Price convexity, debt-related agency costs, and timely loss recognition

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Abstract

The same economic forces that cause debt-related agency costs also yield stock prices that are a convex function of information about the firm's future cash flows. We provide evidence that our proxy for this price convexity (viz. price-change asymmetry) is correlated with the timely recognition of unrealized losses in accounting earnings, which is often viewed as an effective mechanism for reducing agency costs associated with shareholder incentives to expropriate wealth from debtholders. We show that in samples with high leverage, dividend payments, or speculative-grade bond ratings—that is, samples where debt-related agency costs are expected to be high a priori—price-change asymmetry is significantly correlated with timely loss recognition. We argue that since price convexity varies with price levels, deflating by price in earnings-return regressions is tantamount to conditioning on the magnitude of debt-related agency costs. We control for this effect by augmenting the regression with price-change asymmetry; we find that price-change asymmetry has significant incremental explanatory power for price-deflated earnings.

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1. Introduction

A vast recent literature in accounting has argued that the timely recognition of unrealized losses in earnings is the result of demands that originate in contracts between firms and their suppliers of debt capital. Specifically, timely loss recognition is considered the accounting reflection of agency-related conflicts between shareholders and bondholders. Timely loss recognition is most often measured using Basu-type regressions of price-deflated earnings on price-deflated dollar returns conditioned by the sign of returns as a proxy for the "good" and "bad" news that arrives during a period (Basu 1997; Ball and Kothari 2007). No consensus exists in the literature as to how agency costs are best measured, and the use of relatively crude proxies—such as leverage, default risk or debt covenant violations—has somewhat stymied progress in this area (Holthausen and Leftwich 1983; Duke and Hunt 1990; Ahmed, Billings, Morton and Stanford-Harris 2002; Dichev and Skinner 2002; Qiang 2007; Zhang 2008).

Our contribution to the literature is twofold. First, we propose a theory-based (price level-specific) proxy for agency costs and demonstrate the extent to which timely loss recognition depends on the severity of debt-related agency problems. Second, we document an association between agency costs, as measured by our proxy, and stock price levels and argue that price deflation in Basu regressions conditions the earnings-return relation on the magnitude of debt-related agency conflicts. While the Basu regression still provides a valid representation of conditional conservatism under these circumstances, we suggest that researchers interested in examining the association between debt-related agency problems and timely loss recognition should parse the price-deflator effect by including a proxy for agency problems in the regression.[1]

We argue that price convexity (i.e., the observation that stock prices are a convex function of information about underlying economic fundamentals) can be used to gauge the

[1] This suggestion is similar to Ball and Kothari's (2007) recommendations on controlling for cross-sectional variations in market-to-book ratio when the researcher's objective is to estimate the incremental effect of growth opportunities on the timeliness coefficient.

severity of debt-related agency costs. Our price-convexity proxy offers three potential advantages over alternative approaches in the literature. First, the relation between price convexity and debt-related agency costs follows from economic theory, which describes how shareholders holding a convex residual claim on a firm's earnings simultaneously gives rise to convexity in stock prices and to incentives for owners to expropriate bondholders.[2]

Second, price convexity implies that stock prices are more responsive to good news than to an equivalent amount of bad news about future cash flows (Miller 1977; Fischer and Verrecchia 1997; Xu 2007). In our empirical measure of price convexity, we exploit this implication of price-change asymmetry by comparing the expected value of price changes under good-news and bad-news conditions, respectively. Price changes or dollar returns are also central to measuring timely loss recognition. Thus, our proxy for agency costs is a priori likely to be associated with those factors that cause cross-sectional variation in timely loss recognition.

Third, our measure of debt-related agency costs requires only data about stock prices. This feature not only admits broad sample-based tests, but more importantly addresses the criticism of alternative debt-related agency-cost proxies (such as leverage or default risk) constructed from financial statement data; namely, inferences based on regressions that use these proxies to explain earnings properties may be spurious since both sides of the regression rely on the same underlying accounting data.[3]

Intuitively, the idea that price convexity can proxy for debt-related agency costs follows from the notion that a levered firm's equity can be seen as a call option on its assets (Black and Scholes 1973; Merton 1974; Myers 1977). If the firm's value exceeds the debt's face value when repayment is due, shareholders will pay off the debtholders and keep the excess value. If not, shareholders will default on the debt, and, due to limited liability, their

[2] Duke and Hunt (1990) and Dichev and Skinner (2002) argue that it is unclear how alternative proxies like leverage map to conditions in which shareholders are likely to default on the firm's debt (and thus when shareholders' incentives to expropriate debtholders become strong enough that debtholders need to act to protect their claim). Covenant violations are also often used as an indication of debt-related agency conflicts (Nikolaev 2007; Zhang 2008). However, covenants are usually set such that technical default occurs frequently. More often than one would expect, in fact, shareholders want to default on the firm's debt (Dichev and Skinner 2002). Again, the mapping between covenant violation and shareholders' incentives to expropriate debtholder wealth is not clear-cut.

[3] Most bankruptcy prediction models use financial statement data to generate estimates of default risk (Beaver 1966; Altman 1968; Ohlson 1980; Bellovary, Giacomino and Akers 2007).

payoff will be nil. As such, shareholders reap the excess when firm value increases, while facing only limited risk when firm value decreases. As a result, stock prices will respond to bad news less dramatically than to good news (Fischer and Verrecchia 1997; Core and Schrand 1999): that is the relation between equity prices and underlying information is increasing and convex. Debtholders, on the other hand, have a claim on the value of the assets minus the value of equity (Merton 1974). When price convexity is present, the downside risk associated with their claim increases. Indeed, unlike shareholders, bondholders grow ever more sensitive to price changes, since, in the price-convex region, the likelihood that shareholders will default on the debt is higher and therefore so is the risk that wealth will be transferred to shareholders at the debtholders' expense.[4] [5]

Arguably, the conflict of interest between debtholders and shareholders affects accounting by creating a demand for timely loss recognition (Watts 2003a, b; Ball and Shivakumar 2005, 2006; Ball, Robin and Sadka 2008). According to prior literature, when shareholders are closer to defaulting on the firm's debt, debtholders favor contracting mechanisms that reduce agency problems. In particular, to prevent managers from engaging in the kinds of activities that benefit shareholders at the lenders' expense, lenders contract to receive the right to monitor and control managers' actions (Jensen and Meckling 1976). Debt contracts often use accounting numbers to determine the moment when debtholders gain the right to control managers' actions. To the extent these accounting numbers reflect adverse circumstances early on and thereby trigger a timely transfer of power from managers to debtholders, the debtholders are better positioned to prevent detrimental redistributions of wealth.

Indeed, the demands that originate from contracts between firms and their suppliers of debt capital significantly shape the properties of accounting information (Smith and Warner 1979; Watts and Zimmerman 1986; Watts 2003a, b). As the firm gets closer to

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[4] Watts (2003a; 2006) makes a similar point when he argues that the limited liability of shareholders induces an asymmetric loss function for debt holders (which causes lenders to be more sensitive to losses than to gains).

[5] This can happen because managers are especially tempted to engage in asset substitution or risk shifting when the price moves into the convex region and, in an ultimate gamble to turn the firm's prospects around, managers might substitute low-variance investments for high-risk projects. Other agency problems related to a firm's closeness to default are claim dilution, underinvestment, and dividend payment (Black 1976a; Myers 1977; Smith and Warner 1979).

violating its debt covenants or to default, bondholders will increase scrutiny of the firm and expect accounting earnings to recognize losses in a more timely manner. Auditors, too, are likely to respond to the increased possibility of default, not to mention bondholder pressure, since client bankruptcy substantially intensifies their exposure to litigation (St. Pierre and Anderson 1984; Lys and Watts 1994; Krishnan and Krishnan 1997; Heninger 2001). In sum, bondholders and auditors act in unison to increase the timeliness of loss recognition in earnings.

In our first set of empirical analyses, we construct four closely related empirical measures of price convexity and confirm the theoretical notion that price convexity varies across price levels (Hayn 1995; Berger, Ofek and Swary 1996; Fischer and Verrecchia 1997). We also document that in a Basu-type regression the estimated slope coefficient on negative returns is higher in low price-level portfolios than in high price-level portfolios. We then combine both results by regressing the estimated coefficient on negative returns for every price-level portfolio onto our four measures of price convexity, which yields a consistent, strongly significant positive association between price convexity and timely loss recognition. This finding suggests that price-levels, which serve as the deflator of both the dependent and independent variables in a Basu regression, are themselves associated with agency conflicts. As such, when documenting how agency conflicts affect the accounting response to news, separating the deflator-effect becomes paramount.

In the following analyses, we refine our price-convexity proxies by measuring them at each price level. These refined measures allow us to not only analyze the effect of shareholder-bondholder conflicts on the timeliness of accounting earnings at the firm level, but also partial out the deflator effect.

We provide considerable evidence that our refined price-level specific estimates of price convexity capture the probability that wealth will be redistributed from lenders to shareholders. In particular, we show that our measure is highly correlated with the estimates of the probability of default that Altman (1968), Shumway (2001), and Moody's KMV propose. We then include our refined price-convexity proxies as simple and interaction effects in the Basu regression and show that increased levels of price convexity yield significant increases in timely loss recognition. Furthermore, we show that price convexity has a much stronger effect on firms with high leverage than on firms without debt. By including the convexity proxies in the regression, we parse the price-deflator effect from our coefficient estimates of timely loss recognition.

Finally, we examine two other contexts likely to foster shareholder-bondholder conflicts and show that, as predicted, price convexity has a greater (lesser) impact on timely loss recognition in dividend-paying (zero-dividend) firms and in firms with a speculative-grade (an investment-grade) bond rating. We also show that the consequences of price deflation vary across subsamples. Together, these findings provide evidence that price convexity captures specific agency-related problems associated with the provision of debt. In addition, we document that, as proxied by price convexity, the conflict of interest between debtholders and shareholders is a major determinant of the demand for timely loss recognition in accounting earnings.

2. Hypothesis development

The literature in finance and accounting explains the existence of price convexity in various ways as discussed below. With these explanations in mind, we argue that price convexity is a valid proxy for the severity of agency-related conflicts between shareholders and managers, on the one side, and debtholders, on the other. Moreover, we observe that accounting information plays a major role in debt contracts and we develop a testable prediction for its relation with price convexity.

A. Price convexity as a proxy for agency conflicts between shareholders and debtholders

Two closely-related explanations account for the observation that equity prices are a convex function of underlying information about future cash flows: limited liability (Fischer and Verrecchia 1997) and the abandonment option hypothesis (Berger et al. 1996).[6] Our aim is to provide a theoretical basis for the claim that price convexity measures the severity of agency-related conflicts between shareholders and debtholders.

[6] Other explanations for price convexity rely on differences in opinion among investors and on short-selling constraints (Miller 1977; Harris and Raviv 1993; Subramanyam 1996; Diether, Malloy and Scherbina 2002; Boehme, Danielsen and Sorescu 2006; Xu 2007; Xu and Zheng 2007).

In rational-trade and asset-pricing models, the assumption that equity holders bear unlimited liability yields the prediction that equity prices will incorporate information in a linear fashion. Nevertheless, Fischer and Verrecchia (1997), motivated by earlier work on the non-linear relation between returns and earnings, provide a model that suggests a non-linear mapping from information to returns.[7] They then demonstrate that assuming equity holders bear only limited liability yields the prediction that prices will react more strongly to positive than to negative public signals. Intuitively, these reactions reflect equity holders' simultaneous unlimited upside potential (i.e., their ability to capture all potential future gains) and protection from downside risk (i.e., their potential loss is limited to their initial investment).

When prices are in "the convex region", negative signals about the firm's future prospects will only marginally impact the firm's equity price because investors are already bordering on defaulting on the debt and failing to exercise their call option on the firm's assets.[8] Moreover, the value of their out-of-the-money option will be mostly insensitive to further bad news. It is precisely in these circumstances that debtholders need to be most cautious about maintaining the value of their (senior) claim on the firm's assets.

Note that one implication is that when prices are in the convex region, positive returns will be larger than negative returns, since prices respond more strongly to positive information about future cash flows than to negative information. We use this corollary below to construct empirical measures of price convexity.

Similarly, firms have the option to liquidate or adapt their assets when the assets' liquidation value or their value in alternative deployment, exceeds the future cash flows expected from continued operations. The value of this abandonment option (Berger et al. 1996) depends, in turn, on the value of expected future cash flows. Indeed, as the value of expected future cash flows increases, the abandonment option moves farther out-of-the-money and its value declines. Unfavorable information, on the other hand, will generally increase the abandonment option's value and thereby both dampen the equity price effect of

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[7] See, e.g., Beaver, Clarke and Wright (1979), Cheng, Hopwood and McKeown (1992), Freeman and Tse (1992), Das and Lev (1994), Lipe, Bryant and Widener (1998).

[8] We define the convex region more precisely later in the paper when we introduce the empirical measures of price convexity.

negative information about future cash flows and increase the likelihood that the option is exercised. Since prices continue to fully reflect positive (cash flow) information, the assumption that that shareholders possess a put option on the firm's assets also yields a non-linear relation between information and equity prices (e.g., Hayn 1995; Burgstahler and Dichev 1997; Fischer and Verrecchia 1997).

When the likelihood that shareholders will exercise their abandonment option increases, so too does the risk that debt-holders will face detrimental wealth transfers. As the firm's financial health deteriorates, the abandonment option increases in value and prices move into the convex region; at the same time, shareholders' incentives to increase the riskiness of investment projects, sell valuable property, or reduce overall investments and use the proceeds to pay more dividends also become stronger.

To summarize: the same economic forces that move prices into the convex region also provide the circumstances in which shareholder incentives to expropriate are strongest. Price convexity, therefore, is a priori a valid proxy for identifying cases in which debt-related agency problems are pronounced.

B. Price convexity and manager incentives

Thus far, we have implicitly assumed that the incentives of managers and shareholders are aligned. Indeed, we assume that debtholders want to control managers because managers can undertake, on the shareholders' behalf, actions that hurt lenders. Whether manager incentives to act in the shareholders' interest are sufficiently strong in practice remains a question, especially when the firm's financial position worsens. Note, however, that managers have their own incentives, independent of the shareholders' interests, to engage in risk shifting and other behavior potentially harmful to lenders. Guay (1999) suggests that a manager's payoff is more convex when equity prices are themselves in the convex region, especially if the manager owns stock options. Convexity in payoffs implies that managers, like shareholders, also enjoy limited downside risk. Indeed, similar to the implications of shareholder limited liability, lower downside compensation risk provides managers with incentives to engage in risk-shifting behavior and other possibly damaging actions.

Ultimately, it is the convexity of managers' and shareholders' residual claims on the firm's cash flows that both provides the incentives for opportunistic behavior when the firm's financial position deteriorates and yields a convex response of equity prices to public signals.

C. The relation between bondholder-shareholder conflicts and timely loss recognition

The role of accounting information in debt contracts has several distinct features compared with its role in other (implicit) contracts.[9] Ball and Shivakumar (2005) and Ball et al. (2008) argue that debtholders benefit when signals about their claim's value either arrive substantially through or are quickly reflected in financial statement information. Other contract parties, such as equity holders, likewise favor receiving value-relevant information but these parties are relatively indifferent to the channel through which the information arrives on the market. Since the debt contract provisions that arrange for the transfer of control over the firm's assets are usually expressed in accounting numbers (Smith and Warner 1979; Leftwich 1981; Holthausen and Leftwich 1983; Beneish and Press 1993), the degree to which these provisions shield debtholders from opportunistic actions of shareholders depends on whether the accounting numbers flag the probability of impending financial troubles in a timely manner. Indeed, bad news disclosures that do not (as yet) affect the balance sheet or the profit and loss statement will rarely trigger covenant violations and in fact offer relatively little protection to debtholder claims. The ability of accounting numbers to serve as a bellwether is therefore crucial and plays a key role in enabling debtholders to perform their monitoring function. As a consequence, Ball and Shivakumar (2005) predict that there will be a debt contract-induced demand for accounting numbers that encapsulate negative news quickly.

When a firm's default probability increases (and its stock price becomes more convex), it is not just bondholders that scrutinize the firm more closely and expect more timely loss recognition. Auditors face considerable litigation risk when bankruptcy looms (Kothari, Lys, Smith and Watts 1988; Lys and Watts 1994; Watts 2006) and their liability further increases when the firm is found not to have disclosed all pertinent bad news in a timely fashion (i.e., when it became known) (Skinner 1997). Pratt and Stice (1994) and

[9] See Easton, Monahan, and Vasvari (2009) for a detailed discussion and analysis.

Krishnan and Krishnan (1996) document that in the face of client default and increased litigation risk auditors adjust their audit plan and increase their issuance of modified opinions. Both findings suggest more vigilant auditor inspection, which is likely to produce increased conservatism in their client firms' financial statements. Indeed, in a survey conducted among Big-N auditors, Nelson et al. (2002) find that when legal liability increases, auditors more actively thwart attempts by managers to engage in upward earnings management. In some cases, auditors even become a directly interested party to the debt contract when, for example, the contract stipulates that the firm's auditors must attest that the company is not in violation of covenants or in technical default.[10] More direct evidence is provided in Basu (1997), Cahan and Zhang (2006), and Qiang (2007), all of whom document an association between timely loss recognition and auditor legal liability.

Ball and Shivakumar (2008) argue that timely loss recognition can discipline companies that need continued access to the debt-capital markets. Timely loss recognition advances the moment at which shareholders forfeit control to debtholders. Whereas credibly committing to maintaining a particular level of timely loss recognition might be difficult in practice,[11] many firms borrow capital on a repeated basis. Earning a reputation for timely loss recognition may grant these firms certain benefits (e.g., lower interest costs (Zhang 2008)), which they may risk should they subsequently deviate from their commitment. In any case, the demand for timely loss recognition is a function of how often a given firm deals with the debt market (Ball et al. 2008).

In sum, contracting-induced supply-and-demand conditions call for financial statement information able to recognize, in a timely manner, unrealized losses in earnings. Because these contracting conditions derive from the fundamental conflict of interest between

[10] Consider, for example, the following excerpt from the public debt contract of American Color Graphics, Inc., "The Company shall deliver to the Trustee, within 120 days after the end of each fiscal year, beginning with the fiscal year in which this Indenture was executed, a certificate signed by the Company's independent certified public accountants (who shall be a firm of established national reputation) stating that in making the examination necessary for certification of the Company's year-end financial statements for such fiscal year, nothing came to their attention that caused them to believe that the Company was not in compliance with any of the terms, covenants, provisions or conditions of Article Four and Section 5.01 ("COVENANTS") of this Indenture as they pertain to accounting matters."

[11] Zhang (2008) mentions the use of fixed GAAP (the use of accounting procedures that are unaffected by mandatory or voluntary choices of accounting method) as one way to commit to timely loss recognition.

shareholders and debtholders, we predict timely loss recognition to be positively associated with the severity of debt-related agency conflicts as measured by the degree of price convexity.

3. Empirical measures of price convexity

A. Theoretical notion of convexity

To develop an empirical measure of price convexity, we start with the mathematical definition of convexity: a continuous real valued function $f(.)$ is said to be convex if for all real numbers m_0 and x the following inequality holds:

$$f\left(m_0\right) \leq \frac{f(m_0+x)+f(m_0-x)}{2}$$

Rearranging this inequality yields

$$\underbrace{f(m_0+x)-f(m_0)}_{\equiv A}-(\underbrace{f(m_0)-f(m_0-x)}_{\equiv B}) \geq 0$$

The degree of convexity might be assessed by measuring the extent to which the difference between quantity A and quantity B exceeds zero. This means of assessment, however, entails unattractive empirical properties. Alternatively, as long as the function $f(.)$ is positively sloped and we restrict x to positive numbers (at no loss of generality) we arrive at

$$\frac{f(m_0+x)-f(m_0)}{f(m_0)-f(m_0-x)} \geq 1$$

Thus, we employ the following ratio as a measure of convexity:

$$ConvexityRatio \equiv \frac{A}{B} = -\frac{f(m_0+x)-f(m_0)}{f(m_0-x)-f(m_0)}$$

This ratio is the relative measure of convexity we adopt for our empirical tests. Intuitively, we view $f(.)$ as the value of equity and $f(m_0)$ as the beginning-of-period stock price. Thus, the end-of-period stock price is given by $f(m_0+x)$ or $f(m_0-x)$, depending on the sign of the news x that arrives over the period. The amount of news x can be viewed as an average or standardized amount of news. As long as the value of equity is convex, increases in value due to positive news will outweigh decreases in value due to negative news (holding the amount of information constant) and thus *ConvexityRatio* will exceed one. Since the average amount of information (either positive or negative) that arrives during a period varies across firms, it is necessary to look at the ratio of good-news price changes to bad-news price changes and not merely at the difference between the changes.

B. Measures of convexity using price-level portfolios

Since price convexity is likely to vary cross-sectionally and over time, constructing a firm-specific measure of price convexity is not straightforward. To identify the variation in convexity we use the theoretical notions discussed in Section A to argue that the degree of price convexity decreases with the *level* of price.[12] For example, a stock that trades at $5 will exhibit greater price-convexity than a stock that trades at $50.[13] The logic behind our argument is as follows. Limited liability protects investors from downside risk and thereby mutes investors' reactions to bad news. Limited liability has more immediate relevance when prices are low. Indeed, one feature of limited liability is that equity prices are bounded by zero (Fischer and Verrecchia 1997), meaning investors face limited downside and unlimited upside potential. Therefore, for stocks trading at low price levels, price convexity should be high. Alternatively, at low prices, the firm's put option on its assets (i.e., its option to either abandon its assets or adapt their use) will move into the money. Bad news about future profitability, which should have a negative effect on current stock prices, will therefore be cushioned by the increase in the abandonment option's value at low stock prices.

We refer to the empirical measure of price convexity as "price-change asymmetry." To construct measures of price-change asymmetry, we define 46 (beginning-of-year) price-level portfolios. At higher stock prices, we broaden the price interval to maintain a comparable number of observations for each portfolio.[14]

For each price-level portfolio, we construct the ratio of the average price response to "good" news arriving during a year to the average price response to "bad" news arriving

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[12] All analyses are repeated using market capitalization instead of price. Results are similar and inferences are the same.

[13] The possibility of stock splits would appear, at first sight, to contradict our statement that $5 stocks are different from $50 stocks. That is, since nothing has changed in the firm's underlying fundamentals, should a $50 stock after a 10:1 split not exhibit the same convexity as before? We argue, in contrast, that convexity would change, since research in finance suggests that stock splits can indicate agency problems. For example, both the *managerial entrenchment* and the *optimal trading range* hypotheses state that managers concerned with a takeover threat or strict monitoring may carry out stock splits in order to achieve a broad and heterogeneous shareholder base. These changes in ownership structure are expected to make takeovers more difficult since small investors may not tender their shares to a bidder as quickly as institutional investors would. In addition, small investors tend to be less vigilant monitors of the firm (Lakonishok and Lev 1987; Mukherji, Kim and Walker 1997).

[14] The boundaries of the intervals we use are given in the first column in Table 2.

during a year.[15] We expect that in the convex region positive returns will be larger than negative returns due to the equity holders' muted responses to adverse information about future cash flows. Thus,

$$PCA1 = \frac{Average\left(Ret_{jt} \mid Ret_{jt} > 0, Price\text{-}level\right)}{Average\left(\left|Ret_{jt}\right| \mid Ret_{jt} < 0, Price\text{-}level\right)} \tag{1}$$

where Ret_{jt} is the fiscal year annual returns and *PCA1* is the proxy for price-change asymmetry. To avoid potential small denominator problems, we define a very similar ratio:

$$PCA2 = \frac{1 + Average\left(Ret_{jt} \mid Ret_{jt} > 0, Price\text{-}level\right)}{1 + Average\left(\left|Ret_{jt}\right| \mid Ret_{jt} < 0, Price\text{-}level\right)} \tag{2}$$

We base our alternate price-change asymmetry proxies on a related idea. Due to price convexity, upward and downward price volatility will differ in magnitude.[16] Consequently, the alternative price-change asymmetry measure is defined as the ratio of the standard deviation of positive returns to the standard deviation of negative returns, for each price-level portfolio.

$$PCA3 = \frac{\hat{\sigma}\left(Ret_{jt} \mid Ret_{jt} > 0, Price\text{-}level\right)}{\hat{\sigma}\left(Ret_{jt} \mid Ret_{jt} < 0, Price\text{-}level\right)} \tag{3}$$

where $\hat{\sigma}$ is the standard deviation of the expression in parentheses. Like Equation (2), we also adjust this standard deviation-based proxy to avoid small denominator problems:

$$PCA4 = \frac{1 + \hat{\sigma}\left(Ret_{jt} \mid Ret_{jt} > 0, Price\text{-}level\right)}{1 + \hat{\sigma}\left(Ret_{jt} \mid Ret_{jt} < 0, Price\text{-}level\right)} \tag{4}$$

Prices are said to be in the convex region for high values of a price-change asymmetry proxy.

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[15] To avoid spurious effects that may result from using earnings as a dependent variable in subsequent earnings-returns regressions, we do not use accounting variables to measure news when constructing price-convexity proxies.

[16] The literature has documented that low stock return is associated with an increase in the subsequent return volatility (Black 1976b). This pattern, sometimes called "Black's leverage effect," while broadly consistent with the presence of non-linearity in equity prices and possibly associated with firm disclosure policies (Shin 2003), is nevertheless different from our notion of convexity in at least three respects. First, we do not condition on past returns when computing price-change asymmetry. We also do not contrast the variance of high-price level portfolios to the variance of low-price level portfolios. Finally, an implication of Black's leverage hypothesis is that we should have higher variances conditional on bad news (negative returns) and that the price-change asymmetry measure should be lower than unity. This is not what we observe empirically and price-change asymmetry, therefore, is unlikely to pick up Black's leverage effect.

C. Refined price-level measures of price convexity

We refine the first two price change-asymmetry proxies, denoted $PCA1_{jt}$ and $PCA2_{jt}$, by estimating them for each price rather than simply for each portfolio. To do so, we condition the ratios on the individual firm's stock price rather than on the somewhat cruder price-level portfolios we used before. We proceed by estimating two separate non-parametric local regressions to model the conditional mean of both positive and negative returns (Cleveland 1979; Cleveland, Devlin and Grosse 1988). Specifically, we run a local regression of positive (negative) fiscal year annual stock returns on both a constant and the inverse of the beginning-of-year stock price. In the non-parametric analysis, we use the inverse of price, rather than price, to obtain a more homogeneous distribution of the data.[17] Local regression is based on the idea that, at any point, a function can be approximated by low order polynomials. Essentially, the procedure estimates a simple Ordinary Least Squares (OLS) regression in a neighborhood around each point in the dataset and smoothes the predicted curve. We chose to measure price-change asymmetry using a non-parametric method because we argue that convexity is a non-linear function of price albeit of an unknown functional form. Our approach, then, allows us to measure price-change asymmetry more precisely. Figure 1 depicts the non-parametric estimation results.

We use the results from the non-parametric regression to construct the predicted value of positive (negative) annual returns conditional on the firm's beginning-of-year stock price. We then divide, conditional on price, the expected positive returns by the absolute value of expected negative returns to obtain refined versions of $PCA1_{jt}$ and $PCA2_{jt}$.[18]

4. Data

We obtain data from the intersection of the Center for Research in Security Prices (CRSP) and Compustat Annual Industrial files and include all firm-year observations from 1963 to 2006 for non-financial firms (i.e., firms not included in SIC codes 6000−6999). We

[17] We find similar results when we use the natural logarithm of price instead of the inverse of price. We also find similar results when we repeat the analyses with the natural logarithm of market capitalization instead of the inverse of price.

[18] As an example, consider a stock trading at $5 at the beginning of the fiscal year. The inverse of price equals 0.2. It follows from Figure 1 that, for this stock, the expected price change conditional on good news is 65 percent and the expected price change conditional on bad news is (negative) 35 percent. Price-change asymmetry, $PCA1_{jt}$, in this case equals 65/35 = 1.86, while $PCA2_{jt}$ equals (1+0.65/1+0.35) = 1.22. All stocks trading at $5 are assigned this price-change asymmetry estimate.

exclude from our dataset those firms with opening prices below $1 since they are likely to experience severe distress.[19]

All of our main empirical tests involve earnings-return regressions. The dependent variable, opening price-deflated earnings (E_{jt} / P_{jt-1}) are measured as income before extraordinary items (Compustat data item 18) scaled by beginning-of-fiscal-year stock price (Compustat data item 199) multiplied by shares outstanding (Compustat data item 25). Monthly returns compounded over the 12-month fiscal year yield the independent variable, annual returns (Ret_{jt}).[20] In sensitivity analyses, we include size, book-to-market, and leverage variables. Each of these variables is measured for each firm *j* at the beginning of the fiscal year *t;* $LogMktCap_{jt}$ is the logarithm of market capitalization (Compustat data item 199 multiplied by data item 25); the book-to-market ratio (BTM_{jt}) is the book value of equity (Compustat data item 60) scaled by market capitalization (Compustat data item 199); and leverage (Lev_{jt}) is defined as the ratio of long-term debt (Compustat data item 9) to total assets (Compustat data item 6). To reduce the effect of outliers, we exclude from the sample any observations in the top and bottom 0.5 percent of each of the variables.

Table 1 reports some selected descriptive statistics. The findings indicate similarities between our sample and those of studies that use the population of Compustat firms. Correlations among the main variables are reported in Table 4.

5. The impact of price-change asymmetry on timely loss recognition

A. Results using measures of price-change asymmetry based on price-level portfolios

Our first set of tests relies on the price-change asymmetry proxies *PCA1-PCA4* computed for each of the 46 price-level portfolios. We begin the analysis by estimating for each of the price-level portfolios piecewise linear regressions of earnings on returns conditional on the sign of returns (following Basu 1997), which yields the model,

$$E_{jt} / P_{jt-1} = \alpha_0 + \alpha_1 * D(Ret_{jt} < 0) + \beta_0 * Ret_{jt} + \beta_1 * Ret_{jt} * D(Ret_{jt} < 0) + \varepsilon_{jt}, \tag{5}$$

[19] Including these firms in the sample does not change our results.

[20] We also conduct all analyses using market-adjusted returns instead of raw returns. Using market-adjusted returns does not affect our inferences. In addition, as a robustness check to ensure that the results are not due to the market response to the announcement of the previous year's earnings, we replace fiscal-year returns with returns accumulated over a 12-month period starting four months after the beginning of the fiscal year. All conclusions remain the same.

where *D(.)* is an indicator variable that takes the value of unity when the expression in parentheses is true, 0 otherwise; all other variables remain as defined in Section 4.

Table 2 presents the estimation results of Equation (5). Column (1) reports the price-level interval. Column (2) reports the number of observations in each price-level portfolio. Columns (3) and (4) report estimates of β_0 and β_1 from Equation (5). While the estimate of the coefficient on Ret_{jt} ($\hat{\beta}_0$) remains virtually unchanged across low price-level and high price-level portfolios, the opposite is true for $\hat{\beta}_1$, the estimated coefficient on negative returns ("bad news"). For this coefficient, we find a steady decrease from a maximum value of 0.36 (at price level 2.00 to 3.00) to a minimum value of 0.07 (at price level 90 to 100). This finding is our first piece of evidence that the severity of shareholder-debtholder conflicts of interest is indeed positively correlated with timely loss recognition, as we predicted in Section 2.

Columns (5) and (6) in Table 2 provide the input for the computation of *PCA1* and *PCA2*, respectively. Column (5) reports the average return when returns are positive, while Column (6) reports the average return when returns are negative. *PCA1* and *PCA2* (reported in Columns (7) and (8), respectively) decrease, as expected, when moving from low to high price-level portfolios. Similarly, Columns (9) and (10) provide details on the standard deviation of returns when returns are positive and negative, respectively, and we use these statistics to compute the price change-asymmetry proxies *PCA3* and *PCA4* in Columns (11) and (12), respectively. Again, we find high price-change asymmetry for low price-level portfolios and low asymmetry for high price-level portfolios.

An important implication of these findings is that price-levels appear to be associated with debt-related agency costs; thus, price deflation (as in the Basu regression) can confound the relation of interest (i.e., how the estimate of the timely loss recognition coefficient varies with debt-related agency costs). Indeed, both the left-hand and the right- hand side variables in the Basu regression are deflated by price; inasmuch as price captures debt-related agency conflicts, deflation will affect the agency cost-induced cross-sectional variation in how accounting earnings record dollar return news. We highlight this issue here and address it more directly below in our analyses based on our refined price-level measure.

We also tabulate the *Skewness* of annual returns for each price-level portfolio.[21] We include *Skewness* because earlier research avers that it is associated with price convexity (Xu 2007).

Taken together, the findings in Table 2 suggest that timely loss recognition as measured by the slope coefficient on negative returns varies predictably with the degree of price-change asymmetry. We demonstrate this finding more formally in the following analysis.

We use the $\hat{\beta}_1$ estimated for each of the 46 price level-based portfolios as a dependent variable in the following regression:

$$\hat{\beta}_{1p} = c + \gamma * PCA_{pf} + \varphi Controls_p + \varepsilon_p, \qquad (6)$$

where p indicates the price level-based portfolio (p = 1,…,46) and PCA_{pf} is one of our price change-asymmetry proxies (*PCA1*, *PCA2*, *PCA3*, or *PCA4*). Estimation is based on weighted least squares using the number of observations per portfolio as weights. Table 3 presents our findings. Models (1) and (2) in Table 3, provide the baseline for our subsequent tests and regress $\hat{\beta}_{1p}$ either on the opening price-level or on *Skewness*, respectively. The next four models separately regress the same coefficient estimate onto each of our price change-asymmetry proxies. In all four models, price-change asymmetry is strongly (positively) associated with $\hat{\beta}_{1p}$. The adjusted R^2 from these regressions is about 70 percent—a significant improvement over the opening-price level (*Skewness*) baseline model, which reports an adjusted R^2 of 45 percent (less than 1 percent). These results are not sensitive to including the opening price level and *Skewness* controls ($Controls_p$) when estimating Equation (6). Indeed, the coefficient estimate $\hat{\gamma}$ on each of the price change-asymmetry proxies has a similar magnitude and the adjusted R^2s increase only slightly when the control variables are included.

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[21] We compute *Skewness* as: $\sum_{i=1}^{N}(x_i - \bar{x})^3 / N\hat{\sigma}_x^3$, where $\bar{x}$ and $\hat{\sigma}_x$ are the price-level portfolio sample mean and standard error.

The results reported in Table 3 are consistent with those reported in Table 2. Overall, these findings provide evidence consistent with the central prediction of this paper, namely, that timely loss recognition is positively associated with price-change asymmetry.

To complete the analysis, we conduct (untabulated) regressions (6) using β_{0p}, the coefficient on good news, as the dependent variable. Consistent with the idea that price-change asymmetry indicates cases in which timely *loss* recognition is important to the mitigation of agency problems related to debt contracts, we find no significant association between the coefficient on positive returns (which reflects the timely recognition of *unrealized gains*) and any of the price change-asymmetry proxies.

B. Results using refined price-level measures of price-change asymmetry

B.1. Correlations with other estimates of the probability of default

We have argued that the observation that price-change asymmetry increases as price-levels decrease likely results from the intensification of agency-related conflicts between shareholders and debtholders that accompany such a decrease. Similar arguments would explain an increased demand for timely loss recognition. Before analyzing the relation between price-change asymmetry and timely loss recognition further, however, we focus on our refined estimates of price-change asymmetry, measured at each price-level, with a view to providing empirical support for the argument that a high degree of price-change asymmetry at low prices is associated with an increasing possibility of debt-related agency conflicts. To do so, we examine the correlation among, on the one hand, our estimates of price-change asymmetry and, on the other, three estimates of the probability that shareholders will default on their debt: namely, Altman's (1968) Z-score, Shumway (2001), and Moody's KMV EDF®.[22] We include these correlations, which are based on the pooled cross-section and time-series of observations, in Table 4. We report both Pearson (below the diagonal) and Spearman (above the diagonal) correlations. All correlations are significant at at least the 0.01

[22] See Crosbie (2003) for a detailed description of the EDF® measure. Of the three measures, the Moody's KMV estimate of the default frequency is, indeed, an estimate of the probability that the firm will default on the debt and hence of the probability that the assets will pass to the debt-holders. In other words, like our price change-asymmetry estimates, this is an estimate of the likelihood of debt-related agency conflicts.

level, which suggests that our price change-asymmetry estimates are, indeed, capturing debt-related agency conflicts.

Table 4 also reports the correlations for $1/p_{jt\text{-}1}$, which is the inverse of price per share. As suggested by the price level-portfolio analyses, $1/p_{jt\text{-}1}$ is significantly associated with our proxies for price-change asymmetry. At the same time, however, its correlation with other proxies for default probability is, while significant in some instances, much lower than we report for price-change asymmetry. We draw two conclusions from this finding. First, we conclude that the inverse of price is associated with agency problems and thus that price deflation in an earnings-return regression will confound the effect of agency problems on the relation between accounting earnings and dollar-returns (news). Second, we conclude that using $1/p_{jt\text{-}1}$ as a proxy for debt-related agency costs is likely to be less effective than using our price change-asymmetry proxy since the correlations between $1/p_{jt\text{-}1}$ and the other proxies for default probability are not as high as the correlation between the proxies our proxy for price change-asymmetry.

B.2. The relation between price-change asymmetry and estimates of timely loss recognition

Our second set of tests uses the refined (price-level) proxies for price-change asymmetry (i.e., $PCA1_{jt}$ and $PCA2_{jt}$). We conduct piecewise linear cross-sectional regressions of earnings onto returns conditioned by the sign of returns. Since we are interested in the association between price convexity and timely loss recognition, we augment the specification and include proxies for price-change asymmetry, both as a simple effect and as an interaction with all other variables. Specifically, we use the model

$$\begin{aligned} E_{jt} / P_{jt-1} = \alpha_{10} + \alpha_{11} * D(Ret_{jt} < 0) + \beta_{10} * Ret_{jt} + \beta_{11} * Ret_{jt} * D(Ret_{jt} < 0) \\ + (\alpha_{20} + \alpha_{21} * D(Ret_{jt} < 0) + \beta_{20} * Ret_{jt} + \beta_{21} * Ret_{jt} * D(Ret_{jt} < 0)) * PCA_{jt} + \varepsilon_{jt}, \end{aligned} \quad (7)$$

where PCA_{jt} denotes one of the refined price-level price change-asymmetry proxies ($PCA1_{jt}$ *or* $PCA2_{jt}$) and all other variables remain as before. Equation (7) provides us with a direct test of our main prediction: timely loss recognition is positively associated with price convexity. Finding a positive and significant coefficient β_{21} would be consistent with that prediction.

We reparametrize our price change-asymmetry proxies (year-by-year) in regression (7) to obtain economically meaningful interpretations of the coefficients of interest.

Specifically, we linearly transform each proxy such that PCA_{jt} = 0 represents the minimum price change-asymmetry for sample year *t*. Such transformation does not affect the coefficient (or standard errors) of the interaction terms, but simplifies the interpretation of the simple effects (Wooldridge 2000; Jaccard and Turrisi 2003). Thus, the estimated coefficient β_{11} represents the degree of timely loss recognition for firms with minimum price-change asymmetry. This statistic allows us to estimate the timely loss recognition due to agency costs related to debt contracting. When price convexity is at a minimum, while there will be some demand for timely loss recognition, the expropriation risk to debtholders should be comparatively small. As such, we expect that for these firms, timely loss recognition will be due less to the specific default-related debt contracting demands identified by price convexity than to other (contracting) demands (see, e.g., Guay and Verrecchia 2006). By comparing β_{11} with the coefficient on timely loss recognition in a simple Basu regression, which does not control for price convexity, we can better evaluate the economic significance of convexity.

The coefficients α_{20} (on PCA_{jt}) and α_{21} (on $D(Ret_{jt}<0)*PCA_{jt}$) are also of interest. Including price-change asymmetry as both a simple term and an interaction with the negative-returns indicator variable at least partially removes the confounding effect we emphasized earlier caused by the price deflator, which is itself a proxy for debt-related agency costs.

Table 5 reports the estimation results of Equation (7). We compute Fama-MacBeth (1973) *t*-statistics derived from annual cross-sectional regressions. Model 1 replicates the familiar Basu-motivated regression excluding the price change-asymmetry proxy. Consistent with the literature, we find a significant positive coefficient on the negative returns variable ($\hat{\beta}_1$ = 0.36, *t*-statistic = 16.29). Model 2 estimates Equation (7) using price change-asymmetry proxy $PCA1_{jt}$. These findings support our prediction that price-change asymmetry is positively associated with timely loss recognition. The estimated coefficient $\hat{\beta}_{21}$ equals 0.43 (*t*-statistic = 5.35), which implies that in a Basu-type regression as price convexity increases, so too does the bad news coefficient. In Model 2, β_{11} represents the degree of timely loss recognition for firms with minimum price convexity. Compared with the baseline results in Model 1, the estimate of this coefficient is smaller ($\hat{\beta}_{11}$ = 0.24, *t*-statistic = 17.04). Nevertheless, the estimate of this coefficient remains significant, which implies that while debt-related agency costs (as proxied by price-change asymmetry) are associated with timely loss recognition, they do not completely explain it.

Turning now to the controls for the price-deflator effect, we find the following: the estimated coefficient on the simple effect of $PCA1_{jt}$, $\hat{\alpha}_{20}$, equals −0.264 (*t*-statistic = −13.57) and the interaction between $PCA1_{jt}$ and the negative returns indicator, $\hat{\alpha}_{21}$, equals −0.023, which is not significant.[23] We conclude from these findings that when estimating timely loss recognition, correcting for the price-deflator effect is important regardless of the sign of returns.

Model 3 presents the findings from estimation of Equation (7) using price change-asymmetry proxy *PCA2*. These findings are consistent with those reported for Model 2.

The estimate of the coefficient on the interaction of price-change asymmetry and good news (β_{20}) is not significant. Since our theory only predicts an association between price convexity and bad news timeliness there is no reason to believe that good-news timeliness would respond to debt-related agency costs. Correspondingly, we find that good-news timeliness is not associated with price-change asymmetry.

Taken together, these analyses using refined (price-level) price change-asymmetry proxies are consistent with our earlier findings based on price-level portfolio proxies. Essentially, in regressions of earnings onto positive and negative returns, price-change-asymmetry is strongly positively associated with the coefficient on negative returns. Thus, timely loss recognition is much more pronounced in those sample firms with severe shareholder-debtholder conflicts as measured by price convexity.

B.3. Additional analyses using refined price-level proxies for price-change asymmetry

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[23] $\hat{\alpha}_{21}$ does not attain significance in any of the subsequent tests. For the sake of brevity, we focus on $\hat{\alpha}_{20}$ when we discuss the adjustments for the price-deflator effect. However, conceptually, both coefficients need to be evaluated.

Next, we further augment the model by including variables known to influence the earnings-return relation (Freeman 1987; Easton and Zmijewski 1989; Roychowdhury and Watts 2007; LaFond and Watts 2008). This yields the following expanded model

$$\begin{aligned} E_{jt} / P_{jt-1} &= \alpha_{10} + \alpha_{11} * D(Ret_{jt} < 0) + \beta_{10} * Ret_{jt} + \beta_{11} * Ret_{jt} * D(Ret_{jt} < 0) \\ &+ (\alpha_{20} + \alpha_{21} * D(Ret_{jt} < 0) + \beta_{20} * Ret_{jt} + \beta_{21} * Ret_{jt} * D(Ret_{jt} < 0)) * PCA_{jt} \\ &+ \sum_{ki} (\alpha_{i0} + \alpha_{i1} * D(Ret_{jt} < 0) + \beta_{i0} * Ret_{jt} + \beta_{i1} * Ret_{jt} * D(Ret_{jt} < 0)) * Control_{kjt} + \varepsilon_{jt} \end{aligned} \tag{8}$$

where $Control_{kjt}$ denotes the vector of control variables that includes $LogMktCap_{jt}$, BTM_{jt}, and Lev_{jt}. Since these analyses do not change our conclusions, we do not tabulate the results. We note, however, that when we include $LogMktCap_{jt}$ as a control for size, the estimates of all coefficients on PCA_{jt} and its interactions with other variables ($\hat{\alpha}_{20}, \hat{\alpha}_{21}, \hat{\beta}_{20}$, and $\hat{\beta}_{21}$) become less significant. This finding is expected given the correlations between the logarithm of the market value of equity and the inverse of price-level $1/p_{jt-1}$, on the one hand, and price-change asymmetry, on the other (see, Table 4).[24] However, when we measure size as the logarithm of total book value of assets (or, alternatively, as the book value of liabilities plus the market value of equity), the estimates of the coefficients on the PCA_{jt} proxies are significant.

6. Price-change asymmetry in samples partitioned by leverage, dividend payments, and bond ratings

A. Further analyses for samples with zero, low and high levels of leverage

While we have argued that leverage is too crude a proxy to identify debt-related agency conflicts, it is also clear that the potential for conflict varies with the extent to which a firm relies on debt financing. Indeed, all else equal, a high level of leverage implies that debtholders have a large claim on the firm's assets (Watts and Zimmerman 1986; Ahmed et al. 2002). Debtholders in high-leverage firms are commensurately more concerned about potentially harmful activities of shareholders (and managers) than those in low-leverage

[24] When $LogMktCap_{jt}$ is used among other control variables, the coefficients on $Ret_{jt}*D(Ret_{jt}<0)*PCA_{jt}$ become insignificant in some cases. However, $LogMktCap_{jt}$ does not subsume our result, since excluding BTM_{jt} and Lev_{jt} from the analysis (i.e., controlling for $LogMktCap_{jt}$ only) yields a significant coefficient on $Ret*D(Ret<0)*PCA_{jt}$. LaFond and Watts (2008) report that size subsumes their (Probability of Informed Trade-based) proxy for information asymmetry among investors. We interpret the results for $LogMktCap_{jt}$ as being consistent with our prediction that timely loss recognition reflects debt-related agency costs as, in this context, proxied by the market value of equity.

firms. Note, however, that high leverage does not necessarily imply that the debtholders' wealth is at imminent risk of expropriation. In our sample, this fact is underscored by the low correlation between leverage and the three measures of probability of default (see Table 4). That said, when price convexity signals that the debtholders' wealth is at risk, the relation between price convexity and timely loss recognition should a priori be stronger (weaker) in high- (low-) leverage firms. We examine this expectation by partitioning the sample into zero-leverage, low-leverage and high-leverage firms. We use the median of the group of nonzero-leverage firms to split the sample into low- and high-leverage groups. Given that the mapping between leverage and expropriation risk is not straightforward, we hasten to note that empirically the expected relations might be difficult to observe. Given that leverage is a crude proxy for debt-related agency costs, we also do not necessarily expect to find monotonic patterns in the analyses below.

We first examine the effect of leverage using the price change-asymmetry measures based on each of the price-level portfolios. Table 6 reports our findings. While price change-asymmetry is positively and significantly associated with the estimated coefficient on negative returns $\hat{\beta}_1$ for each of our four proxies, the magnitude of this coefficient increases significantly as we move from the zero-leverage sample to the low-leverage and high-leverage samples. Consider, for example, the results for *PCA1*. For firms without long-term debt, the coefficient on *PCA1* is 0.14 (*t*-statistic = 4.56). For low-leverage firms the coefficient increases to 0.33 (*t*-statistic = 8.60), and for high-leverage firms, the coefficient increases further to 0.37 (*t*-statistic = 4.06). The estimates of the coefficients on the alternative price-convexity proxies (*PCA2, PCA3,* and *PCA4*) exhibit similar patterns. Untabulated results indicate that controlling for *Skewness* and for beginning-of-year price level does not significantly alter our inferences. The "Difference" column provides a formal test of our hypothesis that the estimated coefficient on PCA_{pf} will be larger for high-leverage than for zero-leverage firms. Indeed, for all our price change-asymmetry proxies, the difference between the two coefficients is significant and in the predicted direction. These findings are consistent with our expectation that the co-occurrence of high leverage and prices in the convex region describes cases in which the demand for timely loss recognition is particularly strong.

Turning now to the analyses based on the refined (price-level) price change-asymmetry proxies, we confirm our conclusions. Table 7 presents our findings. We first run the baseline model (Equation 5) for each of the three samples partitioned on leverage. We expect that the estimated timely loss recognition coefficient $\hat{\beta}_1$ will increase as we move from the zero-leverage sample to the high-leverage sample. Indeed, $\hat{\beta}_1$ increases from 0.25 (*t*-statistic = 9.99) to 0.46 (*t*-statistic = 16.42) as the level of leverage increases from zero to high, respectively. We predict that as leverage increases, so too should price-convexity. Since leverage does not directly map to the severity of debt-related agency conflicts, partitioning according to leverage captures the size of the debtholders' claim on a given firm's assets, but fails to reflect whether this claim is currently under threat of expropriation. Introducing price change-asymmetry into the regression allows us the tease out the effect of an increased probability of wealth redistribution from the effect of the size of the debtholders' claim. In addition, we observe that the increase of $\hat{\beta}_1$, with increasing leverage, captures both the effect of changes in timely loss recognition *and* the price-deflator effect. Thus, we cannot interpret the change in $\hat{\beta}_1$ in terms of debt-related agency costs until we have adequately controlled for the effect of using price as a deflator in the regression.

Indeed, Table 7 shows that $\hat{\alpha}_{20}$ is strongly significant in all specifications, which highlights the potential effect of price deflation on the analyses in each of the samples. Once we control for price deflation the coefficient $\hat{\beta}_{21}$ represents the effect of agency-related conflicts (as measured by price-change asymmetry) on timely loss recognition. $\hat{\beta}_{21}$ is approximately twice as large for high-leverage firms than for firms without long-term debt (for both $PCA1_{jt}$ and $PCA2_{jt}$) although the difference between these coefficient estimates is not statistically significant. We interpret this finding as further evidence that leverage may be a very noisy indicator of debt-related agency costs. While the coefficient on negative returns ($\hat{\beta}_{11}$), which represents the timely-loss-recognition coefficient for firms with minimum price convexity in sample year *t*, increases as we move from the zero-leverage sample through to the high-leverage sample (e.g., for $PCA2_{jt}$, it increases from 0.08 to 0.21), the effect of leverage weakens, which is consistent with the idea that low-price convexity firms have fewer agency problems regardless of their leverage.

Our conclusion therefore remains unchanged: timely loss recognition is most in demand when the threat of harmful wealth redistribution is large and when debtholders have a substantial claim on the firm's assets. These analyses support the a priori supposition that price convexity should play a greater role in high-leverage firms than in zero- and low-leverage firms; thus, these analyses also further validate our use of price-change asymmetry to identify cases with high debt-related agency costs associated with default.

B. Bond ratings and dividend payments as alternative proxies for debt-related agency costs

Excessive dividend payments are perhaps the most direct means for shareholders to potentially expropriate wealth from debtholders (Kalay 1982; Handjinicolaou and Kalay 1984). Indeed, if shareholders are not restricted by covenants, they can increase dividend payouts in at least one of three ways; by using the proceeds of additional debt raising activities; by selling the firm's assets and thus leaving debtholders with an empty shell (Black 1976a); or by under-investing in new positive net present value projects and thereby reducing the value of the firm. The level of dividend payments may indicate whether payouts are excessive. High dividend payout rates are likely to indicate more severe shareholder-debtholder conflicts of interest (Ahmed et al. 2002).

Bond rating agencies use their ratings of the firm's senior debt to express both their opinion about the firm's capacity and willingness to meet its financial commitments as they come due and their assessment of factors that could affect the firm's ultimate payment in the event of default. As a firm's debt rating deteriorates, so too does the likelihood that debtholders will be able to recover their claim. Thus, we expect debt-related agency costs to be higher for firms whose senior debt receives speculative-grade ratings than for firms with investment grade ratings.

As we did in the case of leveraged firms, we use these ideas to explore how the association between price convexity and timely loss recognition changes in contexts in which the shareholder-debtholder conflict is a priori likely to be more severe. We restrict our discussion to our findings for the refined price change-asymmetry proxies; that said, we note that when we use the measures based on price-level portfolios we obtain consistent results.

To conduct these tests, we obtain additional Compustat data on dividends and debt ratings. Dividend Yield ($DivYld_{jt}$) is common dividends (Compustat data item 21) divided by book value of equity (Compustat data item 60); and Long-term Credit Rating ($LtCr_{jt}$) is measured at the beginning of the year and is based on the Standard & Poor's senior debt ratings (reported as Compustat data item 280).

We consider two separate partitions of the sample. We first divide the sample into firms that pay dividends and firms that do not. We then divide the sample into firms with "investment-grade" ratings (between AAA and BBB−) and firms with "speculative-grade" ratings (between BB and D). Table 8 reports the findings for both dividend paying and zero-dividend firms. First, note that in contrast with the findings for samples partitioned on leverage, the magnitude of the coefficient on timely loss recognition in the original Basu model (β_1) is very similar for dividend-paying and zero-dividend firms. This finding, however, cannot be interpreted as unambiguous evidence that timely loss recognition does not is unrelated to dividend payments (a proxy for debt-related agency costs). To be able to make this claim, we first need to control for the price-deflator effect. Indeed, as Table 8 shows, while controlling for price-deflation significantly affects zero-dividend firms, it seems to have a less important effect on dividend-paying firms. For $PCA1_{jt}$, $\hat{\alpha}_{20}$ equals −0.304 (t-statistic = −15.95) for zero-dividend firms, whereas $\hat{\alpha}_{20}$ equals −0.064 (t-statistic = −3.40) for dividend-paying firms. After controlling for price-deflation, timely loss recognition differs considerably between dividend-paying and zero-dividend firms. Indeed, in those cases where price-change asymmetry indicates the presence of debt-related agency costs, the coefficient on timely loss recognition ($\hat{\beta}_{21}$) is over three times higher for dividend-paying firms than for zero-dividend firms. We observe this finding for all price change-asymmetry proxies. The "Difference" columns in Table 8 report the results of our test of the difference in coefficients between the two groups.

Table 9 reports a similar pattern. In the original Basu specification, timely loss recognition for investment grade firms appears to be quite different from that of speculative-grade firms. This finding, however, may reflect this regression's implicit inclusion of debt-related agency conflicts via the price deflator. Indeed, it turns out that the price-deflator effect is not constant across subsamples. Consider, for example, the results for $PCA1_{jt}$. In the investment-grade subsample, $\hat{\alpha}_{20}$, the estimated coefficient on $PCA1_{jt}$, equals −0.04 (*t*-statistic = −1.704). In the speculative-grade subsample, on the other hand, $\hat{\alpha}_{20}$ equals −0.38 (*t*-statistic of −6.40). After controlling for the price-deflator effect, the magnitude of the estimate of the coefficient on the interaction between negative returns and price change-asymmetry ranges from 0.56 in the investment-grade subsample to 0.88 in the speculative-grade subsample. Formal tests of the difference in coefficient estimates are consistent with our prediction but do not attain the conventional critical values. Ultimately, the association between timely loss recognition and debt-related agency costs appears to be far more consistent across credit ratings than one might glean from the original Basu specification. In addition, the estimate of the coefficient β_{11}, which represents timely loss recognition for firms with low price convexity, is much higher for speculative-grade firms than for investment-grade firms.

As we argued in our analysis of the leverage samples, we expect that the co-occurrence of high dividend payments or speculative-grade bond ratings, on the one hand, and high price convexity, on the other, identifies cases wherein the shareholder-debtholder conflict of interest is likely to become manifest and urgent. Together, these findings for each of our sample partitions—based on leverage, dividend payments, and bond ratings, respectively—consistently support our prediction that our price convexity-based proxy captures agency costs related to debt contracting. We also show that price deflation can have different effects in different samples—a finding that further emphasizes the need to control for its effect.

7. Conclusions

Timely loss recognition is often proposed as a fundamental accounting property that plays a pivotal role in debt contracting. Indeed, in the past decade much empirical research has addressed this subject. This body of work indicates that timely loss recognition functions as an instrument for reducing the conflict of interest between shareholders and debtholders. To protect debtholder claims, lending contracts usually specify that decision-making power be transferred to debtholders when there is a high probability that shareholders will try to redistribute wealth away from lenders. As a rule, such contractual provisions use information derived from financial statements to trigger the transfer of decision-making power. Contracting parties therefore benefit from financial statements that quickly reflect adverse news about the economic fundamentals of the firm; hence the debt contract-related demand for timely loss recognition. That said, extant tests of the relation between timely loss recognition and the severity of debt-related agency problems suffer from the crudeness of available proxies for the shareholder-debtholder conflict. As a consequence, such tests lack power and their findings cannot be attributed unambiguously to debt contracting.

In contrast, we propose a simple measure derived from economic theory that identifies circumstances in which the conflict between shareholders and debtholders is likely to be urgent. Price convexity varies with the value of the shareholders' call option on the firm's assets. When this call option is out-of-the-money, debtholders' risk of expropriation is high because the shareholders are essentially growing ever closer to defaulting on the firm's debt. In such cases, price convexity will likewise be high because the firm's stock price will be relatively impervious to additional bad news since the shareholders' liability, and therefore the amount they stand to lose, is limited.

Given the above, we demonstrate that timely loss recognition is strongly positively associated with debt-related agency problems as measured by price change-asymmetry. We also show that in those contexts where price convexity is more likely to be important—in particular in firms with high leverage, high dividend payouts, or speculative bond ratings—timely loss recognition is more evident. This finding is consistent with the idea that since the potential for shareholder-debtholder conflicts is higher in such firms, so is the a priori demand for timely loss recognition. By including price change-asymmetry in the analysis, we can identify not only the potential for debt-related agency conflicts, but also precisely when these conflicts are likely to become manifest and urgent.

Our examination of price convexity reveals that debt-related agency costs vary with price levels. This finding has important implications for using earnings-return regressions deflated by price to examine the effect of agency costs on timely loss recognition. Price deflation conditions both the dependent and independent variables in the Basu regression on the magnitude of debt-related agency costs. Indeed, when these agency costs are the focus of analysis, price deflation obscures the relation of interest. Consequently, to remove this effect of price deflation, we include in the regression our proxy for debt-related agency costs both as simple and interaction terms.

For our conclusions to pass muster, we must be able to measure price convexity reliably. While we rely on economic theory to inform our measures and while we use several different proxies for price convexity, all of which produce consistent results in our analyses, the issue of how to capture price convexity remains largely unsettled. Indeed, as far as we are aware, we are the first to suggest using a refined price-based measure of convexity. Our proxies have the additional advantage of imposing few data requirements, which allows us to use broad-based samples. Nevertheless, it is possible that our price change-asymmetry variables are simply too crude to capture the shareholder-debtholder conflict of interest. Future researchers may find it worthwhile to improve on our proxies given that price convexity is likely to play a role in many other settings in which accountants are interested.

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Table 1
Descriptive Statistics

Variable	N	Mean	Std. Dev.	Min	Q1	Median	Q3	Max
Ret_{jt}	126981	0.135	0.581	-0.898	-0.215	0.053	0.351	4.129
E_{jt}/P_{jt-1}	126981	0.012	0.224	-2.327	-0.003	0.056	0.100	0.563
$PCA1_{jt}$	126980	0.403	0.228	0.000	0.247	0.326	0.499	1.130
$PCA2_{jt}$	126980	0.112	0.079	0.000	0.052	0.088	0.141	0.444
$Altman_{jt}$	120855	0.008	0.006	0.000	0.005	0.009	0.012	0.970
$Shumway_{jt}$	123151	0.025	0.102	0.000	0.001	0.002	0.007	1.000
KMV_{jt}	62753	3.201	5.189	0.020	0.237	0.936	3.294	20.00
$1/p_{jt}$	126981	0.175	0.507	0.000	0.038	0.072	0.164	32.000
$LogMktCap_{jt}$	125908	4.802	2.028	-1.245	3.300	4.650	6.198	10.510
BTM_{jt}	124274	0.727	0.666	-6.263	0.320	0.571	0.953	5.901
Lev_{jt}	126981	0.182	0.173	0.000	0.021	0.150	0.289	1.000
$DivYld_{jt}$	124111	0.021	0.033	0.000	0.000	0.000	0.036	0.220
$LtCr_{jt}$	19113	11.554	3.902	2.000	9.000	11.000	15.000	29.000

Table 1 reports selected descriptive statistics. Opening price-deflated earnings (E_{jt}/P_{jt-1}) are measured as income before extraordinary items (Compustat data item 18) scaled by beginning of the fiscal year stock price (Compustat data item 199) multiplied by shares outstanding (Compustat data item 25). $PCA1_{jt}$ and $PCA2_{jt}$ are price-level price change-asymmetry measures used in cross-sectional analysis in Table 5. To construct refined price-level measures of price change-asymmetry, we model the conditional mean of positive (negative) returns by estimating a non-parametric local regression of positive (negative) returns on a constant and the inverse of the beginning-of-the-year price (we use the inverse of price instead of price to obtain a more homogeneous distribution of the data when conducting the non-parametric analysis). The results from the non-parametric regression are used to construct the predicted value of positive (negative) returns conditional on the firm's beginning of the year stock price; subsequently, we divide, conditional on price, the expected positive returns by the expected negative returns to obtain *PCA1* and *PCA2*. Annual returns (Ret_{jt}) are obtained from monthly returns compounded over the 12-month fiscal year. *Size* is the logarithm of market capitalization (Compustat data item 199 multiplied by data item 25). $Altman_{jt}$ is the probability of bankruptcy based on the Altman (1968) estimates and $Shumway_{jt}$ is the probability of bankruptcy based on the model in Shumway (2001). KMV_{jt} is the estimate of default frequency (EDF®) provided by Moody's KMV, and $1/p_{jt}$ is the inverse of price (used in non-parametric regressions). The book-to-market ratio (BTM_{jt}) is the book value of equity (Compustat data item 60) scaled by market capitalization (Compustat data item 199). $LogMktCap_{jt}$ is the logarithm of market capitalization (Compustat data item 199 multiplied by data item 25). The book-to-market ratio (BTM_{jt}) is the book value of equity (Compustat data item 60) scaled by market capitalization (Compustat data item 199 multiplied by data item 25). Leverage (Lev_{jt}) is defined as the ratio of long-term debt (Compustat data item 9) to total assets (Compustat data item 60). $DivYld_{jt}$ is dividend yield calculated as a ratio of dividends (Compustat data item 21) to book value of equity (Compustat data item 60). $LtCr_{jt}$ is long-term credit rating by S&P (Compusat data item 280). We use the complete CRSP-Compustat (1963-2006) population of non-financial firms truncating 0.5 percent of observations at each tail to mitigate the influence of outliers.

T a b l e 2
Piecewise linear Earnings-Return Relation and Price-Change Asymmetry: Portfolio Level Estimates

Price Level portfolio ($)	# Obs.	$\hat{\beta}_0$	$\hat{\beta}_1$	Avg(Ret_{jt} | $Ret_{jt} > 0$)	Avg(Ret_{jt} | $Ret_{jt} < 0$)	*PCA1*	*PCA2*	$\hat{\sigma}$ (Ret_{jt} | $Ret_{jt} > 0$)	$\hat{\sigma}$ (Ret_{jt} | $Ret_{jt} < 0$)	*PCA3*	*PCA4*	*Skewness*
(1)	(2)	(3)	(4)	(5)	(6)	(7)= -(5)/(6)	(8)= [(5)+1]/ [-(6)+1]	(9)	(10)	(11)= (9)/(10)	(12)= [(9)+1]/ [(10)+1]	(13)
1.00 to 2	5802	0.03	0.33	0.80	-0.37	2.15	1.31	0.83	0.23	3.57	1.48	1.72
2.00 to 3	5997	0.01	0.36	0.74	-0.36	2.05	1.28	0.78	0.23	3.32	1.44	1.74
3 to 4	6277	0.03	0.32	0.67	-0.35	1.90	1.23	0.70	0.23	3.07	1.38	1.75
4 to 5	5808	0.03	0.32	0.61	-0.34	1.82	1.21	0.65	0.23	2.89	1.35	1.74
5 to 6	5339	0.03	0.30	0.58	-0.34	1.74	1.18	0.64	0.22	2.88	1.34	1.82
6 to 7	4993	0.02	0.34	0.55	-0.34	1.65	1.16	0.57	0.23	2.53	1.28	1.61
7 to 8	5257	0.02	0.30	0.55	-0.33	1.69	1.17	0.60	0.22	2.73	1.31	1.78
8 to 9	4539	0.03	0.25	0.55	-0.31	1.77	1.18	0.58	0.22	2.69	1.30	1.71
9 to 10	4103	0.03	0.23	0.54	-0.31	1.75	1.18	0.57	0.21	2.68	1.29	1.72
10 to 11	3816	0.03	0.24	0.52	-0.30	1.73	1.17	0.55	0.21	2.59	1.28	1.73
11 to 12	3514	0.03	0.26	0.50	-0.29	1.70	1.16	0.51	0.21	2.43	1.25	1.56
12 to 13	3442	0.04	0.22	0.48	-0.31	1.56	1.13	0.53	0.21	2.54	1.27	1.88
13 to 14	3484	0.01	0.26	0.45	-0.30	1.52	1.12	0.49	0.21	2.36	1.23	1.75
14 to 15	3382	0.03	0.15	0.44	-0.29	1.50	1.11	0.50	0.21	2.34	1.23	1.78
15 to 16	3200	0.03	0.18	0.44	-0.28	1.56	1.12	0.46	0.20	2.24	1.21	1.69
16 to 17	3102	0.02	0.20	0.42	-0.29	1.46	1.10	0.45	0.21	2.14	1.20	1.69
17 to 18	3003	0.02	0.17	0.42	-0.28	1.53	1.11	0.45	0.21	2.12	1.20	1.67
18 to 19	2914	0.03	0.13	0.42	-0.27	1.60	1.13	0.47	0.20	2.30	1.22	1.84
19 to 20	2642	0.04	0.12	0.43	-0.26	1.64	1.13	0.46	0.20	2.29	1.22	1.81
20 to 21	2321	0.01	0.16	0.40	-0.26	1.54	1.11	0.44	0.20	2.17	1.20	1.89
21 to 22	2178	0.04	0.13	0.38	-0.25	1.51	1.10	0.42	0.20	2.14	1.19	1.73
22 to 23	2132	0.03	0.14	0.40	-0.26	1.54	1.11	0.44	0.20	2.16	1.20	1.86
23 to 24	2361	0.02	0.09	0.37	-0.25	1.47	1.09	0.39	0.19	2.00	1.16	1.59
24 to 25	2153	0.02	0.15	0.39	-0.25	1.56	1.11	0.39	0.21	1.89	1.15	1.21
25 to 26	2027	0.04	0.10	0.37	-0.25	1.50	1.10	0.39	0.20	1.92	1.15	1.40
26 to 27	1901	0.02	0.14	0.36	-0.25	1.44	1.09	0.36	0.20	1.82	1.13	1.22
27 to 28	1814	0.02	0.12	0.36	-0.24	1.53	1.10	0.38	0.19	1.97	1.16	1.66
28 to 29	1681	0.03	0.10	0.35	-0.25	1.42	1.08	0.35	0.20	1.77	1.13	1.18
29 to 30	1557	0.03	0.16	0.36	-0.24	1.47	1.09	0.35	0.20	1.73	1.12	1.12
30 to 31	1417	0.03	0.17	0.33	-0.25	1.35	1.07	0.31	0.20	1.57	1.09	0.93
31 to 32	1307	0.01	0.13	0.35	-0.23	1.55	1.10	0.39	0.18	2.17	1.18	1.99
32 to 33	1295	0.01	0.14	0.36	-0.24	1.48	1.09	0.39	0.20	1.91	1.15	1.83
33 to 34	1255	0.00	0.11	0.35	-0.23	1.53	1.10	0.37	0.19	1.96	1.15	1.78
34 to 35	1242	0.01	0.09	0.36	-0.23	1.55	1.10	0.41	0.19	2.08	1.18	2.11
35 to 36	1121	0.01	0.08	0.34	-0.23	1.43	1.08	0.37	0.20	1.86	1.14	1.66
36 to 37	1102	0.01	0.12	0.36	-0.23	1.56	1.11	0.35	0.20	1.78	1.13	1.28
37 to 38	1026	0.00	0.13	0.35	-0.23	1.51	1.10	0.40	0.19	2.09	1.17	2.28
38 to 39	964	0.03	0.10	0.35	-0.23	1.50	1.09	0.33	0.20	1.64	1.11	0.94
39 to 40	905	0.04	0.14	0.34	-0.23	1.51	1.09	0.31	0.19	1.68	1.11	0.94
40 to 50	6129	0.01	0.11	0.34	-0.22	1.55	1.10	0.36	0.19	1.89	1.14	1.63
50 to 60	3294	0.01	0.10	0.33	-0.22	1.52	1.09	0.32	0.19	1.70	1.11	1.29
60 to 70	1781	0.00	0.11	0.33	-0.23	1.44	1.08	0.35	0.20	1.76	1.12	1.51
70 to 80	1060	0.00	0.11	0.33	-0.24	1.39	1.07	0.39	0.21	1.81	1.14	2.27
80 to 90	594	0.01	0.07	0.36	-0.25	1.44	1.09	0.40	0.22	1.77	1.14	1.64
90 to 100	328	0.01	0.09	0.35	-0.25	1.42	1.08	0.33	0.21	1.53	1.09	0.76
≥100	929	0.01	0.12	0.37	-0.26	1.42	1.09	0.49	0.23	2.18	1.22	2.49

Table 2 compares the estimates from piecewise-linear regressions of earnings onto returns conditional on the sign of returns with four proxies of price-change asymmetry (*PCA1-PCA4*). The following model is estimated for each of the 46 price-level portfolios:

$$E_{jt} / P_{jt-1} = \alpha_0 + \alpha_1 * D(Ret_{jt} < 0) + \beta_0 * Ret_{jt} + \beta_1 * Ret_{jt} * D(Ret_{jt} < 0) + \varepsilon_{jt},$$

where E_{jt} is earnings, measured as income before extraordinary items (Compustat item 18), P_{jt-1} is beginning of the period market capitalization (Compustat item 199 multiplied by Compustat item 25); Ret_{jt} is stock return compounded over the 12-month fiscal year and *D(.)* is an indicator function. Price-level portfolios are given by intervals specified in the first column; the intervals widen with price to maintain approximately the same number of observations in each portfolio. Firms are allocated across the intervals based on the beginning-of-period price. *PCA1 – PCA4* proxy for price-change asymmetry. *PCA1* is the ratio of average positive fiscal-year returns to average negative fiscal-year returns: $PCA1 = Average(Ret_{jt} | Ret_{jt} > 0) / Average(|Ret_{jt}| \, | Ret_{jt} < 0)$. *PCA2* is defined in a similar way but uses gross returns to avoid small denominator problem: $PCA2 = [Average(Ret_{jt} | Ret_{jt} > 0)+1] / [Average(|Ret_{jt}| \, | Ret_{jt} < 0)+1]$. *PCA3* is the ratio of the standard deviation of positive fiscal-year returns to the standard deviation of negative fiscal-year returns: $PCA3 = \hat{\sigma}(Ret_{jt} | Ret_{jt} > 0) / \hat{\sigma}(Ret_{jt} | Ret_{jt} < 0)$. $PCA4 = [\hat{\sigma}(Ret_{jt} | Ret_{jt} > 0) + 1] / [\hat{\sigma}(Ret_{jt} | Ret_{jt} < 0) + 1]$ is analogous to *PCA3* but adds 1 to both numerator and denominator. *Skewness* is computed as the third moment of return distribution about the mean (scaled by the cube of the variance). We use the complete CRSP-Compustat (1963-2006) population of non-financial firms to estimate the model truncating 0.5 percent of observations at each tail to mitigate the influence of outliers.

Table 3

Regressions of $\hat{\beta}_1$ Slope Coefficient from Piecewise Linear Earnings-Return Relation on Estimates of Price-Change Asymmetry

Variable	Statistic	MODEL1	MODEL2	MODEL3	MODEL4	MODEL5	MODEL6	MODEL7	MODEL8	MODEL9	MODEL10
Intercept	**Estimate**	**0.239**	**0.114**	**-0.457**	**-1.340**	**-0.160**	**-0.780**	**-0.289**	**-1.071**	**-0.078**	**-0.688**
	t-statistic	16.79	2.02	-6.43	-10.06	-5.38	-9.94	-3.06	-6.30	-1.91	-7.12
	p-value	0.000	0.049	0.000	0.000	0.000	0.000	0.004	0.000	0.063	0.000
Price level	**Estimate**	**-0.002**						**-0.001**	**-0.001**	**0.000**	**-0.001**
	t-statistic	*-6.11*						*-2.65*	*-2.40*	*-0.91*	*-1.64*
	p-value	0.000						0.011	0.021	0.370	0.109
Skewness	**Estimate**		**0.035**					**0.004**	**0.000**	**-0.058**	**-0.048**
	t-statistic		*1.03*					*0.20*	*-0.01*	*-3.21*	*-2.93*
	p-value		0.308					0.845	0.990	0.003	0.005
PCA1	**Estimate**			**0.399**				**0.306**			
	t-statistic			*8.88*				*5.50*			
	p-value			0.000				0.000			
PCA2	**Estimate**				**1.343**				**1.124**		
	t-statistic				*11.36*				*7.56*		
	p-value				0.000				0.000		
PCA3	**Estimate**					**0.151**				**0.161**	
	t-statistic					*11.37*				*8.73*	
	p-value					0.000				0.000	
PCA4	**Estimate**						**0.789**				**0.789**
	t-statistic						*12.15*				*9.47*
	p-value						0.000				0.000
Adj. R-Sq		0.446	0.001	0.634	0.740	0.740	0.765	0.671	0.761	0.799	0.820

The analysis in Table 3 is based on the estimates reported in Table 2. The following model is estimated based on 46 price-level portfolio observations using weighted least squares (weights are given by the number of observations in each portfolio):

$$\hat{\beta}_{1p} = c + \gamma\, PCA_p + \varphi * Controls_p + \varepsilon \quad (6),$$

where PCA_p is one of our estimates of price-change asymmetry (*PCA1*, *PCA2*, *PCA3*, or *PCA4*). *PCA1* is the ratio of average positive fiscal-year returns to average negative fiscal-year returns: $PCA1 = Average(Ret_{jt} \mid Ret_{jt} > 0) / Average(|Ret_{jt}| \mid Ret_{jt} < 0)$. *PCA2* is defined in a similar way but uses one-plus returns to avoid small denominator problems: $PCA2 = [Average(Ret_{jt} \mid Ret_{jt} > 0) + 1] / [Average(|Ret_{jt}| \mid Ret_{jt} < 0) + 1]$. *PCA3* is the ratio of standard deviation of positive fiscal- year returns to standard deviation of negative fiscal-year returns: $PCA3 = \hat{\sigma}(Ret_{jt} | Ret_{jt} > 0) / \hat{\sigma}(Ret_{jt} | Ret_{jt} < 0)$. $PCA4 = [\hat{\sigma}(Ret_{jt} | Ret_{jt} > 0)+1] / [\hat{\sigma}(Ret_{jt} | Ret_{jt} < 0)+1]$ is analogous to *PCA3* but adds 1 to both numerator and denominator. *Price level* and *Skewness* of returns are used as control variables (omitted in some specifications). Price levels are given by intervals specified in the first column of Table 2. The lower bound of each interval is used as a control variable. *Skewness* is computed as the third moment of return distribution about the mean (scaled by the cube of the variance). β_1 is estimated by running the following regression for each price-level portfolio:

$$E_{jt} / P_{jt-1} = \alpha_0 + \alpha_1 * D(Ret_{jt} < 0) + \beta_0 * Ret_{jt} + \beta_1 * Ret_{jt} * D(Ret_{jt} < 0) + \varepsilon_{jt} \quad (B),$$

where E_{jt} is earnings, measured as income before extraordinary items (Compustat item 18), P_{jt-1} is beginning-of-period market capitalization (Compustat item 199 times Compustat item 25); Ret_{jt} is stock return compounded over the 12 months of the fiscal year and *D(.)* is an indicator function. Firms are allocated to portfolios based on the beginning-of-period price. We use the complete CRSP-Compustat (1963-2006) population of non-financial firms to estimate equation (*B*) truncating 0.5 percent of observations at each tail to mitigate the influence of outliers.

Table 4

Correlations among Main Variables Including Firm-Specific Estimates of Price-Change Asymmetry and Estimates of the Probability of Default

Variable	Ret_{jt}	E_{jt}/P_{jt-1}	$PCA1_{jt}$	$PCA2_{jt}$	$Shumway_{jt}$	$Altman_{jt}$	KMV_{jt}	$1/p_{jt}$	$Size_{jt}$	BTM_{jt}	Lev_{jt}	$DivYld_{jt}$	$LtCr_{jt}$
Ret_{jt}	1	0.42	-0.17	-0.18	-0.60	-0.19	-0.39	-0.07	0.04	0.15	0.03	0.11	-0.08
E_{jt}/P_{jt-1}	0.20	1	-0.26	-0.26	-0.49	0.12	-0.37	-0.27	0.05	0.26	0.15	0.35	-0.22
$PCA1_{jt}$	-0.09	-0.37	1	0.99	0.51	0.16	0.66	0.81	-0.71	0.22	-0.07	-0.38	0.45
$PCA2_{jt}$	-0.10	-0.38	1.00	1	0.54	0.16	0.68	0.85	-0.73	0.23	-0.07	-0.40	0.54
$Shumway_{jt}$	-0.22	-0.47	0.35	0.35	1	0.41	0.45	0.56	-0.48	0.03	0.12	-0.40	0.56
$Altman_{jt}$	-0.15	-0.03	0.09	0.09	0.09	1	0.77	0.14	-0.18	0.52	0.56	0.13	0.33
KMV_{jt}	-0.28	-0.47	0.59	0.60	0.50	0.40	1	0.69	-0.64	0.23	0.08	-0.46	0.64
$1/p_{jt}$	0.02	-0.24	0.47	0.49	0.21	0.01	0.31	1	-0.71	0.25	-0.08	-0.50	0.62
$LogMktCap_{jt}$	-0.03	0.16	-0.64	-0.66	-0.18	-0.10	-0.48	-0.29	1	-0.34	0.10	0.35	-0.60
BTM_{jt}	0.11	-0.02	0.21	0.21	-0.08	0.29	0.20	0.11	-0.34	1	0.13	0.13	0.12
Lev_{jt}	0.00	0.00	-0.04	-0.04	0.03	0.37	0.11	-0.03	0.08	0.03	1	0.15	0.50
$DivYld_{jt}$	0.01	0.20	-0.32	-0.33	-0.14	0.06	-0.22	-0.15	0.34	-0.04	0.08	1.00	-0.69
$LtCr_{jt}$	0.01	-0.27	0.50	0.55	0.23	0.29	0.40	0.32	-0.61	0.10	0.49	-0.59	1

Table 4 reports correlations (Pearson below the diagonal and Spearman above the diagonal) based on the pooled cross-section end time-series of observations. Opening price-deflated earnings (E_t /P_{t-1}) are measured as income before extraordinary items (Compustat data item 18) scaled by beginning-of-fiscal-year stock price (Compustat data item 199) multiplied by shares outstanding (Compustat data item 25). $PCA1_{jt}$ and $PCA2_{jt}$ are price-level price change-asymmetry measures used in cross-sectional analysis in Table 5. To construct price-level estimates of price-change asymmetry, we model the conditional mean of positive (negative) returns by estimating a non-parametric local regression of positive (negative) returns on a constant and the inverse of the beginning-of-year price (we use the inverse of price instead of price to obtain a more homogeneous distribution of the data when conducting the non-parametric analysis). The results from the non-parametric regression are used to construct the predicted value of positive (negative) returns conditional on the firm's beginning-of-year stock price; subsequently, we divide, conditional on price, the expected positive returns by the expected negative returns to obtain $PCA1_{jt}$ and $PCA2_{jt}$. Annual returns (Ret_{jt}) are compounded over the 12-month fiscal year. $LogMktCap_{jt}$ is the logarithm of market capitalization (Compustat data item 199 multiplied by data item 25). $Altman_{jt}$ is the probability of bankruptcy based on the Altman (1968) estimates and $Shumway_{jt}$ is the probability of bankruptcy based on model in Shumway (2001). KMV_{jt} is the estimate of default frequency (EDF®) provided by Moody's KMV, and $1/p_{jt}$ is the inverse of price (used in the non-parametric regressions). The book-to-market ratio (BTM_{jt}) is the book value of equity (Compustat data item 60) scaled by market capitalization (Compustat data item 199 multiplied by data item 25). $LogMktCap_{jt}$ is the logarithm of market capitalization (Compustat data item 199 multiplied by data item 25). The book-to-market ratio (BTM_{jt}) is the book value of equity (Compustat data item 60) scaled by market capitalization (Compustat data item 199 multiplied by data item 25). Leverage (Lev_{jt}) is defined as the ratio of long-term debt (Compustat data item 9) to total assets (Compustat data item 60). $DivYld_{jt}$ is dividend yield calculated as a ratio of dividends (Compustat data item 21) to book value of equity (Compustat data item 60). $LtCr_{jt}$ is long-term credit rating by S&P (Compustat data item 280). We use the complete CRSP-Compustat (1963−2006) population of non-financial firms truncating 0.5 percent of observations at each tail to mitigate the influence of outliers.

T a b l e 5

Price-level Estimates of Price-Change Asymmetry and Timely Loss Recognition

$$E_{jt} / P_{jt-1} = \alpha_{10} + \alpha_{11} * D(Ret_{jt} < 0) + \beta_{10} * Ret_{jt} + \beta_{11} * Ret_{jt} * D(Ret_{jt} < 0)$$
$$+ (\alpha_{20} + \alpha_{21} * D(Ret_{jt} < 0) + \beta_{20} * Ret_{jt} + \beta_{21} * Ret_{jt} * D(Ret_{jt} < 0)) * PCA_{jt} + \varepsilon_{jt}$$

Variable	**Statistic**	**MODEL1**	**MODEL2**	**MODEL3**
PCA_{jt} =			$\boldsymbol{PCA1_{jt}}$	$\boldsymbol{PCA2_{jt}}$
Intercept	Estimate	0.046***	0.032***	0.030***
	t-statistic	7.04	4.12	3.85
$D(Ret_{jt}<0)$	Estimate	0.002	0.003	0.003
	t-statistic	0.45	0.99	0.93
Ret_{jt}	Estimate	0.022***	0.044***	0.047***
	t-statistic	3.56	8.03	8.46
$D(Ret_{jt}<0)*Ret_{jt}$	Estimate	0.361***	0.237***	0.222***
	t-statistic	16.29	17.04	16.87
PCA_{jt}	Estimate		-0.264***	-0.818***
	t-statistic		-13.57	-13.58
$PCA_{jt} *D(Ret_{jt}<0)$	Estimate		-0.023	-0.067
	t-statistic		-1.18	-1.11
$PCA_{jt} *Ret_{jt}$	Estimate		0.019	0.043
	t-statistic		1.14	0.79
$PCA_{jt} *D(Ret_{jt}<0)*Ret_{jt}$	Estimate		0.427***	1.447***
	t-statistic		5.35	5.70
Adj. R-squared		0.136	0.214	0.221

To construct price-level estimates of price-change asymmetry, we model the conditional mean of positive (negative) returns by estimating a non-parametric local regression of positive (negative) returns on a constant and the inverse of the beginning-of-year price (we use the inverse of price instead of price to obtain a more homogeneous distribution of the data when conducting the non-parametric analysis). The results from the non-parametric regression are used to construct the predicted value of positive (negative) returns conditional on the firm's beginning-of-year stock price. Subsequently, we divide, conditional on price, the expected positive returns by the expected negative returns to obtain refined price-level versions of $PCA1_{jt}$ and $PCA2_{jt}$ (denoted by PCA_{jt} in the model). Opening price-deflated earnings (E_{jt} /P_{jt-1}) are measured as income before extraordinary items (Compustat item 18) scaled by beginning-of-fiscal-year stock price (Compustat item 199) multiplied by shares outstanding (Compustat item 25). Annual returns (Ret_{jt}) are compounded over the 12-month fiscal year. Following Fama-MacBeth (1973), the coefficient estimates and *t*-statistics are based on annual cross-sectional regressions. The control variables are measured at the beginning of the fiscal year. To facilitate the interpretation, $PCA1_{jt}$ and $PCA2_{jt}$ are transformed year by year such that $PCA_{jt} = 0$ corresponds to the sample minimum value of price-change asymmetry. We use the complete CRSP-Compustat (1963–2006) population of non-financial firms truncating 0.5 percent of observations at each tail of all variables to reduce the effect of outliers.

Table 6

Regressions of the Estimated Timely Loss Recognition Coefficient $\hat{\beta}_1$ on Estimates of Price-Change Asymmetry Using Samples Partitioned on Leverage

		Zero Leverage				Low Leverage				High Leverage				Difference
Variable	**Stats**	Model1	Model2	Model3	Model4	Model1	Model2	Model3	Model4	Model1	Model2	Model3	Model4	
Intercept	**Estimate**	**-0.087**	**-0.674**	**-0.063**	**-0.439**	**-0.382**	**-1.207**	**-0.127**	**-0.639**	**-0.387**	**-1.697**	**-0.199**	**-1.061**	
	t-statistic	-1.716	-5.137	-1.738	-4.572	-6.177	-10.531	-4.978	-9.412	-2.654	-6.015	-3.508	-7.017	
	p-value	0.093	0.000	0.089	0.000	0.000	0.000	0.000	0.000	0.011	0.000	0.001	0.000	
PCA1	**Estimate**	**0.142**				**0.334**				**0.370**				**0.229**
	t-statistic	4.556				8.599				4.056				2.372
	p-value	0.000				0.000				0.000				0.018
PCA2	**Estimate**		**0.714**				**1.201**				**1.693**			**0.979**
	t-statistic		6.213				11.825				6.734			3.541
	p-value		0.000				0.000				0.000			0.000
PCA3	**Estimate**			**0.085**				**0.123**				**0.192**		**0.107**
	t-statistic			5.765				10.967				7.221		3.521
	p-value			0.000				0.000				0.000		0.000
PCA4	**Estimate**				**0.462**				**0.648**				**1.068**	**0.606**
	t-statistic				6.047				11.608				8.369	4.076
	p-value				0.000				0.000				0.000	0.000
Adj. R-Sq		0.310	0.461	0.423	0.447	0.618	0.755	0.726	0.748	0.256	0.496	0.532	0.605	

The following model is estimated based on 46 price-level observations for each leverage-based subsample using weighted least squares (weights are given by the number of observations in each portfolio):

$$\hat{\beta}_{1p} = c + \gamma\, PCA_p + \varepsilon \qquad (A),$$

where PCA_p is one of our estimates of price-change asymmetry (*PCA1*, *PCA2*, *PCA3*, or *PCA4*). *PCA1* is the ratio of average positive fiscal-year returns to average negative fiscal-year returns: $PCA1 = Average(Ret_{jt} \mid Ret_{jt} > 0) / Average(|Ret_{jt}| \mid Ret_{jt} < 0)$. *PCA2* is defined in a similar way, but uses one-plus returns to avoid small denominator problems: $PCA2 = Average(Ret_{jt}+1 \mid Ret_{jt} > 0) / Average(|Ret_{jt}|+1 \mid Ret_{jt} < 0)$. *PCA3* is the ratio of standard deviation of positive fiscal-year returns to standard deviation of negative fiscal-year returns: $PCA3 = \hat{\sigma}(Ret_{jt} \mid Ret_{jt} > 0) / \hat{\sigma}(Ret_{jt} \mid Ret_{jt} < 0)$. $PCA4 = [\hat{\sigma}(Ret_{jt} \mid Ret_{jt} > 0)+1] / [\hat{\sigma}(Ret_{jt} \mid Ret_{jt} < 0)+1]$ is analogous to *PCA3*, but adds 1 to both numerator and denominator. β_1 is estimated by running the following regression for each price level portfolio:

$$E_{jt} / P_{jt-1} = \alpha_0 + \alpha_1 * D(Ret_{jt} < 0) + \beta_0 * Ret_{jt} + \beta_1 * Ret_{jt} * D(Ret_{jt} < 0) + \varepsilon_{jt} \qquad (B),$$

where E_{jt} is earnings, measured as income before extraordinary items (Compustat item 18), P_{jt-1} is beginning-of-period market capitalization (Compustat item 199 times Compustat item 25); Ret_{jt} is stock return compounded over the 12-month fiscal year and *D(.)* is an indicator function. Firms are allocated to portfolios based on the beginning-of-period price. Leverage is measured at the beginning of fiscal year and is defined as long term debt (Compustat item 9) divided by total assets (Compustat item 6). The sample is split into high and low groups at the median value of nonzero leverage companies. We use the complete CRSP-

Compustat (1963−2006) population of non-financial firms to estimate equation (*B*) truncating 0.5 percent of observations at each tail to mitigate the influence of outliers.

T a b l e 7

Refined Estimates of Price-Change Asymmetry and Timeliness Loss Recognition Using Samples Partitioned by Leverage

$$E_{jt} / P_{jt-1} = \alpha_{10} + \alpha_{11} * D(Ret_{jt} < 0) + \beta_{10} * Ret_{jt} + \beta_{11} * Ret_{jt} * D(Ret_{jt} < 0)$$

$$+ (\alpha_{20} + \alpha_{21} * D(Ret_{jt} < 0) + \beta_{20} * Ret_{jt} + \beta_{21} * Ret_{jt} * D(Ret_{jt} < 0)) * PCA_{jt} + \varepsilon_t$$

Variable	Stat.	Zero Lev.	Low Lev.	High Lev.	Zero Lev.	Low Lev.	High Lev.	High-Zero Difference	Zero Lev.	Low Lev.	High Lev.	Difference
						PCA=PCA1				*PCA=PCA2*		
Intercept	**Estimate**	**0.006**	**0.045**	**0.059**	0.081	0.093	0.110	0.029	0.075	0.088	0.105	0.030
	t-statistic	0.920	6.737	9.049	18.613	20.648	17.623	3.861	19.408	19.887	16.739	4.034
	p-value	0.363	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$D(Ret_{jt}<0)$	**Estimate**	**-0.004**	**-0.002**	**0.010**	**0.017**	**0.001**	**0.020**	**0.003**	**0.019**	**0.001**	**0.017**	**-0.002**
	t-statistic	-0.722	-0.702	1.839	2.432	0.259	3.447	0.341	3.082	0.268	3.370	-0.203
	p-value	0.474	0.486	0.073	0.019	0.797	0.001	0.733	0.004	0.790	0.002	0.839
Ret_{jt}	**Estimate**	**0.005**	**0.022**	**0.032**	**0.033**	**0.041**	**0.045**	**0.013**	**0.043**	**0.045**	**0.048**	**0.006**
	t-statistic	0.808	3.568	4.431	4.392	6.795	6.093	1.192	5.559	7.401	6.532	0.559
	p-value	0.424	0.001	0.000	0.000	0.000	0.000	0.233	0.000	0.000	0.000	0.576
$D(Ret_{jt}<0)*Ret_{jt}$	**Estimate**	**0.250**	**0.310**	**0.458**	**0.099**	**0.076**	**0.223**	**0.125**	**0.080**	**0.064**	**0.205**	**0.125**
	t-statistic	9.988	14.784	16.415	4.221	3.770	8.165	3.463	3.519	3.585	8.214	3.718
	p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.000	0.000
PCA_{jt}	**Estimate**				**-0.283**	**-0.234**	**-0.280**	**0.003**	**-0.873**	**-0.721**	**-0.882**	**-0.009**
	t-statistic				-10.868	-10.787	-13.423	0.077	-10.794	-10.964	-13.420	-0.087
	p-value				0.000	0.000	0.000	0.939	0.000	0.000	0.000	0.930
$PCA_{jt}*D(Ret_{jt}<0)$	**Estimate**				**-0.058**	**-0.017**	**-0.029**	**0.030**	**-0.204**	**-0.057**	**-0.067**	**0.137**
	t-statistic				-1.518	-0.820	-0.888	0.591	-1.555	-0.918	-0.668	0.833
	p-value				0.136	0.417	0.379	0.555	0.127	0.364	0.508	0.405
$PCA_{jt} *Ret_{jt}$	**Estimate**				**-0.014**	**0.006**	**0.046**	**0.060**	**-0.102**	**0.006**	**0.143**	**0.245**
	t-statistic				-0.494	0.300	2.006	1.659	-1.195	0.108	1.945	2.173
	p-value				0.624	0.766	0.051	0.097	0.239	0.914	0.058	0.030
$PCA_{jt}*D(Ret_{jt}<0)*Ret_{jt}$	**Estimate**				**0.220**	**0.483**	**0.412**	**0.191**	**0.813**	**1.591**	**1.412**	**0.600**
	t-statistic				1.877	5.448	3.548	1.160	1.956	5.872	3.902	1.088
	p-value				0.067	0.000	0.001	0.246	0.057	0.000	0.000	0.277
Adj R-Sq		0.112	0.135	0.158	0.205	0.214	0.235		0.225	0.220	0.242	
Number of years		44	44	44	44	44	44		44	44	44	

The model is estimated separately on subsamples of companies with zero, low, and high leverage. To construct firm-level estimates of price-change asymmetry, we model the conditional mean of positive (negative) returns by estimating a non-parametric local regression of positive (negative) returns on a constant and the inverse of the beginning-of-year price (we use the inverse of price instead of price to obtain a more homogeneous distribution of the data when conducting the non-parametric analysis). The results from the non-parametric regression are used to construct the predicted value of positive (negative) returns conditional on the firm's beginning-of-year stock price. Subsequently, we divide, conditional on price, the expected positive returns by the expected negative returns to obtain $PCA1_{jt}$ and $PCA2_{jt}$ (denoted by PCA_{jt} in the model). Opening price-deflated earnings (E_{jt} /P_{jt-1}) are measured as income before extraordinary items (Compustat item 18) scaled by beginning-of-fiscal-year stock price (Compustat item 199) multiplied by shares outstanding (Compustat item 25). Annual returns (Ret_{jt}) are compounded over the 12-month fiscal year. Leverage (Lev_{jt}) is defined as the ratio of long-term debt (Compustat item 9) over total assets (Compustat item 6). The sample is split into high and low group at the median value of non-zero leverage companies. Following Fama-MacBeth (1973), the coefficient estimates and *t*-statistics are based on annual cross-sectional regressions. To facilitate the interpretation, $PCA1_{jt}$ and $PCA2_{jt}$ are transformed year by year such that $PCA_{jt} = 0$ corresponds to the sample minimum value of price-change asymmetry. We use the complete CRSP-Compustat (1963−2006) population of non-financial firms truncating 0.5 percent of the observations at each tail of all variables to reduce the effect of outliers.

Table 8

Refined Estimates of Price-Change Asymmetry and Timeliness Loss Recognition Using Samples Partitioned by Dividends

$$E_{jt} / P_{jt-1} = \alpha_{10} + \alpha_{11} * D(Ret_{jt} < 0) + \beta_{10} * Ret_{jt} + \beta_{11} * Ret_{jt} * D(Ret_{jt} < 0)$$
$$+ (\alpha_{20} + \alpha_{21} * D(Ret_{jt} < 0) + \beta_{20} * Ret_{jt} + \beta_{21} * Ret_{jt} * D(Ret_{jt} < 0)) * PCA_{jt} + \varepsilon_t$$

Variable	Statistic	Zero Dividend	Non-Zero Dividend	Zero Dividend	Non-Zero Dividend	Difference	Zero Dividend	Non-Zero Dividend	Difference
				PCA=PCA1			*PCA=PCA2*		
Intercept	**Estimate**	**-0.004**	**0.083**	**0.087**	**0.091**	**0.003**	**0.085**	**0.089**	**0.004**
	t-statistic	-0.631	14.320	15.933	15.588	0.414	15.204	15.727	0.509
	p-value	0.532	0.000	0.000	0.000	0.679	0.000	0.000	0.611
D(Ret_{jt}<0)	**Estimate**	**0.003**	**0.009**	**0.020**	**-0.001**	**-0.020**	**0.020**	**-0.001**	**-0.021**
	t-statistic	0.672	3.478	3.417	-0.174	-3.016	3.660	-0.466	-3.408
	p-value	0.505	0.001	0.001	0.863	0.003	0.001	0.643	0.001
Ret_{jt}	**Estimate**	**0.025**	**0.055**	**0.032**	**0.054**	**0.022**	**0.036**	**0.054**	**0.018**
	t-statistic	3.909	10.994	6.683	6.660	2.318	7.036	7.017	1.904
	p-value	0.000	0.000	0.000	0.000	0.020	0.000	0.000	0.057
D(Ret_{jt}<0)*Ret_{jt}	**Estimate**	**0.308**	**0.285**	**0.160**	**0.054**	**-0.106**	**0.147**	**0.055**	**-0.092**
	t-statistic	15.925	11.368	7.004	2.465	-3.356	6.799	2.945	-3.196
	p-value	0.000	0.000	0.000	0.018	0.001	0.000	0.005	0.001
PCA_{jt}	**Estimate**			**-0.304**	**-0.064**	**0.241**	**-0.959**	**-0.198**	**0.760**
	t-statistic			-15.951	-3.397	9.000	-15.987	-3.197	8.811
	p-value			0.000	0.001	0.000	0.000	0.003	0.000
PCA_{jt}*D(Ret_{jt}<0)	**Estimate**			**-0.040**	**0.031**	**0.071**	**-0.123**	**0.109**	**0.232**
	t-statistic			-1.745	1.217	2.068	-1.808	1.365	2.212
	p-value			0.088	0.230	0.039	0.078	0.179	0.027
PCA_{jt}*Ret_{jt}	**Estimate**			**0.023**	**0.036**	**0.013**	**0.052**	**0.138**	**0.086**
	t-statistic			1.422	1.101	0.360	1.031	1.325	0.742
	p-value			0.162	0.277	0.719	0.308	0.192	0.458
PCA_{jt}*D(Ret_{jt}<0)*Ret_{jt}	**Estimate**			**0.272**	**1.038**	**0.765**	**0.927**	**3.436**	**2.509**
	t-statistic			3.674	5.600	3.835	4.020	6.152	4.153
	p-value			0.001	0.000	0.000	0.000	0.000	0.000
Adj. R-Sq		0.110	0.172	0.183	0.221		0.189	0.228	
Number of years		44	44	44	44		44	44	

The model is estimated separately on subsamples of firms that do not pay dividends and firms that do pay dividends. To construct firm-level estimates of price-change asymmetry, we model the conditional mean of positive (negative) returns by estimating a non-parametric local regression of positive (negative) returns on a constant and the inverse of the beginning-of-year price (we use the inverse of price instead of price to obtain a more homogeneous distribution of the data when conducting the non-parametric analysis). The results from the non-parametric regression are used to construct the predicted value of positive (negative) returns conditional on the firm's beginning-of-year stock price. Subsequently, we divide, conditional on price, the expected positive returns by the expected negative returns to obtain $PCA1_{jt}$ and $PCA2_{jt}$ (denoted by PCA_{jt} in the model). Opening price-deflated earnings (E_{jt} / P_{jt-1}) are measured as income before extraordinary items (Compustat item 18) scaled by beginning-of-fiscal-year stock price (Compustat item 199) multiplied by shares outstanding (Compustat item 25). Annual returns (Ret_{jt}) are compounded over the 12-month fiscal year. Dividend ($DivYld_{jt}$) is defined as the ratio of long-term debt (Compustat item 9) over total assets (Compustat item 6). Following Fama-MacBeth (1973), the coefficient estimates and *t*-statistics are based on annual cross-sectional regressions. To facilitate the interpretation, $PCA1_{jt}$ and $PCA2_{jt}$ are transformed year by year such that $PCA_{jt} = 0$ corresponds to the sample minimum value of price-change-asymmetry. We use the complete CRSP-Compustat (1963−2006) population of non-financial firms, truncating 0.5 percent of observations at each tail of all variables to reduce the effect of outliers.

T a b l e 9

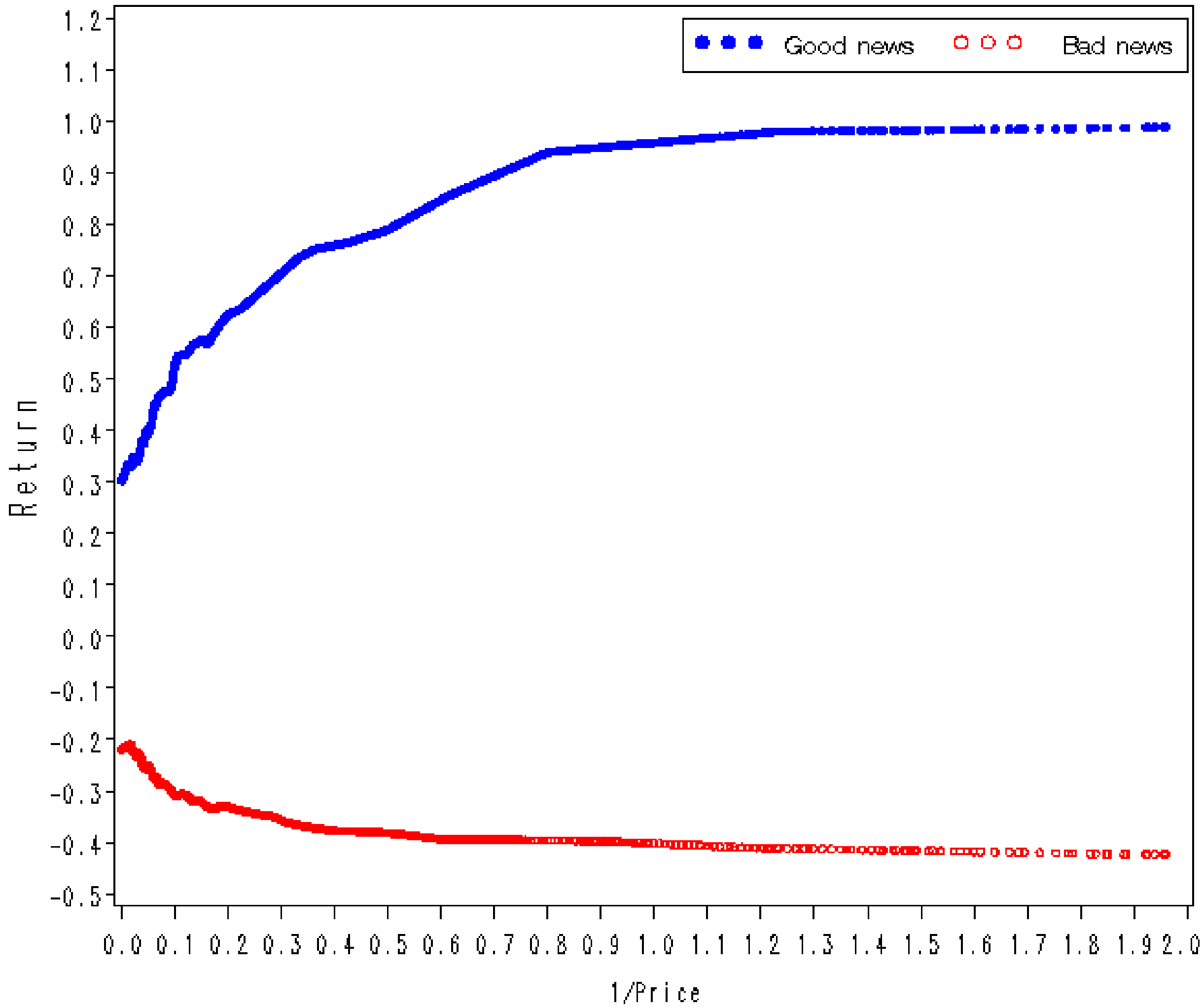
Refined Estimates of Price-Change Asymmetry and Timely Loss Recognition Using Samples Partitioned by Credit Ratings

$$E_{jt} / P_{jt-1} = \alpha_{10} + \alpha_{11} * D(Ret_{jt} < 0) + \beta_{10} * Ret_{jt} + \beta_{11} * Ret_{jt} * D(Ret_{jt} < 0)$$
$$+ (\alpha_{20} + \alpha_{21} * D(Ret_{jt} < 0) + \beta_{20} * Ret_{jt} + \beta_{21} * Ret_{jt} * D(Ret_{jt} < 0)) * PCA_{jt} + \varepsilon_t$$

Variable	Statistic	Investment Grade	Non-Investment	Investment Grade	Non-Investment	Difference	Investment Grade	Non-Investment	Difference
					PCA=PCA1			PCA=PCA2	
Intercept	**Estimate**	**0.060**	**0.028**	**0.063**	**0.086**	**0.023**	**0.064**	**0.080**	**0.015**
	t-statistic	19.306	4.419	19.140	11.049	2.679	19.051	11.800	2.021
	p-value	0.000	0.000	0.000	0.000	0.007	0.000	0.000	0.043
$D(Ret_{jt}<0)$	**Estimate**	**0.006**	**0.045**	**0.000**	**0.044**	**0.044**	**0.000**	**0.043**	**0.043**
	t-statistic	1.355	5.512	-0.045	2.463	2.304	-0.076	2.560	2.445
	p-value	0.191	0.000	0.965	0.023	0.021	0.940	0.019	0.014
Ret_{jt}	**Estimate**	**0.031**	**0.013**	**0.033**	**0.065**	**0.032**	**0.031**	**0.068**	**0.037**
	t-statistic	5.638	1.216	3.031	3.866	1.590	3.214	4.263	1.990
	p-value	0.000	0.238	0.007	0.001	0.112	0.004	0.000	0.047
$D(Ret_{jt}<0)*Ret_{jt}$	**Estimate**	**0.189**	**0.623**	**0.097**	**0.282**	**0.186**	**0.086**	**0.266**	**0.179**
	t-statistic	3.576	11.949	2.528	3.062	1.859	2.882	3.072	1.960
	p-value	0.002	0.000	0.020	0.006	0.063	0.009	0.006	0.050
PCA_{jt}	**Estimate**			**-0.038**	**-0.380**	**-0.342**	**-0.233**	**-1.209**	**-0.976**
	t-statistic			-1.704	-6.398	-5.388	-2.757	-6.634	-4.861
	p-value			0.104	0.000	0.000	0.012	0.000	0.000
$PCA_{jt}*D(Ret_{jt}<0)$	**Estimate**			**0.035**	**-0.001**	**-0.036**	**0.108**	**0.011**	**-0.097**
	t-statistic			0.509	-0.007	-0.321	0.401	0.041	-0.254
	p-value			0.617	0.994	0.748	0.693	0.968	0.799
$PCA_{jt}*Ret_{jt}$	**Estimate**			**0.004**	**-0.067**	**-0.072**	**0.141**	**-0.220**	**-0.361**
	t-statistic			0.040	-1.102	-0.586	0.366	-1.167	-0.841
	p-value			0.968	0.284	0.558	0.718	0.257	0.401
$PCA_{jt}*D(Ret_{jt}<0)*Ret_{jt}$	**Estimate**			**0.558**	**0.879**	**0.321**	**2.672**	**2.904**	**0.232**
	t-statistic			1.379	3.136	0.653	2.001	3.436	0.147
	p-value			0.183	0.005	0.514	0.059	0.003	0.883
Adj. R-Sq		0.146	0.176	0.188	0.297		0.200	0.307	
Number of years		21	21	21	21		21	21	

The model is estimated separately on subsamples of companies with investment grade credit ratings and companies with non-investment grade credit ratings. To construct firm-level estimates of price-change asymmetry, we model the conditional mean of positive (negative) returns by estimating a non-parametric local regression of positive (negative) returns on a constant and the inverse of the beginning-of-year price (we use the inverse of price instead of price to obtain a more homogeneous distribution of the data when conducting the non-parametric analysis). The results from the non-parametric regression are used to construct the predicted value of positive (negative) returns conditional on the firm's beginning-of-year stock price. Subsequently, we divide, conditional on price, the expected positive returns by the expected negative returns to obtain $PCA1_{jt}$ and $PCA2_{jt}$ (denoted by PCA_{jt} in the model). Opening price-deflated earnings (E_{jt} / P_{jt-1}) are measured as income before extraordinary items (Compustat item 18) scaled by beginning-of-fiscal-year stock price (Compustat item 199) multiplied by shares outstanding (Compustat item 25). Annual returns (Ret_{jt}) are compounded over the 12-month fiscal year. Investment grade companies are those companies with credit rating above BBB−. Following Fama-MacBeth (1973), the coefficient estimates and *t*-statistics are based on annual cross-sectional regressions. To facilitate the interpretation, $PCA1_{jt}$ and $PCA2_{jt}$ are transformed year by year such that $PCA_{jt} = 0$ corresponds to the sample minimum value of price-change asymmetry. We use the complete CRSP-Compustat (1963−2006) population of non-financial firms, truncating 0.5 percent of observations at each tail of all variables to reduce the effect of outliers.

Figure 1: Fitted Positive and Negative Returns Conditional on (the Inverse of) Price



Non-parametric local regression of positive (negative) fiscal year returns on a constant and the inverse of the beginning-of-year price (we use the inverse of price instead of price to obtain a more homogeneous distribution of the data when conducting the non-parametric analysis). Separate local regressions are used to estimate each line in the graph. The results from the non-parametric regression are used to construct the predicted value of positive (negative) returns conditional on the firm's beginning-of-year stock price. The analysis is based on 128,000 observations.