ so that $r$ remains fixed. Such variations would cause the ratio $\frac{\beta}{\alpha}$ to increase and therefore the ratio $\frac{N}{K}$ to increase if intangible and tangible assets are combined efficiently in forming the firm’s capital stock.

Holding the sum $r \equiv \alpha + \beta$ fixed, (3.17) can be expressed as:

$$\left(1 + \frac{b_2}{1 + b_1}\right) > \left(1 + \frac{1}{1 - \beta}\right)^{r/\beta}$$

(3.20)

The range of $\beta$ is the interval $[0, r]$. KSV show that the right hand side of (3.20) is strictly decreasing in $\beta$ and equals 2 at $\beta = 0$ and equals 1 at $\beta = r$. The left hand side of (3.20) is strictly decreasing in $\sigma_{w}^2$, converges to 2 as $\sigma_{w}^2 \to 0$ and converges to 1 as $\sigma_{w}^2 \to \infty$. Therefore, for each fixed $\beta$ the left hand side of (3.20) is strictly smaller than the right hand side of (3.20) if $\sigma_{w}^2$ is large enough, in which case the expensing regime is socially preferable to the
capitalization regime. Also, for each fixed $\sigma_\omega^2$ the left hand side of (3.20) is bigger than the right hand side of (3.20) if $\beta$ is big enough, in which case the capitalization regime is socially preferable to the expensing regime. Since $\beta$ captures the relevance (importance) of intangibles and $\sigma_\omega^2$ captures the reliability of the intangibles measurement, there is a clear relevance-reliability tradeoff.

The new insight provided by KSV, from a real effects perspective, is that the greater the ratio of intangible assets to tangible assets, i.e. the more important is the presence of intangibles in the mix of tangible and intangible assets the greater should be the tolerance for noise in the measurement of intangible assets. If the importance of intangibles is low and the noise in measuring intangible assets is sufficiently large, it is better to leave intangibles unmeasured. This insight only emerges when real effects are explicitly modeled because there is no relevance-reliability tradeoff if the firm’s investment choices are suppressed. Thus, in an exchange economy, the only argument that can be made is that more information must be better than less in which case the measurement of intangible investments is always more desirable than non-measurement regardless of the degree of noise in the measurement.

### 3.4 Is More Information Always Preferred to Less?

In non-strategic settings, where the information provided is about the state of Nature, Blackwell’s theorem implies that more information is always preferred to less. Does this result continue to hold in strategic settings where information has real effects? In the economic settings described in sections 3.1 and 3.3 the answer is yes: Greater precision in measuring the firm’s investment enhances social welfare. This gain occurs not because greater precision reduces uncertainty which reduces the cost of capital, but because greater precision in measuring investment alters the weights that the capital market attaches to various accounting reports.
resulting in valuation rules that sustain greater investment efficiency and less myopia. Is this result true in all strategic situations?

In sections 3.1 and 3.3 the information asymmetry between the firm’s manager and the market concerned only the single variable about which information was being provided. But, consider the following more general setting. Suppose there are two value relevant variables \(x\) and \(y\) and the values of both are known to the firm’s manager. Suppose that it is infeasible to credibly disclose information about variable \(x\) to the capital market (because the information possessed by managers about variable \(x\) is non-quantifiable and difficult to communicate, or disclosure of the information would impose large proprietary costs on the firm, or the information is simply too costly to verify). But it is feasible to measure and credibly disclose information about variable \(y\). Given that \(x\) cannot be disclosed, is it socially desirable to measure and disclose \(y\) as precisely as possible? As far as we know, there is no general answer to this question. But, there are several examples in the real effects literature where the answer is negative. Sapra [2002] found that disclosing firms’ trades in derivative markets could induce firms to speculate in an undesirable way, Kanodia, Singh and Spero [2005] (KSS) found that some degree of imprecision in measuring a firm’s investment is actually desirable when information about the profitability of that investment cannot be directly communicated to the capital market. Gigler, Kanodia, Sapra and Venugopalan [2014] show that providing more information on the results of operations by increasing reporting frequency could induce managerial myopia when the nature of investment projects chosen by managers is not visible to the capital market. Gao and Jiang [2015] found that reporting discretion allows banks to decrease panic based bank runs. Bertomeu and Cheynel [2015] find that when credit markets are imperfect, social efficiency is enhanced by an information system that pools asset values that are used for satisfying collateral requirements.
We provide a sketch of the KSS [2005] analysis in order to provide some intuition for why less information may be preferred to more. KSS consider the investment decision of a firm that has private information about the profitability of its investment and this profitability cannot be credibly disclosed to outsiders. The amount that the firm chooses to invest is also not directly observable. The firm’s investment is measured and reported to outsiders, and the noise in this measurement is the object of analysis. Both the size of investment and the profitability of investment are value relevant to the capital market.

To see the tradeoffs that are present in such a setting, consider two hypothetical variations. In the first variation, the profitability of the firm’s investment is publicly known, but the firm’s investment is measured and reported with imprecision. Then, as we have seen in our canonical model of section 3.1, noisy measurement of investment cannot communicate any information about how much the firm has invested and this results in significant under-investment. Next, suppose that the firm’s investment is perfectly measured and reported, but direct disclosure of the profitability of investment lacks credibility. The market would then seek to infer profitability from the reported investment, so that investment acquires an informational value over and above its fundamental value. The equilibrium is a fully revealing signaling equilibrium as in Spence [1974]. In such a signaling equilibrium there is significant over-investment. Both equilibria are clearly undesirable – in one there is under-investment and in the other there is over-investment. If investment levels between these two extremes can be supported in equilibrium, the firm’s shareholders would be better off.

KSS show that imprecision in measuring the firm’s investment, together with information asymmetry about profitability, results in “noisy signaling” equilibria that lies between the two extremes described above. Information asymmetry about the profitability of investment allows imprecise measurements of investment to acquire information content. This alleviates the under-investment problem. Imprecision in the measurement of investment dilutes its signaling role and thus deters over-investment. There is, in fact an optimal degree of measurement imprecision that
balances the firm’s under-investment and over-investment incentives. KSS show that the greater is the information asymmetry between the market and the manager about the profitability of investment the greater should be the imprecision in measuring that investment.

We are not suggesting that FASB mandate an optimal degree of imprecision in accounting measurements. But the above analysis indicates that the sentiment that noise in accounting measurements should be eliminated to the maximum extent possible, i.e. more information is better than less, is incorrect in many plausible settings where real effects are present. The key factor that determines how much measurement imprecision is desirable is the extent of the gap between what the firm’s manager knows and what the market a priori knows about related value relevant variables. Such information asymmetry is likely to be quite large regarding investment in research and development (R&D). Corporate insiders would have much finer information about the profitability of various ongoing R&D projects than traders in the capital market. The insight developed in KSS indicates that in such settings a good deal of imprecision in the measurement of R&D expenditures may actually be a good thing.

4. Mark-to-Market Accounting for the Loan Portfolios of Financial Institutions

Mark-to-Market accounting or fair value accounting (as it is more commonly known) is a radical departure from historical cost accounting. It requires a firm’s assets and liabilities to be restated at their market values at every reporting date and changes in market values to be treated as income. In its ideal implementation a firm’s balance sheet value would be equivalent to its market value and periodic earnings would be equivalent to changes in the firm’s market value. The application of this accounting measurement principle to the loan portfolios of financial institutions stirred much controversy during the financial crisis of 2008-2009. Critics argued that mark-to-market accounting was contributing to the financial crisis by causing banks’ loan portfolios to deteriorate beyond the level justified by economic fundamentals. The argument was follows. The writing down of loan portfolios due to mark-to-market accounting caused a
tightening of capital adequacy requirements, forcing banks to securitize and sell their loan portfolios. Due to illiquidity in the market such forced sales caused further deterioration in the values of these portfolios which, in turn, caused additional write downs and additional forced sales and so on. Thus, it was alleged that mark-to-market accounting had pro-cyclical properties and had entrapped banks in a self-confirming downward spiral. Supporters of fair value accounting argued that the reports produced by fair value accounting were merely reflecting a grim objective reality, but had nothing to do with the making of that reality. They argued that nothing would be achieved by “shooting the messenger.”

Laux and Leuz [2009] point out that a major weakness of historical cost accounting for loan portfolios is that it allows banks to engage in “gains trading” that obscures the true financial condition of banks. In order to avoid the reporting of losses when their assets lose value, banks merely have to hold onto those assets in which case they would be reported at their higher historical cost. On the other hand, banks could prematurely sell assets in rising markets in order to book gains that would otherwise not be reported until much later. Thus, if \( v^0 \) is the historical cost of an asset and \( v \) is its current market value, a historical cost regime allows banks to freely choose between \( v^0 \) and \( v \) and essentially report \( \max\{v, v^0\} \). So, an accounting regime based upon historical cost allows bad news to be postponed and good news to be preponed. Such opportunistic reporting would not occur in a fair value accounting regime as the banks assets would always be reported at \( v \) regardless of whether those assets were retained or sold.

There seems to be considerable merit to the above argument, so a closer examination is warranted. Clearly, there is an assumption here that for some unspecified reason the bank’s management is concerned about the bank’s balance sheet in the short-run, while the social good depends upon the ultimate long-run proceeds that the bank’s assets could yield. Let us additionally make the plausible assumption that the current market value \( v \) of the bank’s asset portfolio is also the market’s current expectation of the ultimate proceeds from those assets.
(otherwise there would be arbitrage possibilities). Then, in an expectations sense, the value realized by the bank is essentially the same regardless of whether the bank prematurely sells the asset or continues to hold it. Under fair value accounting the bank is indifferent between selling and holding those assets, so we assume the bank holds them. But, here too the current expectation is that the bank will ultimately realize $v$. This implies that even though the accounting regime causes the bank to behave differently, the two actions are economically equivalent, in which case outsiders would be indifferent between historical cost and fair value accounting.

Plantin, Sapra and Shin (PSS) [2008] developed conditions under which the choice between historical cost and fair value accounting regimes does have real economic consequences and showed how fair value accounting for banks’ loan portfolios could have the pro-cyclical properties described by the critics of fair value.

PSS maintain the assumption that the bank’s management is concerned about the bank’s balance sheet in the short-run, while the social good depends upon the ultimate long-run proceeds that the bank’s loan portfolio could yield. However, PSS assume that the premature sale of a loan portfolio is an inefficient action. PSS claim there are two inefficiencies associated with securitizing and prematurely selling a loan portfolio. First, due to a lack of monitoring capability, buyers of a securitized loan extract less value from the borrower than the bank that originated the loan. So, selling the loan causes the value of the loan to shrink from its current and long-term market value of $v$ to $\delta v$, $0 < \delta < 1$. Second, the market for securitized loans is illiquid causing the market price to decline in the presence of selling pressure. When banks wish to sell securitized loans they enter a queue with sales occurring sequentially from the queue. Later sales fetch a smaller price than earlier sales. The average, or expected, sales price is the price that is realized half way down the queue:

$$p(v,s) = \delta v - \gamma \frac{s}{2}, \quad (4.1)$$
where $s$ is the ex post observed fraction of loan portfolios that were sold collectively by all banks and $\gamma$ is a measure of illiquidity. The observed closing price at the end of the day is the price at the bottom of the queue $\delta v - \gamma s$, and this is the price to which a loan will be marked-to-market if the loan does not pay off or isn’t sold in period 1.

PSS assume that some fraction $(1 - d)$, $0 < d < 1$ of a bank’s loan portfolio is of short duration in the sense that it pays off the full amount $v$ at date 1. Thus, in a mark-to-market regime the expected date 1 balance sheet value of a bank’s loan portfolio, if the bank does not collateralize and sell the portfolio, is:

$$b_{MM}(v, d, s) = (1 - d)v + d(\delta v - \gamma s)$$  \hspace{1cm} (4.2)

On the other hand, if the bank sells its loan portfolio the price it attracts depends on the bank’s position in the queue. A bank’s place in the queue is a random variable, but on average it would be placed half way down the queue so that the expected sale price is $\frac{\delta v - \gamma s}{2}$, as specified in (4.1). Then, in this mark-to-market regime, a bank would sell rather than hold its loan portfolio if $\frac{\delta v - \gamma s}{2} > (1 - d)v + d(\delta v - \gamma s)$, or equivalently if:

$$(1 - d)(1 - \delta)v < \gamma s \left( d - \frac{1}{2} \right)$$  \hspace{1cm} (4.3)

In a historical cost regime a bank would sell its loan portfolio if $\frac{\delta v - \gamma s}{2} > (1 - d)v + dv^0$, or equivalently if:

$$[\delta - (1 - d)]v > dv^0 + \gamma s$$  \hspace{1cm} (4.4)

where $v^0$ is the historical value of the loan portfolio at the date the loan was originated.
From (4.3) it is immediately apparent that if loan portfolios are of sufficiently long duration, i.e. if \( d > \frac{1}{2} \), then a mark-to-market regime with illiquid markets creates strategic complementarity. The greater is the selling pressure from other banks the greater is the payoff to each individual bank from also selling its loan portfolio. Thus when the market value of loan portfolios decline to the point where the market value of some loan portfolios become negative so that (4.3) is satisfied at \( s = 0 \), selling will emerge causing the right hand side of (4.3) to increase, which in turn will stimulate banks to sell even those loan portfolios that have positive market values, which further increases the value of \( s \), which will cause additional selling, and so forth. In this sense, mark-to-market has pro-cyclical properties. On the other hand (4.4) indicates that a historical cost regime has counter-cyclical properties. Higher values of \( s \) discourage selling so that when other banks are selling, an individual bank’s incentive for holding on to its loan portfolio actually goes up.

PSS show that mark-to-market works well only when loan portfolios are of sufficiently short duration, markets are sufficiently liquid, and the distribution of market values of loan portfolios across banks is skewed so that there is much greater probability mass around big market values. These conditions are unlikely to be satisfied in times of financial distress.

The PSS model identifies market liquidity as an important determinant of which of the two accounting regimes is socially preferred. Highly illiquid markets (\( \gamma \) sufficiently big) favor the historical cost regime over the mark-to-market regime. The converse is true if markets are sufficiently liquid (i.e., if \( \gamma \) is sufficiently small). Intuitively, this is because, in a historical cost regime, illiquidity hurts the bank’s balance sheet only if it sells, not if it continues to hold. Thus big values of \( \gamma \) discourage the inefficient action of selling. On the other hand, in the mark-to-market regime illiquidity hurts regardless of whether the bank sells or holds and, in fact, illiquidity hurts more when the bank holds than when it sells. This is because when the bank
holds and end of period market prices are used to value a bank’s asset holdings it is as if the bank was the last person in the queue to sell. On the other hand, if the bank actually does decide to sell it expects to land at the midpoint of the queue resulting in a higher expected valuation. Thus holding produces a valuation of $\delta v - \gamma s$ if the asset has not already paid off, while selling results in a higher expected valuation of $\frac{\delta v - \gamma s}{2}$.

The findings here are in sharp contrast to the conventional wisdom that mark-to-market accounting must unambiguously dominate historical cost accounting because the current market value of a bank’s assets and liabilities are always more relevant to outsiders than the historical cost of those assets. The PSS analysis makes it clear that what is missing in the conventional wisdom is the fact that banks are not passive to how their financial situation is measured and reported to outsiders. Banks will change their business practices in response to accounting measurements and such real effects could be socially detrimental, even though the information provided to outsiders is enhanced.

5. Real Effects of Hedge Accounting

Hedging of price risk is an important component of a firm’s risk management strategy. Firms hedge and also speculate on prices by trading in markets for derivative securities. Prior to SFAS 133, such transactions in derivative securities were not incorporated into financial statements until the date they were settled because until that date they were considered to be executory in nature. FASB adopted SFAS 133 following the financial scandals of Orange County, Barings Bank, and others, where large losses on derivative securities were reported at settlement dates and these losses apparently caught stakeholders by surprise. The new accounting standard required that the derivative positions taken by firms be marked-to-market at every reporting date with gains or losses from marking-to-market flowing through the income statement. The rationale for SFAS 133 was that firms were undertaking new risks by trading in
derivatives and that stakeholders need to be informed in a timely manner about the gains or losses from such new risks. SFAS 133 and the exposure draft preceding its adoption ignited a storm of controversy. Firms claimed that they used derivatives to decrease and manage their risks while SFAS 133 would increase the volatility of reported income making it appear that their risks had actually increased. Many firms feared that prudent risk management would be compromised in response to the new accounting standard.

The real effects of hedge accounting, as mandated by SFAS 133, was studied by Melumad, Weyns and Ziv [1999], Kanodia, Mukherji, Sapra and Venugopalan [2000], Sapra [2002] and Gigler, Kanodia and Venugopalan [2007]. These studies indicate that the nature of real effects that are caused by hedge accounting varies depending on three important features of the environment in which firms hedge and speculate:

i. Whether a perfect hedge is feasible or not.
ii. Whether it is possible to disentangle hedging from speculation.
iii. Whether corporate managers acquire information that is not available to capital market traders about the commodity price whose risk is being hedged.

A perfect hedge is infeasible if derivative markets do not exist for the specific commodity whose price risk is being hedged or if the settlement date of the derivative transaction is different from the date the price risk of the commodity is resolved. For example, consider the case of a farmer who commits resources to wheat production at the present time and harvests the wheat and sells it in a spot market nine months later. The price in the spot market is uncertain and the farmer seeks to hedge this price risk. (This example will serve as a prototype for our discussion of hedge accounting). If there is no futures market in wheat, but there is a futures market in corn and the price of corn is correlated, but not perfectly correlated with the price of wheat, then some hedging is feasible but the hedge is not perfect in the sense that there is residual risk that the farmer cannot escape. Also, if trades in wheat futures must be settled in the sixth month, but the
wheat produced by the farmer is available for sale only in the ninth month, then again a perfect hedge is infeasible.

5.1 The Effect of Hedge Accounting on Industry Production

When perfect hedges are feasible Danthine’s [1978] separation result holds. The separation result says that a farmer’s choice of how much wheat to produce is independent of his beliefs about the spot price of wheat, and independent of his risk aversion, and is determined entirely by the current price in the futures market. Thus, if the futures price perfectly aggregates and reflects the beliefs of individual farmers and speculators about the uncertain spot price that will prevail in the future, then the production of the entire industry is informed by the collective wisdom of all agents in the economy. This is the ideal situation. However, if the futures price is inefficient, i.e., if it is affected by variables that have no relationship to the spot price or if the futures price aggregates information differently than the spot price then the production of the entire industry is adversely affected. This being the case, accounting regulators should be very concerned about how hedge accounting affects the information that is reflected by the futures price. Surprisingly, concern for this very significant real effect of hedge related disclosures has been absent in the debate surrounding SFAS 133.

Danthine’s separation result additionally implies that if the futures price does not coincide with a farmer’s belief about the spot price that will prevail nine months later, the farmer’s optimal position in wheat futures will inevitably consist of both a hedge component and a speculative component. The farmer’s belief about the spot price for wheat is reflected in the speculative component of his trade, not in his entire trade in the futures market. For example, if a farmer is observed to sell 60 bushels of wheat in the futures market such sale does not necessarily indicate that the farmer expects the spot price to be lower than the futures price. If, in addition to selling 60 bushels of wheat futures, the farmer anticipates his production of wheat to be 100 bushels, then the farmer has actually taken a speculative long position of 40 bushels rather than a
short position of 60 bushels and the farmer must believe that the spot price for wheat will be higher than the futures price. Because the information that should be reflected in the futures price is contained in the speculative portion of the farmer’s trade, accounting disclosures that help to disentangle hedge motivated trades from speculative trades go a long way towards making the futures price more efficient.

Thus, a real effects perspective indicates that determining how much is hedging and how much is speculation is a key consideration in hedge accounting. When such a determination can be made perfectly, marking-to-market only the speculative component and accounting for the hedge component on a historical cost basis would provide exactly the kind of information that would facilitate both corporate governance and price efficiency. This is because it is only the gains or losses on the speculative component that persists; the gains or losses on the hedge component are offset by the corresponding fluctuations in the value of the intrinsic risk that is hedged. Unfortunately, when a firm hedges and speculates at the same time, determining the speculative component directly is virtually impossible because it would require knowing the firm’s beliefs about the spot price to be realized in the future.

However when Danthine’s separation result holds, marking-to-market only the speculative portion of the firm’s derivatives trade is equivalent to marking-to-market the firm’s entire derivatives trade but also simultaneously marking-to-market the intrinsic risk that the firm seeks to hedge. Therefore, measuring and disclosing a firm’s intrinsic risk is a crucial component of hedge disclosures. The main point illustrated in the Kanodia, Mukherji, Sapra, and Venugopalan (KMSV) [2000] paper is that when hedging and speculation cannot be disentangled the equilibrium price in the futures market is invariably inefficient. Additionally, the price inefficiency caused by such confounding leads, on average, to lower futures prices. This translates into a major real effect. On average, industry output is lower than what it would be in an efficient market, thus decreasing the profitability of the industry and decreasing consumer
welfare. The inefficiency of the futures price also leads to inadequate production responses to shocks in consumer demand which causes spot prices to become unduly volatile.

Using a generalization of KMSV, we show below how the confounding of hedging and speculation makes the futures price inefficient and how it induces a downwards bias to industry production. Consider a continuum of wheat farmers divided into two groups, each having unit mass. The first group consists of “informed” farmers while the second group consists of “uninformed” farmers. Informed farmers are a fraction $\lambda$ of the total population of farmers. Farmers commit resources to wheat production at date 1, but the output of wheat is available for sale only at a later time, date 2. The quantity of wheat produced and owned by a farmer in the first group is privately known only to that farmer, while the wheat production of the second group is common knowledge. We model this situation by assuming that each farmer in the first group receives a random additive shock to his/her planned production and this shock is privately observed by the farmer but not by other agents in the economy. If $q_i$ is the planned production of a representative informed farmer, the actual output available to that farmer is $q_i + \tilde{\theta}_i$ where $\tilde{\theta}_i = \theta + \nu_i$ are idiosyncratic variations around some aggregate shock $\theta$ to industry production. We assume that the $\nu_i$ shocks are independent and identically distributed Normal random variables with zero mean. Let $q_j$ be the known production of a representative farmer in the uninformed group.

The spot price $\tilde{p}$ that will prevail at date 2 is uncertain, and is described by a downward sloping demand function:

$$\tilde{p} = \tilde{\eta} + \tilde{\omega} - (Q + \lambda \tilde{\theta}),$$

where $Q + \lambda \tilde{\theta} = \lambda \int_0^1 (q_i + \tilde{\theta}_i) di + (1 - \lambda) \int_0^1 q_j \, dj$ is the aggregate quantity of wheat available for sale at date 2.
In addition to having private information about the quantity of wheat he possesses, each informed farmer also has private information about the spot price $\bar{p}$. We model this by assuming that each informed farmer privately observes the parameter $\eta$ of spot market demand. We assume that all random variables are independent of each other. The demand shock $\tilde{\eta}$ is distributed Normal with mean $\mu > 0$ and variance $\sigma^2_{\tilde{\eta}}$, the additional demand shock $\tilde{\omega}$ is also Normal with mean zero and variance $\sigma^2_{\tilde{\omega}}$, and the supply shock $\tilde{\Theta}$ is Normally distributed with mean zero and variance $\sigma^2_{\tilde{\Theta}}$.

Farmers operate on personal account and are identically risk averse with constant absolute risk aversion parameter $\rho > 0$. There is a futures market in wheat, with price $p^f$, in which farmers can take hedge and speculative positions. If farmer $i$ has planned production of $q_i$ units of wheat, realizes a shock of $\sigma_i$ units of wheat and sells $z_i$ units of wheat futures, his terminal wealth is: $\tilde{w}_i = z_i p^f + (q_i + \theta_i - z_i) \bar{p} - \left(q_i^2 / 2k\right)$. The quantity $\left(q_i^2 / 2k\right)$ is the cost of resources committed to wheat production. Given constant absolute risk aversion and assuming that the conditional distribution of $\bar{p}$ is Normal (as will turn out to be the case), the objective function of a representative farmer can be expressed as:

$$\text{Max}_{q_i, z_i} p^f + (q_i + \theta_i - z_i) E_i(\bar{p}) - \left(q_i^2 / 2k\right) - \left(1 / 2\right) \rho(q_i + \theta_i - z_i)^2 \text{var}_i(\bar{p}),$$

where, $E_i(\bar{p})$ and $\text{var}_i(\bar{p})$ are farmer $i$’s beliefs about the spot price conditional on all the information available to farmer $i$. In the absence of hedge disclosures, such information consists of $\{\eta, \theta_i, p^f\}$ if the farmer is informed and $\{p^f\}$ if the farmer is uninformed. The first order conditions with respect to $q_i$ and $z_i$, respectively, are:

$$E_i(\bar{p}) - (q_i / k) - \rho(q_i + \theta_i - z_i) \text{var}_i(\bar{p}) = 0,$$

and

$$p^f - E_i(\bar{p}) + \rho(q_i + \theta_i - z_i) \text{var}_i(\bar{p}) = 0.$$
Substituting from the second equation into the first, yields:

$$q_i = kp^f$$  \hspace{1cm} (5.2)

Rearranging terms in the second equation, yields

$$z_i = q_i + \theta_i - \frac{E_i(\tilde{p}) - p^f}{\rho \text{var}_i(\tilde{p})}$$  \hspace{1cm} (5.3)

Equation (5.2) is Danthine’s separation result indicating that the production quantity planned by a farmer is determined entirely by the marginal cost of production and the price in the futures market. Equation (5.3) says that a farmer’s position in the derivatives market has both a hedge component and a speculative component, where the hedge component is the farmer’s intrinsic risk $q_i + \theta_i$ and the speculative component is proportional to the difference between the farmer’s belief about the uncertain spot price and the currently known futures price. The hedge component reflects the farmer’s private information about his intrinsic risk while the speculative component reflects the farmer’s private information about the spot price.

Now, consider the case where farmers are not required to make any public disclosures. Then, for each informed farmer $E_i(\tilde{p}) = E(\tilde{p} | \eta_i, \theta_i, p^f)$, and $\text{var}_i(\tilde{p}) = \text{var}(\tilde{p} | \eta_i, \theta_i, p^f)$. The production and derivative positions of each uninformed farmer are identical to (5.2) and (5.3) except that $\theta_j \equiv 0$ and $E_j(\tilde{p}) = E(\tilde{p} | p^f)$ and $\text{var}_j(\tilde{p}) = \text{var}(\tilde{p} | p^f), \forall j$.

The market clearing requirement for the futures market is:

$$\lambda \int_0^1 z_i di + (1 - \lambda) \int_0^1 z_j dj = 0$$, which, using (5.3) is equivalent to:

$$\lambda \left( \frac{E_i(\tilde{p} | \eta_i, \theta_i, p^f) - p^f}{\rho \text{var}(\tilde{p} | \eta_i, \theta_i, p^f)} \right) + (1 - \lambda) \left( \frac{E(\tilde{p} | p^f) - p^f}{\rho \text{var}(\tilde{p} | p^f)} \right) = Q + \lambda \theta$$  \hspace{1cm} (5.4)

Since the futures price conditions farmers’ beliefs about the spot price, the equilibrium futures price cannot be characterized without first determining what information is conveyed by the
futures price. We conjecture that, in equilibrium, the futures price is strictly increasing in the statistic:

\[ y = \eta - (\lambda + \rho \sigma_\omega^2)\theta \]

If this is true, the futures price reveals \( \theta \) to the informed farmers because they already know the value of \( \eta \). But, uninformed farmers cannot distinguish between the demand shock \( \eta \) and the supply shock \( \theta \) and must condition their beliefs on the statistic \( y \). Then:

\[
E(p|\eta, \theta, p^f) = \eta - \lambda \theta - Q - p^f, \\
\text{var}(p|\eta, \theta, p^f) = \sigma_\omega^2, \\
E(p|p^f) = E(\eta - \lambda \theta|y) - Q - p^f, \text{ and} \\
\text{var}(p|p^f) = \text{var}(\eta - \lambda \theta|y) + \sigma_\omega^2
\]

Now, because \((\eta - \lambda \theta, y)\) is multivariate Normal with prior means \(E(\eta - \lambda \theta) = E(y) = \mu\):

\[
E(\eta - \lambda \theta|y) = \beta y + (1 - \beta)\mu, \text{ where}
\]

\[
\beta = \frac{\text{cov}(\eta - \lambda \theta, y)}{\text{var}(y)} = \frac{\sigma_\eta^2 + \lambda(\lambda + \rho \sigma_\omega^2)\sigma_\theta^2}{\sigma_\eta^2 + (\lambda + \rho \sigma_\omega^2)^2 \sigma_\theta^2}
\]

Inserting these calculations into (5.4), the market clearing condition becomes:

\[
\lambda \left( \frac{\eta - \lambda \theta - Q - p^f}{\rho \sigma_\omega^2} \right) + (1 - \lambda) \left( \frac{\beta y + (1 - \beta)\mu - Q - p^f}{\rho[\text{var}(\eta - \lambda \theta|y) + \sigma_\omega^2]} \right) = Q + \lambda \theta,
\]

which is equivalent to:

\[
\lambda \left( \frac{y - Q - p^f}{\rho \sigma_\omega^2} \right) + (1 - \lambda) \left( \frac{\beta y + (1 - \beta)\mu - Q - p^f}{\rho[\text{var}(\eta - \lambda \theta|y) + \sigma_\omega^2]} \right) = Q.
\]

Inserting \(Q = kp^f\) and solving for the futures price, gives:

\[
p^f \left( k + \frac{\lambda(1+k)}{\rho \sigma_\omega^2} + \frac{(1-\lambda)(1+k)}{\rho[\text{var}(\eta - \lambda \theta|y) + \sigma_\omega^2]} \right) = \frac{\lambda y + (1-\lambda)[\beta y + (1-\beta)\mu]}{\rho \sigma_\omega^2 + \rho[\text{var}(\eta - \lambda \theta|y) + \sigma_\omega^2]} \quad (5.5)
\]
Because the right hand side of (5.5) is strictly increasing in $y$ and the coefficients multiplying $p^f$ and $y$ are known positive constants, the futures price is strictly increasing in the statistic $y$ and must reveal $y$ to all economic agents.

Now, suppose that mandatory hedge disclosures reveal how much of each firm’s derivative position is a hedge and how much is speculation. This can be accomplished by mandating the disclosure of each firm’s derivative position $z_i$ as well as its intrinsic risk $q_i + \theta_i$. Knowledge of each firm’s intrinsic risk allows all economic agents to directly calculate the aggregate supply $Q + \lambda \theta$ of wheat futures in the market. Then, it is easy to verify that the equilibrium futures price reveals the demand parameter $\eta$. Therefore, in equilibrium, the demand function of a representative informed farmer for the derivative security is:

$$z_i = q_i + \theta_i - \eta \lambda \theta - Q - p_f^f,$$

and the demand function of a representative uninformed farmer is:

$$z_j = q_j - \frac{\eta \lambda \theta - Q - p_f^f}{\rho \sigma^2_{\omega}}.$$

Then, calculating the equilibrium futures price from the market clearing condition and using $Q = kp^f$, yields:

$$p_f^f \left( k + \frac{1+k}{\rho \sigma^2_{\omega}} \right) = \frac{\eta - \lambda \theta (1+\rho \sigma^2_{\omega})}{\rho \sigma^2_{\omega}} \quad (5.6)$$

Let $p_f^{f*}$ denote the equilibrium futures price characterized in (5.6) for the setting with hedge disclosures and let $p_f^{f0}$ denote the equilibrium futures price characterized in (5.5) for the setting without hedge disclosures. KMSV show that, relative to $p_f^{f*}$, $p_f^{f0}$ is less sensitive to fluctuations in the wheat demand parameter $\eta$ and overly sensitive to the aggregate shock, $\lambda \theta$. 

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to firms’ hedging needs. In this sense the absence of hedge disclosures makes the equilibrium futures price less efficient. Because the futures price guides farmers’ production decisions, the aggregate supply of wheat in the spot market does not respond appropriately to fluctuations in the demand for wheat and increases the volatility of spot prices.

KMSV show that, on average, the futures price is lower in the setting without hedge disclosures than in the setting with hedge disclosures. To see why this is the case, take an expectation over the random variables $\tilde{\eta}$ and $\tilde{\theta}$ in equations (5.5) and (5.6):

$$E(p_{f0}^*) \left( k + (1+k) \left\{ \frac{\lambda}{\rho \sigma_{\omega}^2} + \frac{(1-\lambda)}{\rho \{\text{var}(\eta - \lambda \theta \mid y) + \sigma_{\omega}^2 \} } \right\} \right) = \mu \left\{ \frac{\lambda}{\rho \sigma_{\omega}^2} + \frac{(1-\lambda)}{\rho \{\text{var}(\eta - \lambda \theta \mid y) + \sigma_{\omega}^2 \} } \right\}$$

and,

$$E(p_{f0}^*) \left( k \rho \sigma_{\omega}^2 + 1 + k \right) = \mu$$

Therefore, $E(p_{f0}^*) < E(p_{f*}^*)$ if:

$$\frac{\text{var}(\eta - \lambda \theta \mid y) + \sigma_{\omega}^2}{\lambda \{\text{var}(\eta - \lambda \theta \mid y) + \sigma_{\omega}^2 \} + (1-\lambda)\sigma_{\omega}^2} > 1,$$

which is true whenever $\text{var}(\eta - \lambda \theta \mid y) > 0$ i.e. whenever the statistic $y$ does not perfectly reveal $(\eta - \lambda \theta)$ as is the case here.

This result shows how important it is to structure hedge disclosures in such a way that market participants can distinguish between hedging and speculation. When these two activities are confounded, the informational properties of futures prices are affected in such a manner that the entire industry under-produces resulting in lower profitability and lower consumer welfare.
5.2 How Hedge Disclosures Could Cause Excessive Speculation:

We have examined the real effects of hedge disclosures in settings where a perfect hedge is feasible. However, in settings where firms are unable to perfectly hedge the price risk to which they are exposed, the futures price plays a lesser role in guiding production decisions, and the effect of hedge disclosures on prudent risk management and speculation become more prominent. A popular belief among academics and regulators is that the periodic marking-to-market of a firm’s outstanding positions in derivative markets would discourage speculative activities by managers because the gains or losses from such speculation would become visible in a timely manner. This hypothesis was investigated by Sapra [2002] who found that the opposite is true. In a setting where managers possess private information about spot prices and hedging is imperfect, hedge disclosures actually encourage the manager to speculate beyond the amount that should be considered prudent. Below, we provide an intuitive sketch of Sapra’s analysis.

Consider the decisions of a single farmer who produces wheat but must hedge in the futures market for corn where the price of corn is imperfectly correlated with the price of wheat. Let $\tilde{p}_w$ be the spot price of wheat, $\tilde{p}_c$ the spot price of corn and $p^f$ the futures price of corn, and assume that $0 < \text{correlation}(\tilde{p}_w, \tilde{p}_c) < 1$. The farmer’s terminal payoff from production of $q$ units of wheat and sale of $z$ units of corn futures is:

$$\tilde{\pi} = \tilde{p}_w q - c(q) + z(p^f - \tilde{p}_c)$$

The farmer is risk averse with constant absolute risk aversion parameter $\rho$. Assume initially that the farmer operates on personal account, i.e. the farmer directly consumes all of the cash flows from farming, and is unaffected by any inferences that outsiders may make. Assuming that the price of wheat and corn is multivariate Normal, the farmer’s decision problem is:
Max_{z,q} \ qE(\hat{\rho}_w) - c(q) + z[p^f - E(\hat{\rho}_c)] = (1/2) \rho \left[ q^2 \text{var}(\hat{\rho}_w) + z^2 \text{var}(\hat{\rho}_c) - 2qz \text{cov}(\hat{\rho}_w, \hat{\rho}_c) \right]

The solution to the above maximization problem \{q^*, z^*\} will be referred to as “first best.” The first order condition with respect to \( z \) yields:

\[
z^* = \left( \frac{\text{cov}(\hat{\rho}_w, \hat{\rho}_c)}{\text{var}(\hat{\rho}_c)} \right) q^* - \frac{E(\hat{\rho}_c) - p^f}{\rho \text{var}(\hat{\rho}_c)}
\]

Equation (5.7) defines prudent risk management. It consists of a mix of hedging and speculation. The first component of \( z \) is hedge motivated while the second component (i.e. the speculative component) is information motivated. Consistent with the imperfect correlation between the prices of wheat and corn, we assume that \( 0 < \text{cov}(\hat{\rho}_w, \hat{\rho}_c) < \text{var}(\hat{\rho}_c) \), so that

\[
\Gamma \equiv \frac{\text{cov}(\hat{\rho}_w, \hat{\rho}_c)}{\text{var}(\hat{\rho}_c)} \in (0,1)
\]

Thus, prudent risk management dictates that when the farmer does not have access to perfect hedging, he hedges only a fraction, \( \Gamma \), of his output, rather than his entire output. The speculative component of his derivative position is unaffected by the correlation between the two prices because the farmer is only allowed to speculate in corn futures, so only the futures price of corn and the farmer’s expectation of the spot price for corn is relevant.

Using, (5.7), the first order condition with respect to \( q \) yields:

\[
c'(q^*) + 2 \lambda q^* \text{var}(\hat{\rho}_w | \hat{\rho}_c) = E(\hat{\rho}_w) + \Gamma [p^f - E(\hat{\rho}_c)]
\]

If \( \text{correlation}(\hat{\rho}_w, \hat{\rho}_c) = 1 \) and \( \text{var}(\hat{\rho}_w) = \text{var}(\hat{\rho}_c) \) then \( \Gamma = 1 \), \( \text{var}(\hat{\rho}_w | \hat{\rho}_c) = 0 \) and \( E(\hat{\rho}_w) = E(\hat{\rho}_c) \). In this case, Danthine’s separation result would hold and production would be governed entirely by the futures price. But with imperfect correlation between the prices of wheat and corn, the farmer’s production is affected not only by his beliefs about the spot price for wheat, but also by his beliefs about the spot price of corn. Additionally, his production is affected by the price in the futures market for corn and his risk aversion. This being the case, price
efficiency in the futures market may not be the dominant consideration in determining the real
effects of hedge disclosures. But, notice from (5.7) and (5.8) that both of the farmer’s choices
reflect his beliefs about the spot price of wheat. Therefore, in a setting where the farmer’s beliefs
are private and outsiders seek to infer the farmer’s information, hedge disclosures that convey the
farmer’s production and derivative position to outsiders would effectively make these decisions a
vehicle for signaling. Sapra [2002] explicitly modeled such a signaling role of hedge disclosures
and found that efficient signaling causes the farmer to deviate from prudent risk management and
speculate excessively relative to the prudent risk management characterized in (5.7).

Sapra analyzed the situation of a single firm that chooses its production quantity and its
derivatives trade after obtaining a private signal \( y \) about the demand for wheat that will prevail
in the spot market for wheat. Assume that \((\tilde{p}_w, \tilde{p}_c, \tilde{y})\) is multivariate Normal and that higher
values of the signal \( y \) conveys that the demand for wheat will be higher, so \( \text{cov}(\tilde{p}_w, y) > 0 \).
Because \( \text{cov}(\tilde{p}_w, \tilde{p}_c) > 0 \) the signal \( y \) must also convey information about the spot price of
corn, i.e. \( \text{cov}(\tilde{p}_c, y) > 0 \), but \( \text{cov}(\tilde{p}_w, y) > \text{cov}(\tilde{p}_c, y) \). It is assumed that the spot market for
corn opens at an earlier date than the spot market for wheat, and that the firm is priced and sold in
a capital market at this earlier date, but after the firm’s trade in corn futures is settled up.

Sapra shows that if all three hidden variables, \( \{y, q, z\} \), could be disclosed to outsiders
then the early sale of the firm in the capital market is inconsequential, and first best decisions are
achieved. However, suppose the private signal observed by the firm’s manager is unverifiable
and therefore cannot be communicated to outsiders. Sapra then considers two feasible disclosure
regimes. In the regime with hedge disclosures the firm’s wheat production \( q \) and its derivatives
trade \( z \) in the futures market for corn are both revealed. In the regime without hedge disclosure
only the firm’s production is publicly observed.
First consider the regime with hedge disclosures. Given that $z$ is disclosed, the gain or loss in the futures trade, $z(p^{f} - p_{c})$, is publicly known before the firm is priced in the capital market. Assuming mean-variance pricing, the firm’s value in the capital market is:

$$\varphi(q, z, p_{c}) = qE(\hat{p}_{w} | q, z, p_{c}) - c(q) + z(p^{f} - p_{c}) - \lambda q^2 \text{var}(\hat{p}_{w} | q, z, p_{c}),$$  \hspace{1cm} (5.9)$$

where $\lambda$ is the aggregate risk aversion in the capital market. The firm’s decision problem is:

$$\text{Max}_{q, z} E(\hat{\varphi} \mid y) - \lambda \text{var}(\hat{\varphi} \mid y)$$

Given that the firm is sold before its terminal cash flows are realized, the risk associated with the price of wheat is born by the capital market and not by the firm’s current owners. This fact changes the hedging needs of the current owners. As indicated in (5.9), the price of the firm at date 1 depends on the price of corn, and from the perspective of date 0 the price of corn $\hat{p}_{c}$ is uncertain, making the value of the firm uncertain. Therefore, the firm will seek to hedge its market value rather than hedge the price of wheat. Additionally, (5.9) indicates that the beliefs of the capital market about the price of wheat are influenced by the firm’s choice of $\{q, z\}$. The market seeks to extract information from $\{q, z\}$ because these choices are made in the light of the information that the manager has received about the price of wheat. Therefore, the firm’s decisions will be affected by its need to influence the expected price of the firm, the need to hedge the price of the firm, and also by the desire to influence the market’s beliefs about the price of wheat.

To see how the firm’s hedging decision is affected by the capital market’s need for signal extraction, suppose that the market infers $\hat{y} = \hat{y}$ from some $\{q, z\}$ that is disclosed. Then given the multivariate Normal structure that has been assumed, the market must assess:
\[ E(\tilde{p}_w | q, z, p_c) = E(\tilde{p}_w | \hat{y}, p_c) = A + \beta_c p_c + \beta_y \hat{y} \]

where \( A \) is a constant and,

\[
\beta_c = \frac{\text{cov}(\tilde{p}_w, \hat{y} | \hat{y})}{\text{var}(\tilde{p}_c | \hat{y})}, \text{ and} \]

\[
\beta_y = \frac{\text{cov}(\tilde{p}_w, \hat{y} | p_c)}{\text{var}(\hat{y} | p_c)}
\]

Thus, the price in the capital market must be:

\[
\varphi(q, z, p_c) = q \left( A + \beta_c p_c + \beta_y \hat{y} \right) - c(q) + z(p' - p_c) - \lambda q^2 \text{var}(\tilde{p}_w | p_c, \hat{y})
\]

Now, let us examine how the market’s inferences affect the payoff to the firm’s owners.

From the perspective of the firm’s owners the only random variable in the capital market’s valuation of the firm is the spot price of corn. Because the signal \( y \) that is observed by the firm’s current owners is informative about the spot price of corn, their expectation of the market’s valuation conditional on the true value of their signal is:

\[
E[\varphi(q, z, p_c) | \hat{y}, y] = q \left( A + \beta_c E(p_c | y) + \beta_y \hat{y} \right) - c(q) + z(p' - E(p_c | y)) - \lambda q^2 \text{var}(\tilde{p}_w | p_c, \hat{y})
\]

and,

\[
\text{var}(\hat{\varphi} | y) = (\beta_c q - z)^2 \text{var}(\tilde{p}_c | y)
\]

Therefore the payoff to the firm’s current owners is function of both the inferred value of \( y \) as well as its true value:

\[
\Psi(q, z, \hat{y}, y) = q \left( A + \beta_c E(p_c | y) + \beta_y \hat{y} \right) - c(q) + z(p' - E(p_c | y)) - \lambda q^2 \text{var}(\tilde{p}_w | p_c, \hat{y}) - \lambda (\beta_c q - z)^2 \text{var}(\tilde{p}_c | y)
\]

(5.10)

Methodologically, one can think of the true signal \( y \) as the firm’s “type” and the inferred signal \( \hat{y} \) as the market’s response to an observed \( \{q, z\} \) pair. From (5.10) it is easily verified that the
marginal rates of substitution $\frac{\partial \tilde{y}}{\partial z}$ and $\frac{\partial \tilde{y}}{\partial q}$ are both strictly monotone in the firm’s type. Thus, both of the firm’s decisions $z$ and $q$ have the single crossing property and could serve as signals of the firm’s true type. Kanodia and Lee [1998] showed how the mechanism design methodology can be used to construct the most efficient fully revealing signaling equilibrium in such situations.

Applying the Kanodia and Lee [1998] methodology, Sapra found that when hedge disclosures reveal both $q$ and $z$ the statistic $s(y) \equiv \beta_c q(y) - z(y)$ is used by the market to infer the firm’s information $y$. If $\beta_c q(y)$ is the fraction of its production that is hedged by the firm, as turns out to be the case, then the statistic $s(y)$ is simply the firm’s speculative trade. This would indicate that only the firm’s speculative trade would be affected by the signal extraction needs of the capital market. The firm’s production choice should not be affected. Indeed, Sapra finds that the firm’s optimal choice of production $q(y)$ satisfies:

$$c'(q) + 2\lambda q \text{var}(\tilde{p}_w | p_c, y) = E(\tilde{p}_w | y) + \Gamma [ p^f - E(\tilde{p}_c | y) ] ,$$

which is identical to first best production as characterized in (5.8). However, the firm’s speculation $s(y)$ is strongly affected. It turns out that:

$$\frac{ds(y)}{dy} > \frac{ds^*(y)}{dy} > 0, \forall y \quad \text{and} \quad s(y) = s^*(y) \quad \text{only at } y = y^0 \quad \text{where} \quad y^0 \quad \text{is characterized by:}$$

$$E(\tilde{p}_w | y^0) = \Gamma [ E(\tilde{p}_c | y^0) - p^f ]$$

Thus, there is excessive speculation at almost every signal value that could be observed by the firm.

Sapra goes on to show that when the firm’s derivatives trade $z$ is not disclosed, the firm’s observable production becomes the vehicle for signaling, resulting in overproduction at every $y$. However the firm’s risk management and speculation activities are undistorted and

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remain at prudent levels. Therefore the desirability of hedge disclosures in this setting depends upon whether excessive speculation or excessive production is the greater evil.

Both in KMSV [2000] and Sapra [2002] it is assumed that accounting disclosures perfectly separate hedging from speculation. But, it is not uncommon for firm’s to hedge the price uncertainty in anticipated future transactions. In these cases, known as cash flow hedges, the intrinsic risk that is being hedged is not observable to auditors and therefore cannot be reported to outsiders. Thus, hedging and speculation cannot be disentangled, and any reported gain or loss on derivatives contains a fictitious component that will reverse when the future transaction materializes. But outsiders do not know how much of the gain or loss is fictitious. Gigler, Kanodia and Venugopalan [2007] analyzed how outsiders would interpret mark-to-market disclosures in such a case and found that rational market inferences have many non-intuitive properties. How firms would alter their risk management strategy in anticipation of such inferences is an important issue that remains unexplored.

6. Conclusion

We have placed all the emphasis on accounting’s role of providing information to the capital market and may appear to have short changed the stewardship role. Such an emphasis is inconsistent with the assertion by Kothari, Ramanna and Skinner [2010] that the primary purpose of accounting is to provide information that is useful for assessing the performance of managers and for writing contingent contracts. So some explanation is in order. We do not wish to suggest that performance measurement and contracting are unimportant. But, as pointed out by Lambert [2010], accounting standard setters explicitly reject the claim that this stewardship role has significant influence on the structure of GAAP. We think that accounting regulators are not ill informed, but are rationally responding to the commonplace observation that performance measures and contract contingencies need to be tailor made to fit an individual firm’s business strategy, organization structure, technology, and competitive environment. Therefore, the design
of measurement and reporting systems for stewardship purposes is best left to the discretion of boards of directors of individual firms. Accounting standards are intended to govern only the mandatory disclosures that are made to the public at large, including the firm’s current stakeholders and also all potential stakeholders. As pointed out by Morris and Shin [2007] the value of such large scale public disclosure depends upon having a “shared” language, which in turn requires the kind of uniform measurements that are enshrined in accounting standards.

Accounting standard setters emphasize that GAAP is intended to facilitate the investment and portfolio decisions of external agents who supply capital to the firm. Instead, the real effects we describe relate to the internal decisions made by firms, rather than the decisions made by investors who are located outside the firm. However, we are not theorizing about information that facilitates managerial decisions, such as information about the quantity of rainfall that would facilitate the choice between planting corn or rice. We are concerned with the disclosure of information that managers already possess rather than the production of new information for managers. The main point we are seeking to make is that such disclosure not only facilitates decisions made by external parties, it also alters the decisions of the disclosing firm. In turn, these altered corporate decisions impact the payoff to the firm’s stakeholders and therefore impact social welfare. We are arguing that standard setters who ignore such real effects will likely produce many unintended consequences.
References


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