Evaluating Price Informativeness and its Determinants

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ABSTRACT

We develop a price informativeness measure that reflects the accuracy of investors' forecasts of future earnings embedded in current price. We then empirically evaluate economy- and firm-level price informativeness. Investors' forecasts of economy-level earnings are more optimistic (pessimistic) when sentiment is positive (negative). Their forecasts are more biased and more imprecise when sentiment is extreme, and especially when it is negative and extreme. Firm-level prices are less informative when: (1) uncertainty is high; (2) analyst following is low; (3) the firm provides highly aggregated accounting data; and, (4) a large fraction of the firm's shares is held by retail investors.

Keywords: Price efficiency and price informativeness

JEL: D84, G10, G14, M40.

1 INTRODUCTION

Equity markets play a central role in the economy. They facilitate risk sharing and consumption smoothing (Arrow 1964). They provide a mechanism for entrepreneurs to obtain funding; and, they generate price signals that agents can use when making decisions or determining contractual performance (Bond, Edmans, and Goldstein 2012). The extent to which equity markets fulfill their role depends on price informativeness, which we define as the accuracy of the forecasts of future earnings embedded in current equity price. When economy-level price informativeness is high, investors pay a fair price for risk sharing and consumption smoothing. When firm-level price informativeness is high, entrepreneurs receive funding that is commensurate with their value creation potential and price signals are more useful.

Although price informativeness is important, how to measure it and how it varies across time and across firms remain unanswered questions. With these questions in mind, we do two things. First, we propose a new measure of price informativeness. Second, we provide evidence about the determinants of the: (1) temporal variation in economy-level price informativeness and (2) cross-sectional variation in firm-level price informativeness.

Our measure of price informativeness is inspired by Tobin (1983) and well-known results in the accounting literature (i.e., Ohlson 1995; Christensen and Feltham 2009). As discussed in Tobin (1983), *fundamental valuation efficiency* occurs when (emphasis added) "valuations reflect *accurately* the future payments to which the asset gives title."[1] And, straightforward extensions of results in Ohlson (1995) and Christensen and Feltham (2009) show that a firm's equity market value equals the sum of: (1) its expected future aggregate earnings capitalized by the risk-free rate

[1] Fundamental valuation efficiency is equivalent to *forecast price efficiency* as defined in Bond, Edmans, and Goldstein (2012); and, as they discuss, it is related to *revelatory price efficiency*, which they define as "the extent to which prices reveal the information necessary for real efficiency."

and (2) a risk adjustment. Consequently, we infer the accuracy of investors' earnings forecasts via a two-step process. First, we calculate the variable $DIFF_{i,t}^{T}$, which equals the difference between a firm's equity market value at the end of period t and its capitalized *realized* aggregate earnings for the subsequent T quarters.[2] Second, we compute the variable $ERR_{i,t}^{T}$, which is the component of $DIFF_{i,t}^{T}$ that is orthogonal to a large set of variables that capture risk and the amount of value that investors expect will be created after quarter $t + T$. Hence, $ERR_{i,t}^{T}$ reflects the accuracy of the forecasts of future earnings embedded in current equity price: When its absolute magnitude is small (large), investors' earnings expectations are more (less) accurate, and thus price informativeness is relatively high (low).

Our measure of price informativeness has two advantages vis-à-vis extant measures. First, it is a price-based measure, not a returns-based measure. Consequently, it reflects the difference between the *level* of expected future earnings and the *level* of ex post realized earnings. This is important because it is the accuracy of the levels of expectations that matters. Returns-based measures, on the other hand, primarily reflect *changes* in expectations. And, even if these changes reflect rational updating on the part of investors, the underlying levels of the expectations may be inaccurate. That is, they may be biased and/or imprecise.

Second, we extend the price-based approach developed by Bai, Phillipon, and Savov (2016) (BPS hereafter). BPS use the cross-sectional covariance between current prices and future earnings for a *specific* year (i.e., year $t + T$) as their measure of price informativeness. (A higher covariance implies higher informativeness.) Our measure, on the other hand, reflects the accuracy

[2] In our economy-level (firm-level) tests, we deflate $DIFF_{i,t}^{T}$ by firm $i's$ equity market value at the end of quarter t (at the end of the second quarter of fiscal year $t + 1$) and we set T equal to 28 quarters (i.e., seven years). We obtain similar results when we deflate $DIFF_{i,t}^{T}$ by equity book value and when we set T equal to 40 quarters (i.e., 10 years).

of investors' forecasts of earnings for a multiyear period (i.e., years $t + 1$ through $t + T$). In addition, whereas BPS's measure can only be estimated for a portfolio of firms, our measure can be used to evaluate the informativeness of both portfolio-level and firm-level prices. Finally, in our empirical tests we include variables that control for variation in risk and other potential confounding factors. BPS do not.

We begin our empirical analyses by evaluating the temporal association between economy-level price informativeness and the investor sentiment index developed by Baker and Wurgler (2007). We consider four measures of price informativeness. The first three are: (2) the cross-sectional average of $ERR_{i,t}^{T}$; (2) the absolute value of this average; and, (3) the cross-sectional standard deviation of $ERR_{i,t}^{T}$. These variables capture the sign and magnitude of the bias in investors' forecasts and the imprecision of those forecasts. The fourth variable equals the square root of the mean of the squared values of $ERR_{i,t}^{T}$ (i.e., root mean square error). Hence, it reflects the combined effects of bias and imprecision. We use detrended quarterly data; and, we estimate regressions in which we control for a large number of variables including the log of aggregate equity market value, the aggregate book-to-price ratio, the aggregate earnings-to-price ratio and a set of macro variables that capture the state of the economy and economy-level risk.

As discussed in Baker and Wurgler (2007), both high and low sentiment can affect price informativeness. So, we evaluate both the raw and absolute value of the sentiment index. We find that as sentiment increases, investors' forecasts become more optimistic, less biased and less imprecise. However, we find the exact opposite results for the absolute value of sentiment. That is, extreme sentiment (either high or low) is associated with forecasts that are less optimistic, more biased and more imprecise. Taken together, these results imply that investors' collective mood affects the price they pay for risk sharing and consumption smoothing. Investors pay a high (low) price when sentiment is positive (negative); and, the risk that investors overpay is higher when sentiment is extreme, and especially when it is negative and extreme.

In our second set of empirical tests, we evaluate cross-sectional variation in firm-level price informativeness. To do this, we evaluate the variable $ABS\_ERR_{i,t}^{T}$, which equals the absolute value of $ERR_{i,t}^{T}$. We use annual data and we estimate panel regressions of $ABS\_ERR_{i,t}^{T}$ on a set of variables that includes measures of firm-level uncertainty, analyst following, disclosure quality and quantity, investor composition and liquidity. These regressions include industry and year fixed effects as well as the log of equity market value, the book-to-price ratio, the earnings-to-price ratio and eight additional control variables that capture potential accounting measurement error and firms' exposures to economy-level risk.

We find that firm-level prices are less informative for firms that: (1) have high historical return volatility; (2) have high earnings uncertainty; (3) have low analyst following; (4) provide highly aggregated accounting data; and, (5) have a large fraction of their shares held by retail investors. We also evaluate the "readability" of firms' financial statements and the amount of earnings guidance provided by their managers. However, we find no evidence that either less readable financial statements or lack of earnings guidance is associated with lower price informativeness. Similarly, we find only weak evidence that a firm's price is less informative when its shares are relatively illiquid as measured by the bid-ask spread.

Our finding that prices are less informative when uncertainty is high is not too surprising. The remaining results are less obvious, however. They imply that analysts produce information that investors would not have discovered in the short term (i.e., within six months of the fiscal year end) and that detailed quantitative disclosures reveal information that also would have gone undiscovered in the short term. On the other hand, although low readability and lack of earnings guidance are associated with high return volatility (e.g., Loughran and McDonald 2014) and high information asymmetry (e.g., Coller and Yohn 1997), these effects are relatively short lived. Finally, our results regarding the effects of trading constraints are mixed. Illiquidity, as measured by the bid-ask spread (e.g., Amihud and Mendelson 1986), does not appear to have a first order effect on informed trading. However, short selling constraints, which are inversely related to the level of institutional holdings (e.g., Akbas 2016), do appear to impede informed trade.[3]

2 RESEARCH DESIGN AND KEY EMPIRICAL PROXIES

We assume that: (1) there are no arbitrage opportunities in the securities market and (2) earnings, $X_{i,t}$, equity book value, $B_{i,t}$, and dividends, $D_{i,t}$, satisfy the accounting identity (i.e., the clean surplus relation) shown below:

$$B_{i,t+1} = B_{i,t} + X_{i,t+1} - D_{i,t+1}. \tag{1}$$

These assumptions imply Equation (2) (see Appendix A for details):

$$DIFF_{i,t}^{T} = \frac{P_{i,t} - \left(\frac{ACE_{i,t}^{T}}{R_{t,t}^{t+T}-1}\right)}{P_{i,t}} = \frac{\frac{\mathbb{E}_t\left[ACE_{i,t}^{T}\right]-ACE_{i,t}^{T}}{R_{t,t}^{t+T}-1} + TVC_{i,t}^{T} + COV_{i,t}}{P_{i,t}}. \tag{2}$$

In Equation (2), $P_{i,t}$ is firm $i's$ equity market value at the end of period t. $\mathbb{E}_t[\cdot]$ is the expected value at the end of period t. $R_{a,b}^{c}$ is the gross holding period return on a zero-coupon bond that will be delivered on date b in order to satisfy the terms of a contract entered into on date a. This contract obligates the issuer to issue on date b a zero-coupon bond that generates a guaranteed (i.e., riskless) holding period return of $R_{a,b}^{c}$ and matures on date c. Hence, $R_{a,b}^{c}$ is a

[3] To execute a short-sell the prospective seller must first borrow shares. When the investor base consists of a disperse set of retail investors, finding a shareholder who is willing to lend is difficult and because the set of potential lenders tends to be small, borrowing costs tend to be prohibitive. However, as discussed in Akbas (2016), when institutional holdings are high, there is a large number of potential lenders who are easy to identify and who will compete along the dimension of borrowing costs. Hence, when institutional holdings are high, more shares are available to borrow and borrowing costs are lower.

known and certain amount on date a.[4] $ACE_{i,t}^T$ is firm $i's$ aggregate cum dividend accounting earnings for quarters $t+1$ through $t+T$.[5] $TVC_{i,t}^T$ is the terminal value correction. It reflects the amount of value that investors expect will be created after quarter T. $COV_{i,t}$ is a risk adjustment that is a function of the covariance between future dividends and the stochastic discount factor, $Q_{t,t+k}$. Specifically, $ACE_{i,t}^T$, $TVC_{i,t}^T$ and $COV_{i,t}$ are defined as follows:

$$ACE_{i,t}^T = \sum_{k=1}^{T}\{X_{i,t+k} + (R_{t,t+k}^{t+T} - 1) \times D_{i,t+k}\}, \quad (3)$$

$$TVC_{i,t}^T = \sum_{k=T+1}^{\infty} \frac{\mathbb{E}_t[RI_{i,t+k}]}{R_{t,t}^{t+k}} - \frac{1}{R_{t,t}^{t+T} - 1} \times \sum_{k=1}^{T} \frac{\mathbb{E}_t[RI_{i,t+k}]}{R_{t,t}^{t+k}}, \quad (4)$$

$$COV_{i,t} = \sum_{k=1}^{\infty} \frac{COV_t(D_{i,t+k}, Q_{t,t+k})}{R_{t,t}^{t+k}}. \quad (5)$$

In equation (4), $RI_{i,t+k} = X_{i,t+k} - (R_{t,t+k-1}^{t+k} - 1) \times B_{i,t-1}$. That is, it is residual income for period $t+k$.[6]

Per Equation (2), $DIFF_{i,t}^T$ is an increasing function of $\mathbb{E}_t[ACE_{i,t}^T] - ACE_{i,t}^T$, which is the error in investors' forecasts of aggregate cum dividend earnings. Hence, ceteris paribus, as forecast accuracy decreases, the absolute value of $DIFF_{i,t}^T$ increases. Consequently, ceteris paribus, when the absolute value of $DIFF_{i,t}^T$ is high (low), price informativeness is low (high).

2.1 Choice of Horizon

As shown in Appendix A, as T approaches infinity, $TVC_{i,t}^T$ converges to zero. Unfortunately, it is infeasible to set T equal to infinity. Hence, we have to choose a finite value,

[4] When $a = b$ ($a < b$), $R_{a,b}^c$ is the spot (forward) riskless rate of return.

[5] Aggregate cum dividend earnings are the earnings the firm would have reported if, instead of paying dividends, it had purchased risk free bonds with the funds that it would have distributed to its shareholders. Hence, $ACE_{i,t}^T$ embeds the notion that dividend policy choices do not have a first order effect on value (i.e., Miller and Modigliani 1961). That is, ceteris paribus, assuming dividends are paid from excess cash that the firm would have invested in risk free bonds, $ACE_{i,t}^T$ (and thus the capitalized value of $ACE_{i,t}^T$) is unaffected by dividend policy.

[6] In the valuation model underlying equation (2), residual income is a function of the riskless forward rate (i.e., $R_{t,t+k-1}^{t+k}$) not a firm-specific discount rate. The reason for this is that risk is captured by the variable $COV_{i,t}$.

and then deal with confounding effects attributable to the fact that $TVC_{i,t}^{T} \neq 0$. We choose to set T equal to 28 quarters (i.e., seven years). We choose a seven-year horizon for two reasons. First, per Koeva (2000), the typical investment plan takes two years to implement. Hence, a seven-year horizon captures the full effects of investment plans initiated in years t through $t+5$ and a portion of the effects of plans initiated in years $t+6$ and $t+7$. Second, by choosing a seven-year horizon, we have a sufficient number of quarters for our economy-level, time-series tests.

2.2 Controlling for Potential Confounding Effects

Our objective is to learn about the determinants of investors' forecast errors (i.e., $\mathbb{E}_t\left[ACE_{i,t}^{T}\right] - ACE_{i,t}^{T}$). However, because $DIFF_{i,t}^{T}$ is also a function of $TVC_{i,t}^{T}$ and $COV_{i,t}$, we cannot directly infer forecast errors from it. Rather, we need to isolate the component of $DIFF_{i,t}^{T}$ that is attributable to these errors.

With the above mind, we do two things. First, we base our informativeness measures on the variable $ERR_{i,t}^{T}$. This variable is the residual from a first-stage regression of $DIFF_{i,t}^{T}$ on variables that capture $TVC_{i,t}^{T}$ and $COV_{i,t}$. Specifically, when calculating our economy-level measures of informativeness, we set $ERR_{i,t}^{T}$ equal to the residual from a panel regression of $DIFF_{i,t}^{T}$ on ten variables: (1) the log of equity market value, $LNMV_{i,t}$; (2) the book-to-price ratio, $BP_{i,t}$; (3) the earnings-to-price ratio, $EP_{i,t}$; (4) contemporaneous stock return, $RET_{i,t}$; (5) stock return volatility, $VOL_{i,t}$; (6) CAPM beta, $BETA_{i,t}$; (7) the factor loading on size, $SMB_{i,t}$; (8) the factor loading on book-to-market; $HML_{i,t}$; (9) the factor loading on momentum, $MOM_{i,t}$; and, (10) the variable $DIRT_{i,t}$, which captures ex post violations of the clean surplus relation shown in equation (1).[7] When calculating our firm-level measures of informativeness, we set $ERR_{i,t}^{T}$ equal to the

[7] Specifically, $DIRT_{i,t}^{T} = \left\{\left(B_{i,t+T} - B_{i,t}\right) - \sum_{k=1}^{T}\left(X_{i,t+k} - D_{i,t+k}\right)\right\}/P_{i,t}$.

residual from a panel regression of $DIFF_{i,t}^{T}$ on the ten variables mentioned above and six additional variables that we describe in Section 6.[8]

We use quarterly (annual) data when estimating the first-stage regression that generates our economy-level (firm-level) measure of $ERR_{i,t}^{T}$. We include year and industry fixed effects in the first-stage regression that we use to calculate our firm-level measure of $ERR_{i,t}^{T}$. However, we omit fixed effects from the first-stage regression that we use to calculate our economy-level measure of $ERR_{i,t}^{T}$. The reason for this is that these fixed effects would remove from $ERR_{i,t}^{T}$ the time-series variation in price informativeness that we want to study.

Second, we include control variables in the second-stage regressions that we use to evaluate the determinants of the informativeness measures. Specifically, in our economy-level, time-series regressions, we use detrended data and we include ten variables that reflect the state of the economy and economy-level risk. These variables include the log of aggregate equity market value, $LNMV_t$; the aggregate book-to-price ratio, BP_t; the aggregate earnings-to-price ratio, EP_t; and, seven additional control variables. We choose these seven variables from a set of 13 candidate variables that are inspired by arguments and results in Chen, Roll, and Ross 1986. In particular, we calculate the correlation between each candidate variable and each of our four economy-level measures of informativeness. If *any* of these four correlations is significant at the 10% level, we include the candidate variable in the set of controls. (We elaborate on the candidate control variables in Section 5.) In our firm-level, panel regressions, we include the same control variables and fixed effects that we include in the first-stage regressions that we use to calculate $ERR_{i,t}^{T}$.

The research design features described above are rigorous. Consequently, it is unlikely that

[8] These six additional variables are not observable on a quarterly basis. Hence, we cannot include them in our economy-level, first-stage regressions.

the associations we document between our informativeness measures and the determinants we consider are attributable to temporal and/or cross-sectional variation in either discount rates (i.e., $COV_{i,t}$) or expected future growth opportunities (i.e., $TVC_{i,t}^{T}$). Rather, these associations reflect the relations between the determinants and the accuracy of investors' forecasts, which is what we are interested in.

2.3 Bias and Imprecision

Price informativeness is a function of both forecast bias and forecast imprecision. Forecasts are biased, and price is less informative, when the expected value of the forecast error embedded in price (i.e., $\mathbb{E}_t\left[ACE_{i,t}^{T}\right] - ACE_{i,t}^{T}$) is non-zero. A lack of bias does not imply high informativeness, however. Rather, imprecision – that is, the standard deviation of the forecast error – matters too. Ceteris paribus, price informativeness falls as imprecision increases.

In our economy-level tests, we evaluate temporal variation in four measures of informativeness. The first two measures, $BIAS_t^T$ and $ABS\_BIAS_t^T$, capture the sign and magnitude of the bias, respectively. The third measure, STD_t^T, captures the degree of imprecision; and, the final measure, $RMSE_t^T$, captures the combined effects of bias and imprecision. We calculate these four variables as follows (N_t denotes the number of observations with non-missing values of $ERR_{i,t}^{T}$ in quarter t):

$$BIAS_t^T = \frac{1}{N_t}\sum_{i=1}^{N_t} ERR_{i,t}^{T}, \qquad ABS\_BIAS_t^T = |BIAS_t^T|,$$

$$STD_t^T = \sqrt{\frac{1}{N_t}\sum_{i=1}^{N_t}\left(ERR_{i,t}^{T} - BIAS_t^T\right)^2}, \qquad RMSE_t^T = \sqrt{(BIAS_t^T)^2 + (STD_t^T)^2}. \tag{6}$$

In our firm-level tests, we evaluate cross-sectional variation in the variable $ABS\_ERR_{i,t}^{T} = \left|ERR_{i,t}^{T}\right|$. Higher values of $ABS\_ERR_{i,t}^{T}$ reflect less accurate forecasts, and thus lower price informativeness.

2.4 Determinants of Price Informativeness

We focus on four determinants of price informativeness: (1) uncertainty; (2) investor behavior; (3) information production; and, (4) trading constraints. Ceteris paribus, as uncertainty increases, investors' forecasts are more imprecise and possibly, but not necessarily, biased. When investors conduct less private information acquisition, ceteris paribus, their forecasts are more imprecise. Moreover, their forecasts are biased and more imprecise if they process the information they collect incompletely or in a biased manner. Ceteris paribus, firms that produce less information will have less informative prices. Finally, ceteris paribus, trading constraints (e.g., lack of arbitrage capital, restrictions on short-selling or insider trading, etc.) imply lower price informativeness.

2.4.1 Economy-level Determinants

In our economy-level tests, we focus on investor behavior. Specifically, we evaluate the sentiment index, $SENT_t$, developed by Baker and Wurgler (2007), who argue that when sentiment is positive (negative) investors speculate too much (too little) and "difficult-to-value" stocks are overvalued (undervalued) while "bond-like" stocks are undervalued (overvalued). Consequently, the relation between $SENT_t$ and price informativeness is ambiguous. Rather, it depends on two phenomena: (1) the relative prominence of difficult-to-value stocks vis-à-vis bond-like stocks and (2) the relative effect of sentiment on the prices of these two groups of stocks.

To overcome this ambiguity, we also evaluate the variable $ABS\_SENT_t = |SENT_t|$. High values of ABS_SENT_t occur during periods of extreme sentiment. We predict that when ABS_SENT_t is high, imprecision (i.e., STD_t^T) is also high. For the reasons described above, we do not predict the relation between ABS_SENT_t and either $BIAS_t^T$ or $ABS\_BIAS_t^T$. Rather, these relations depend on: (1) the relative prominence of difficult-to-value stocks vis-à-vis bond-like stocks and (2) the relative effect of sentiment on the prices of these two groups of stocks. For instance, if these two groups of stocks are equally prominent and equally affected by sentiment, the *average* effect of sentiment is zero regardless of its sign or magnitude. Moreover, because we cannot predict the relation between ABS_SENT_t and either $BIAS_t^T$ or $ABS\_BIAS_t^T$, we cannot predict its relation with $RMSE_t^T$.

2.4.2 Firm-level Determinants

In our firm-level tests, we evaluate all four determinants. We use two measures of uncertainty. The first measure, $VOL_{i,t}$, is the historical standard deviation of the firm's daily stock returns. The second measure, $SDFUTROE_{i,t}$, is the forecast of the standard deviation of lead return on equity obtained from the model developed by Chang et al. (2021). Ceteris paribus, uncertainty is associated with less informative prices, and thus we predict a positive association between each uncertainty measure and $ABS\_ERR_{i,t}^T$.

Our measures of investor behavior reflect their information acquisition decisions. We argue that sell-side analysts are delegated information intermediaries who acquire and process information, and then pass it on to investors. Hence, ceteris paribus, as analyst coverage increases, investors acquire more information and price informativeness rises. We use two measures of analyst coverage: (1) $FOLLOWING_{i,t}$, which equals one (zero) if the firm is (not) covered by analysts and (2) $LNNUMFCST_{i,t}$, which equals the log of one plus the number of analysts' following the firm. We predict that both measures have a negative association with $ABS\_ERR_{i,t}^T$.

We evaluate three phenomena that relate to the amount and quality of information provided by the firm: (1) disaggregation of *quantitative* data disclosed in the annual report; (2) "readability" of the *text* of the annual report; and, (3) the amount of earnings guidance provided by management. We use the disaggregation measure, $DQ_{i,t}$, developed by Chen, Miao, and Shevlin (2015), who show that $DQ_{i,t}$ captures the "fineness" of the quantitative data provided in the annual report. To measure readability, we use the fog index, $FOG_{i,t}$, developed by Li (2008) and the log of the file size of the 10-K, $SIZE10K_{i,t}$, which is described in Loughran and McDonald (2014). These measures are inversely related to "readability." To measure management guidance, we use the variables: (1) $GUIDANCE_{i,t}$, which equals one (zero) if the firm's managers provided (did not provide) earnings guidance and (2) $LNNUMGUID_{i,t}$, which equals the log of one plus the number of instances in which management provided guidance. We predict that lower disclosure quality and quantity are associated with less informative prices. Hence, we predict that $DQ_{i,t}$, $GUIDANCE_{i,t}$, and $LNNUMGUID_{i,t}$ ($FOG_{i,t}$ and $SIZE10K_{i,t}$) have a negative (positive) association with $ABS\_ERR^T_{i,t}$.

Finally, we consider two measures of trading constraints. Our first measure, $INSTITHOLD_{i,t}$, equals the fraction of the firm's shares that are owned by institutional investors. As discussed in Akbas (2016), institutional investors are the primary lenders of shares, and thus higher values of $INSTITHOLD_{i,t}$ imply fewer short-selling constraints ceteris paribus. The bid-ask spread, $BASPR_{i,t}$, is our second measure of trading constraints. It reflects the round-trip costs of trading the firm's shares. We expect that $INSTITHOLD_{i,t}$ ($BASPR_{i,t}$) has a negative (positive) relation with $ABS\_ERR^T_{i,t}$. That is, when short-selling is harder (transactions costs are high), there is less informed trade and lower price informativeness.

3 LITERATURE REVIEW

Extant empirical measures of price informativeness fall into three categories: (1) returns-based measures; (2) microstructure-based measures; and, (3) price-based measures.

3.1 Returns-based Measures

Studies of return predictability, future earnings response coefficients (FERCs hereafter) and synchronicity fall into this category.[9] Return predictability concerns the relation between current publicly available information and future stock returns. FERCs reflect the relation between current stock returns and future earnings. Synchronicity is the fraction of the variation in a firm's stock returns that is explained by contemporaneous "authenticated" information.

The main drawback to using stock returns as a measure of price informativeness is that, as discussed in Campbell (1991) and Vuolteenaho (2002), stock returns reflect *changes* in expectations. This has three implications. First, even if changes in expectations reflect rational reactions to new information, the underlying expectations may still be biased or imprecise. Hence, a high FERC does not necessarily imply high price informativeness. Rather, investors may be reacting to "stale" information that management disclosed with a delay, management may still be withholding value relevant information, residual uncertainty may still be high, some traders may be unable to trade on their private information because of trading constraints, etc.

Second, return predictability does not necessarily imply low price informativeness. This is true even if predictability is the result of investor irrationality. Although the price would not be perfectly informative, the *degree* of bias and imprecision would remain unknown. Rather, it may be that residual uncertainty is relatively low, management is fully divulging information in a timely manner, and investors are rationally evaluating most (but not all) of the information available to them. Consequently, price informativeness may still be *relatively* high. The only way to know is to evaluate the underlying expectations.

Finally, there is no obvious benchmark that changes in expectations can be compared to. Consequently, as discussed in Roll (1988) and West (1988), low synchronicity may be attributable

[9] The literature on return predictability is vast, recent studies include Engelberg, McLean, and Pontiff (2018) and Hou, Xue, and Zhang (2018). Examples of studies that use the synchronicity measure include Morck, Yeung, and Yu (2000) and Durnev et al. (2003). Examples of studies that use future earnings response coefficients include Gelb and Zarowin (2002) and Lundholm and Myers (2002).

either to rational traders impounding their unobservable, private information into price or to uninformed noise trading.

3.2 Microstructure-based Measures

Microstructure-based measures include the PIN measure developed by Easley, Kiefer, and O'Hara (1996, 1997a,b) and measures of liquidity. These measures are useful in empirical studies that evaluate whether managers learn from the private information embedded in stock prices (e.g., Chen, Goldstein, and Jiang 2007; Fang, Noe, and Tice 2009). However, these measures are not designed to capture overall price informativeness. Rather, highly informed trade could be accompanied by high uncertainty, private information and public information might be substitutes, etc. Consequently, a high probability of informed trade and high liquidity do not necessarily imply low bias and low imprecision.[10]

3.3 Price-based Measures

Price-based measures are not subject to the concerns raised above. The reason for this is that prices reflect *levels* of expectations. Consequently, price-based measures generate evidence about bias and imprecision. We are not the first to recognize this. Specifically, BPS calculate the cross-sectional covariance between current prices and earnings for a *specific* future year (e.g., year $t + T$). They interpret a high covariance as evidence of high price informativeness.

Our approach to measuring price informativeness builds on BPS's approach in three ways. First, our measure pertains to the accuracy of investors' forecasts of earnings for a multiyear period (i.e., years $t + 1$ through $t + T$). Hence, it is more comprehensive than the measure used by BPS and less affected by time-specific idiosyncrasies. For example, suppose a firm's managers

[10] This caveat also applies to the synchronicity measure. Even if low synchronicity is attributable to private information being impounded into price by informed traders, it is not necessarily synonymous with high price informativeness.

manipulate reported earnings for quarter $t+r$. Under accrual accounting, this manipulation will eventually reverse and, if the reversal occurs in quarter $t+s \leq t+T$, there is no effect on our measure of price informativeness.

Second, the measure described in BPS can only be calculated for a portfolio of firms whereas our measure can be calculated both at the portfolio-level and firm-level. Hence, unlike BPS, we can evaluate firm-specific determinants of informativeness such as the quality and quantity of disclosure, analyst coverage, liquidity, etc. Finally, current price is a function of expected earnings for all future years and risk. Hence, as discussed in the previous section, we control for $TVC_{i,t}^{T}$ and $COV_{i,t}$. BPS do not. Consequently, the covariance term they calculate may be biased.

4 DATA

Compustat is our primary data source.[11] To construct our initial sample, we consider the time-period 1975 to 2016; and, we include all firm-quarter observations in the database that are incorporated in the US and are not ADRs. We exclude firms that do not provide quarterly reports. We remove firm quarters with $SALES_{i,t}$, $TA_{i,t}$ (total assets) or $TL_{i,t}$ (total liabilities) that are either missing or not greater than zero. We also remove firm quarters that have a stock price that is less than or equal to one dollar. We require return on equity, $ROE_{i,t}$, and, return on assets, $ROA_{i,t}$, to each be between one and negative one; sales profit margin, $MARGIN_{i,t}$, to be below one; and, $LEVERAGE_{i,t}$ to be between one and 20. Finally, for each quarterly cross-section we delete observations for which $DIFF_{i,t}^{T}$ is either below the first percentile or above the 99$^{\text{th}}$ percentile of its cross-sectional distribution. Our main dataset consists of 448,310 firm-quarter observations,

[11] We describe our other data sources and provide detailed variable definitions in Appendix B.

covering 140 quarters and spans the years 1975 to 2009.[12]

To create our economy-level sample, we first exclude firms that do not have a calendar quarter fiscal year end. Next, for each calendar quarter, we create economy-level measures of price informativeness by aggregating the variables $ERR_{i,t}^{T}$ for that quarter. This leads to an economy-level sample of 140 quarters.

To create our firm-level sample, we extract all quarters from the main dataset that relate to the fourth fiscal quarter, and then we obtain annual data for the corresponding fiscal year. We then match these observations with the variable $ABS\_ERR_{i,t}^{T}$, which is imputed from the variable $DIFF_{i,t}^{T}$. We use the value of $DIFF_{i,t}^{T}$ observed at the end of the second quarter of fiscal year $t+1$ – i.e., two quarters ahead. This ensures that our price informativeness measure reflects the annual accounting information from the most recent fiscal year. We trim the sample at the top and bottom one percentile based on the value of $DIFF_{i,t}^{T}$ and we require availability of all control variables. Our final firm-year sample consists of 60,828 observations.

5 ECONOMY-LEVEL TESTS

5.1 Descriptive Statistics

In Figures 1 and 2, we provide time-series plots of the raw and detrended values of $BIAS_{t}^{T}$, $ABS\_BIAS_{t}^{T}$, STD_{t}^{T} and $RMSE_{t}^{T}$. We also provide descriptive statistics for these variables in Table 1. First, per Figure 1, there is evidence of a time trend in the raw price informativeness measures.[13] Consequently, in our regressions we use the detrended data. Second, Panel A of Table 1 shows

[12] We need seven years of ex post earnings and dividends to calculate $DIFF_{i,t}^{T}$; consequently, our sample ends in 2009.

[13] To confirm the presence of a time trend we construct the variable $TIME\_TREND_{t}$, which equals one in the first quarter of the sample period, and then increases by increments of one for each subsequent quarter until it reaches its maximum value of 140. We find that $TIME\_TREND_{t}$ has a correlation of roughly 0.50 with $BIAS_{t}$, STD_{t} and $RMSE_{t}$ and a correlation of -0.22 with ABS_BIAS_{t}. All of these correlations are statistically significant.

that raw $BIAS_t^T$ is negative and steadily increasing during the early part of the sample period (i.e., until the fourth quarter of 1982). It then hovers around zero until the first quarter of 2004 at which time it begins to increase. It peaks in the fourth quarter of 2007, and then it plummets and stays negative throughout the remainder of the sample period, which coincides with the global financial crisis. Third, raw STD_t^T and $RMSE_t^T$ are highly correlated. Moreover, like $BIAS_t^T$ and $ABS\_BIAS_t^T$ they behave atypically during the early part of the sample period as well as during the financial crisis. Finally, there is considerable variation in raw $BIAS_t^T$, $ABS\_BIAS_t^T$, STD_t^T and $RMSE_t^T$ during the sample period.

Panel B of Table 1 summarizes the descriptive statistics for the detrended variables in Figure 2. Per Figure 2a, the detrended values of $BIAS_t^T$ and $ABS\_BIAS_t^T$ are negatively correlated, which implies that they capture different phenomena. Per Figure 2b, the detrended values of STD_t^T and $RMSE_t^T$ are highly correlated. This implies that most of the variation in $RMSE_t^T$ reflects variation in the imprecision of investors' forecasts.

In Panel C (Panel D) of Table 1, we show the raw (detrended) values of $SENT_t$, ABS_SENT_t, $LNMV_t$, BP_t, EP_t and the 13 additional "candidate" control variables. The set of candidate control variables consists of: (1) GDP growth, $GDPGROW_t$; (2) consumption growth, $CONGROW_t$; (3) industrial production, $INDPROD_t$; (4) growth in industrial production, $INDGROW_t$; (5) the level of unemployment, $UNEMP_t$; (6) the historical standard deviation of daily returns on the S&P 500, $SPVOL_t$;[14] (7) expected inflation, $EXPINF_t$; (8) the change in expected inflation, $CHEXPINF_t$; (9) unexpected inflation, $UNEXPINF_t$; (10) the real interest rate, $REALINT_t$; (11) the spread between the yield on Baa rated corporate bonds and the yield on 20

[14] We do not use the VIX index because, as it is currently measured, it is unavailable prior to 2003. Untabulated results show that, for the portion of our sample period in which the VIX index is available, the Pearson correlation between $SPVOL_t$ and the VIX index is 0.87.

year maturity government bonds, $RISKPREM_t$; (12) the spread between the yield on 20 year maturity government bonds and the treasury bill rate, $TERMST_t$; and, (13) the value weighted return on the market portfolio, $VWRET_t$. Our choice of candidate variables is inspired by Chen, Roll, and Ross (1986).

5.2 Correlations

We present correlations in Tables 2 through 4. In Table 2, we present correlations between the detrended values of our four measures of price informativeness. Consistent with the time-series plots in Figure 2, the correlation between $BIAS_t^T$ and $ABS\_BIAS_t^T$ (STD_t^T and $RMSE_t^T$) is negative (positive) and its absolute magnitude is large. Moreover, $ABS\_BIAS_t^T$ has a positive correlation with STD_t^T (and $RMSE_t^T$). Hence, the two key drivers of informativeness -- i.e., the size of the absolute bias and the degree of imprecision – overlap.

In Table 3, we present correlations between our informativeness measures and $SENT_t$ and ABS_SENT_t. First, $SENT_t$ is positively correlated with $BIAS_t^T$ (0.63), but negatively correlated with $ABS\_BIAS_t^T$, STD_t^T and $RMSE_t^T$ (-0.62, -0.62 and -0.67, respectively). Conversely, ABS_SENT_t has a negative correlation with $BIAS_t^T$ (-0.47) and a positive correlation with $ABS\_BIAS_t^T$, STD_t^T and $RMSE_t^T$ (0.49, 0.28 and 0.35, respectively).

In Table 4, we present correlations between the detrended values of each of our four measures of price informativeness and the detrended values of $LNMV_t$, BP_t, EP_t and the 13 additional candidate control variables. We make two comments. First, seven of the 13 candidate control variables have a statistically significant correlation with at least one of our measures of price informativeness. Hence, per the discussion in Section 2.2, we include these seven variables in our regressions. Second, the variable $VWRET_t$ is not correlated with any of our measures of informativeness. As discussed in Campbell (1991) and Vuolteenaho (2002), positive (negative) revisions in expected future discount rates lead to negative (positive) current realized returns. Consequently, if temporal variation in $ERR_{i,t}^{T}$ is driven by temporal variation in risk, $ERR_{i,t}^{T}$ would be correlated with $VWRET_t$. It is not, which reinforces our argument that temporal variation in $ERR_{i,t}^{T}$ is not driven by temporal variation in risk.[15]

5.3 Regression Results

We present our regression results in Table 5. The results for both $SENT_t$ and ABS_SENT_t are consistent with our univariate correlations shown in Table 4. That is, there is a positive relation between $SENT_t$ and $BIAS_t^T$; and, a negative relation between $SENT_t$ and $ABS\_BIAS_t^T$, STD_t^T and $RMSE_t^T$. However, the associations between ABS_SENT_t and these four variables have the opposite signs. Taken together, these results imply that investors' collective mood affects the price they pay for risk sharing and consumption smoothing. Specifically, investors pay a high (low) price when sentiment is positive (negative); and, they face a higher risk of overpaying when sentiment is extreme, and especially when it is negative and extreme.

5.4 Robustness

We evaluate the robustness of our inferences to the choice of deflator and horizon. Regarding the deflator, we recalculate $DIFF_{i,t}^{T}$ but we deflate by equity book value instead of equity market value. Regarding the horizon, we recalculate $DIFF_{i,t}^{T}$ but we set T equal to 40 quarters instead of 28 quarters. When we use a seven-year horizon and deflate by equity book value, we obtain results that are similar to those shown in the tables with one exception: The association between ABS_SENT_t and $BIAS_t^T$ is only marginally significant (the sign does not

[15] We also evaluate the correlations between the independent variables (e.g., $SENT_t$, $LNMV_t$ etc.). In untabulated results, we find that the Pearson correlation between $SENT_t$ and ABS_SENT_t is 0.07. Some of the remaining correlations are greater than 0.50, however. Specifically, the Pearson correlation between: $LNMV_t$ and BP_t ($UNEMP_t$) is -0.57 (-0.55); BP_t and EP_t ($UNEMP_t$) is 0.58 (0.67); $INDPRO_t$ and $UNEMP_t$ is -0.76; $CHEXPINF_t$ and $REALINT_t$ is -0.71; and, $RISKPREM_t$ and $TERMST_t$ is -0.71.

change). When we set $T = 40$ none of the signs of the coefficients change, but some coefficients are insignificant. Specifically, when we deflate by equity market value, $SENT_t$ is no longer associated with $ABS\_BIAS_t^T$; and, ABS_SENT_t is no longer associated with either STD_t^T or $RMSE_t^T$. When we deflate by equity book value, neither $SENT_t$ nor ABS_SENT_t has a statistically significant relation with either $BIAS_t^T$ or $ABS\_BIAS_t^T$ (the signs remain unchanged). However, $SENT_t$ (ABS_SENT_t) continues to have a statistically significant negative (positive) relation with STD_t^T and $RMSE_t^T$.

Overall, our economy-level results are robust. Although, they are somewhat sensitive to the choice of horizon, the results based on a ten-year horizon (i.e., T equal to 40 quarters) should be taken with a grain of salt for two reasons. First, when we set $T = 40$, we only have 128 observations in our time-series regressions. Yet, we have to estimate 16 coefficients.[16] Consequently, these tests have low power. Second, the univariate correlations are not sensitive to either the choice of deflator or horizon. This is not trivial given that the informativeness variables are based on the variable $ERR_{i,t}^T$, which is orthogonal to a large set of firm-level control variables that capture risk and expected growth in residual income.

6 FIRM-LEVEL TESTS

6.1 Descriptive Statistics

We present descriptive statistics in Table 6. In Panel A, we show descriptive statistics for the variables $ERR_{i,t}^T$ and $ABS\_ERR_{i,t}^T$.[17] Both variables exhibit considerable variation across the

[16] The number of coefficients is different from the number shown in Table 5 because when we set $T = 40$, we find that ten of the 13 candidate control variables are associated with at least one of the informativeness measures. Whereas when we set $T = 28$, only seven of the 13 candidate control variables are associated with at least one of the informativeness measures. Hence, when we extend the horizon to 40 quarters, we have three additional coefficients to estimate.

[17] The variable $ABS\_ERR_{i,t}^T$ is the absolute value of the residual from a first-stage regression of $DIFF_{i,t}^T$ on *all* the independent variables included in the second-stage regression in which $ABS\_ERR_{i,t}^T$ is the dependent variable. Hence, $ABS\_ERR_{i,t}^T$ varies across regression specifications. In Table 6, we show the value of $ABS\_ERR_{i,t}^T$ that is based

sample.

In Panel B, we show descriptive statistics for our empirical measures of firm-level determinants of price informativeness. And, in Panel C, we provide descriptive statistics for the set of control variables. This set includes the variables described in Section 2.2 and two additional variables: (1) $RDSALES_{i,t}$ is the ratio of research and development (i.e., R&D) spending to sales and (2) $FROE_{i,t}$ is the forecast of return on equity in year $t + 1$ obtained from the model described in Chang et al. (2021).[18]

6.2 Correlations

In Table 7, we present correlations between $ABS\_ERR^T_{i,t}$ and the remaining variables. First, both $VOL_{i,t}$ and $SDFUTROE_{i,t}$ exhibit positive correlations with $ABS\_ERR^T_{i,t}$. Second, $ABS\_ERR^T_{i,t}$ has a negative association with both of our measures of analyst coverage.

Third, the correlations between our measures of information production and $ABS\_ERR^T_{i,t}$ are mixed. Our measures of disaggregation (i.e., $DQ_{i,t}$), and readability (i.e., $FOG_{i,t}$ and $SIZE10K_{i,t}$) are positively correlated with $ABS\_ERR^T_{i,t}$. However, $ABS\_ERR^T_{i,t}$ is negatively correlated with both of the guidance measures. Finally, $INSTITHOLD_{i,t}$ ($BASPR_{i,t}$) is negatively (positively) correlated with $ABS\_ERR^T_{i,t}$.

6.3 Regression Results

In Table 8. we present the results of our firm-level regressions. The dependent variable is $ABS\_ERR^T_{i,t}$. We measure $ABS\_ERR^T_{i,t}$ two quarters after the end of fiscal year t. We include

on the residual obtained from a first-stage regression of $DIFF^T_{i,t}$ on $VOL_{i,t}$. $SDFUTROE_{i,t}$, $INSTITHOLD_{i,t}$, $BASPR_{i,t}$, $LNMV_{i,t}$. $BP_{i,t}$, $EP_{i,t}$, $RET_{i,t}$, $DIRT_{i,t}$, $RDSALES_{i,t}$, $FROE_{i,t}$, $BETA_{i,t}$, $SMB_{i,t}$, $HML_{i,t}$ and $MOM_{i,t}$. This regression includes firm and year fixed effects and it corresponds to the specification shown in column (1) of Table 8. Untabulated results show that the different values of $ABS\_ERR^T_{i,t}$ are highly correlated.

[18] If $INSTITHOLD_{i,t} > 1$, we set it equal to one. We winsorize the remaining control variables at their 1st and 99th percentiles.

industry (based on the Fama and French 12 industry classification) and year fixed effects. We calculate standard errors by clustering separately on industry and year. We show eight specifications. The first specification (column (1)) excludes the variables that relate to analyst coverage and firms' information production decisions. Each of the next seven columns relates to a specification in which one of the seven different analyst coverage or information production variables is included. The headings of columns (2) through (8) state the analyst coverage or information production variable included in the specification and the row labeled "AC_IP" contains the coefficient and t-statistic for this variable.[19]

First, we find that both firm-level measures of uncertainty (i.e., $VOL_{i,t}$ and $SDFUTROE_{i,t}$) have positive and significant associations with $ABS\_ERR_{i,t}^{T}$. Hence, as expected, higher uncertainty is associated with lower price informativeness. Second, we find that both measures of analyst coverage are negatively associated with $ABS\_ERR_{i,t}^{T}$, which implies that sell-side analysts discover and disseminate value relevant information.

Third, regarding our measures of information production, $DQ_{i,t}$ has a significantly negative correlation with $ABS\_ERR_{i,t}^{T}$. Hence, firms that provide more aggregated (i.e., less detailed) *quantitative* data in their annual reports have less informative prices. However, there is no evidence that less readable annual reports are associated with lower price informativeness. Although the coefficients on $FOG_{i,t}$ and $SIZE10K_{i,t}$ are positive, neither coefficient is statistically significant. Similarly, there is no evidence that earnings guidance leads to more informative prices.

Finally, the evidence regarding the effect of trading constraints on price informativeness is

[19] We estimate separate regressions for the analyst following and information production variables for three reasons. First, some of the variables are very similar (e.g., $FOLLOWING_{i,t}$ and $LNNUMFCST_{i,t}$). Second, some variables are not available for the entire sample. For example, the readability (guidance) measures are only available for years beginning on or after 1993 (1992). Finally, collinearity may be an issue. Specifically, when we include either of our analyst coverage variables and any of the disclosure variables in the regression, we find that many of the variables in the regression have high variance inflation factors.

mixed. The relation between $INSTITHOLD_{i,t}$ and $ABS\_ERR_{i,t}^{T}$ is negative and significant for seven of the eight specifications. However, the relation between $BASPR_{i,t}$ and $ABS\_ERR_{i,t}^{T}$ is positive and significant for only three of the eight specifications. Moreover, as discussed below, this result is sensitive to both the choice of deflator and the choice of horizon.

Taken together, the above results suggest the following. First, analysts produce information that investors would not have discovered in the short term (i.e., within six months of the fiscal year end). Second, the role of disclosure is nuanced. Managers that provide more detailed (i.e., less aggregated) *quantitative* data in the annual report reveal information that investors would not have discovered in the short term. However, providing more readable *textual* content does not appear to improve price informativeness. This suggests that the effects of low readability are temporary. Even if a report is complicated or long, investors eventually decipher it and embed its information into price. The effects of guidance also appear to be temporary, which is consistent with the fact that managers rarely provide forecasts for horizons beyond one year (e.g., Beyer et al. 2010).

Finally, the results regarding $INSTITHOLD_{i,t}$ and $BASPR_{i,t}$ suggest that short-selling constraints do impede informed trade but that illiquidity does not.

6.4 Robustness

We evaluate the robustness of our inferences to the choice of deflator and horizon. Regarding the deflator, we recalculate $DIFF_{i,t}^{T}$ but we deflate by equity book value instead of equity market value. Regarding the horizon, we recalculate $DIFF_{i,t}^{T}$ but we set T equal to 40 quarters instead of 28 quarters. Overall our results remain the same with three exceptions. First, the coefficient on $BASPR_{i,t}$ is sensitive to both the choice of deflator and the choice of horizon. In many specifications, it is insignificant; and, when it is significant it is often *negative*, which is opposite to what we predict. Second, when we use a ten-year horizon and deflate by equity market value, the coefficient on $INSTITHOLD_{i,t}$ is insignificant (the sign remains negative). That said, this coefficient is negative and significant in all other specifications. Finally, when we use a ten-year horizon and deflate by equity book value, the coefficient on $DQ_{i,t}$ is insignificant (the sign remains negative).

7 CONCLUSION

When equity prices are more informative, investors pay a fairer price for risk sharing and consumption smoothing, entrepreneurs receive funding that is commensurate with their value creation potential and economic agents learn more from prices, which, in turn, implies that they write better contracts and make better decisions. Hence, measuring price informativeness and understanding its determinants are important.

In this study, we develop a new measure of price informativeness, and then we evaluate its determinants. Our measure reflects the accuracy of investors' forecasts of future earnings embedded in current equity price. It is simple to calculate, easy to interpret and rigorous. It can be used both at the economy-level and firm-level; and, it reflects the combined effects of bias and imprecision, which are the fundamental determinants of informativeness.

Our results are both new and robust. The results of our economy-level tests imply that investors' collective mood affects the price they pay for risk sharing and consumption smoothing. Our firm-level results show that prices are less informative when: (1) uncertainty is high; (2) analyst coverage is low; (4) the firm provides highly aggregated accounting data; and, (4) a large fraction of the firm's shares is held by retail investors. However, we do not find persuasive evidence that firms that either provide less readable financial statements or forgo providing earnings guidance have less informative prices. Similarly, we do not find persuasive evidence that price informativeness is lower when liquidity is low.

APPENDIX A
DERIVATION OF $DIFF_{i,t}^{T}$

As shown in Christensen and Feltham (2009), if there are no arbitrage opportunities in the securities market and Equation (1) holds, firm $i's$ equity market value at time t is equal to the following:

$$P_{i,t} = B_{i,0} + \sum_{k=1}^{\infty} \frac{\mathbb{E}_t\left[X_{i,t+k} - \left(R_{t,t+k-1}^{t+k} - 1\right) \times B_{i,t-1}\right]}{R_{t,t}^{t+k}} + COV_{i,t}$$

$$= B_{i,0} + \sum_{k=1}^{\infty} \frac{\mathbb{E}_t\left[RI_{i,t+k}\right]}{R_{t,t}^{t+k}} + COV_{i,t}. \qquad \text{(A.1)}$$

We make two comments about Equation (A.1). First, it is very general as it does not require interest rates to have a flat term structure and it allows for a stochastic, time-varying risk adjustment. Second, as discussed in Section 2, the interest rate used to discount expected residual income (i.e., $R_{t,t}^{t+k}$) and the interest rate used to determine residual income (i.e., $R_{t,t+k-1}^{t+k}$) are both known certain amounts at time t. Specifically, $R_{t,t}^{t+k}$ ($R_{t,t+k-1}^{t+k}$) is the gross holding period return on a zero-coupon bond that will be issued on date t ($t + k - 1$) in order to satisfy the terms of a spot (forward) contract entered into on date t. This contract obligates the seller to issue on date t ($t + k - 1$) a zero-coupon bond that generates a guaranteed (i.e., riskless) holding period return of $R_{t,t}^{t+k}$ ($R_{t,t+k-1}^{t+k}$) and matures on date $t + k$. Hence, $\forall\, j \in [1, k]$, $R_{t,t}^{t+k}$ and $R_{t,t+k-j}^{t+k}$ are related as follows ($R_{t,t}^{t} = 1$ by definition):

$$R_{t,t+k-j}^{t+k} = \frac{R_{t,t}^{t+k}}{R_{t,t}^{t+k-j}} \qquad \text{(A.2)}$$

A.1 Derivation of $\mathbf{DIFF_{i,t}^{T}}$

We begin by noting that the clean surplus relation shown in Equation (1) and the definition of residual income imply:

$$B_{i,t+T} = RI_{i,t+T} + R_{t,t+T-1}^{t+T} \times B_{i,t+T-1} - D_{i,t+T}. \qquad \text{(A.3)}$$

Next, we iterate backwards and repeatedly substitute for $B_{i,t+T-k}$, which leads to the following expression for $B_{i,t+T}$:

$$B_{i,t+T} = \sum_{k=1}^{T} R_{t,t+k}^{t+T} \times RI_{i,t+k} + R_{t,t}^{t+T} \times B_{i,t} - \sum_{k=1}^{T} R_{t,t+k}^{t+T} \times D_{i,t+k}. \tag{A.4}$$

Third, we note that Equation (1) implies:

$$\sum_{k=1}^{T} X_{i,t+k} = B_{i,t+T} - B_{i,t} + \sum_{k=1}^{T} D_{i,t+k}. \tag{A.5}$$

Fourth, we substitute (A.4) into (A.5), rearrange and divide by $\left(R_{t,t}^{t+T} - 1\right)$ to obtain:

$$\frac{ACE_{i,t}^{T}}{R_{t,t}^{t+T}-1} = \frac{\sum_{k=1}^{T} X_{i,t+k} + \sum_{k=1}^{T}\left(R_{t,t+k}^{t+T}-1\right)\times D_{i,t+k}}{R_{t,t}^{t+T}-1}$$

$$= B_{i,t} + \frac{R_{t,t}^{t+T}}{R_{t,t}^{t+T}-1} \times \sum_{k=1}^{T} \frac{RI_{i,t+k}}{R_{t,t}^{t+k}} \tag{A.6}$$

Fifth, we take expectations of both sides of Equation (A.6) and we note that $\frac{R_{t,t}^{t+T}}{R_{t,t}^{t+T}-1} \to 1$ as $T \to \infty$, which implies that $\left(\frac{\mathbb{E}_t\left[ACE_{i,t}^{T}\right]}{R_{t,t}^{t+T}-1} + COV_{i,t}\right) \to P_{i,t}$ as $T \to \infty$.

Sixth, we add $0 = \left(\frac{R_{t,t}^{t+T}}{R_{t,t}^{t+T}-1} \times \sum_{k=1}^{T} \frac{\mathbb{E}_t\left[RI_{i,t+k}\right]}{R_{t,t}^{t+k}} - \frac{R_{t,t}^{t+T}}{R_{t,t}^{t+T}-1} \times \sum_{k=1}^{T} \frac{\mathbb{E}_t\left[RI_{i,t+k}\right]}{R_{t,t}^{t+k}}\right)$ to Equation (A.1), which allows us to re-express equity market value as follows:

$$P_{i,t} = \left(B_{i,t} + \frac{R_{t,t}^{t+T}}{R_{t,t}^{t+T}-1} \times \sum_{k=1}^{T} \frac{\mathbb{E}_t\left[RI_{i,t+k}\right]}{R_{t,t}^{t+k}}\right) + \frac{R_{t,t}^{t+T}-1}{R_{t,t}^{t+T}-1} \times \sum_{k=1}^{T} \frac{\mathbb{E}_t\left[RI_{i,t+k}\right]}{R_{t,t}^{t+k}} - \frac{R_{t,t}^{t+T}}{R_{t,t}^{t+T}-1} \times \sum_{k=1}^{T} \frac{\mathbb{E}_t\left[RI_{i,t+k}\right]}{R_{t,t}^{t+k}}$$

$$+ \sum_{k=T+1}^{\infty} \frac{\mathbb{E}_t\left[RI_{i,t+k}\right]}{R_{t,t}^{t+k}} + COV_{i,t}$$

$$= \frac{\mathbb{E}_0\left[ACE_{i,t}^{T}\right]}{R_{t,t}^{t+T}-1} + \sum_{k=T+1}^{\infty} \frac{\mathbb{E}_t\left[RI_{i,t+k}\right]}{R_{t,t}^{t+k}} - \frac{1}{R_{t,t}^{t+T}-1} \times \sum_{k=1}^{T} \frac{\mathbb{E}_t\left[RI_{i,t+k}\right]}{R_{t,t}^{t+k}} + COV_{i,t}$$

$$= \frac{\mathbb{E}_0\left[ACE_{i,t}^{T}\right]}{R_{t,t}^{t+T}-1} + TVC_{i,t}^{T} + COV_{i,t} \tag{A.7}$$

Finally, we obtain $DIFF_{i,t}^{T}$ (i.e., Equation (2)) by subtracting $\frac{ACE_{i,t}^{T}}{R_{t,t}^{t+T}-1}$ from Equation (A.7), and then dividing by $P_{i,t}$.

APPENDIX B
VARIABLE DEFINITIONS

In Table B.1, we summarize the variables that we use to calculate $DIFF_{i,t}^{T}$ and we describe the variable $ERR_{i,t}^{T}$. In Table B.2, we describe the variables used in the economy-level, time-series tests. And, in Table B.3, we summarize: (1) the independent variables we include in the first-stage regressions that we use to estimate $ERR_{i,t}^{T}$ and (2) the variables we use in our firm-level, cross-sectional tests.

The variable $P_{i,t}$ is firm $i's$ equity market value at the end of quarter t. It is calculated from Compustat as PRCCQ (Price Close – Quarter) multiplied by CSHOQ (Common Shares Outstanding).

The variable $X_{i,t}$ is firm $i's$ earnings for quarter t. We use Compustat data and one of the following definitions (shown in the order of preference): (1) IBCOMQ (Income Before Extraordinary Items - Available for Common); (2) IBQ (Income Before Extraordinary Items) less MIIQ (Noncontrolling Interest - Income Account); (3) NIQ (Net Income/Loss) less XIQ (Extraordinary Items); (4) IBCOM (Annual income) less sum of income for the other three quarters of the fiscal year; or, (5) EPSX12 (Earnings Per Share (Basic) - Excluding Extraordinary Items - 12 Months moving) multiplied by CSH12Q (Common Shares Used to Calculate Earnings Per Share - 12 Months Moving) less the cumulative income for the previous three quarters.

The variable $B_{i,t}$ is firm $i's$ equity book value at the end of quarter t. We use Compustat data. We prefer to use CEQQ (Common Equity – Total). We use CEQ (Common Equity – Total) if: (1) CEQQ is not available and (2) t corresponds to the last quarter of the fiscal year. Alternatively, we use ATQ (Assets – Total) less LTQ (Liabilities – Total) less MIBTQ (Noncontrolling Interests - Total - Balance Sheet) less PSTKQ (Preferred/Preference Stock (Capital) – Total). (Missing values of MIBTQ and PSTKQ are set to zero.) Finally, if we still have a missing value, we attempt to impute $B_{i,t}$ via the clean surplus relation shown in Equation (1).

The variable $D_{i,t}$ is the quarterly dividend for firm i. It is calculated as the product of DVPSXQ (Div per Share - Exdate – Quarter) and CSHOQ (Common Shares Outstanding) at the beginning of the quarter. We adjust CSHOQ for stock splits etc. using AJEXQ (Adjustment Factor (Company) - Cumulative by Ex-Date). In case the previous amount is missing, we divide the annual dividend (DVC) by four. If this is also missing, we set $D_{i,t}$ to zero.

We calculate $DIFF_{i,t}^{T}$ for every firm-quarter for which there is at least four leading contiguous quarters of non-missing values of $X_{i,t}$. We identify delisting years from CRSP and all four quarters of such years are excluded from the calculation of $DIFF_{i,t}^{T}$ and $X_{i,t+k}$. This implies that $DIFF_{i,t}^{T}$ is not calculated for any of the quarters in the delisting fiscal year and that the last $X_{i,t+k}$ values used to calculate $DIFF_{i,t}^{T}$ are from the quarters of the fiscal year that occurred immediately before the delisting fiscal year. For example, if a firm delists in the fiscal year 2000, $DIFF_{i,t}^{T}$ is calculated for this firm up to the fourth fiscal quarter of the fiscal year 1998. And, the $DIFF_{i,t}^{T}$ estimate for the fourth fiscal quarter of 1998 uses 4 quarters of $X_{i,t+k}$ from the fiscal year 1999. For firms that are temporarily delisted but subsequently resume trading (e.g., after a bankruptcy, restructuring, etc.), we resume calculating $DIFF_{i,t}^{T}$ as soon after the delisting year as possible.

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Figure 1
Time-Series Graph of Economy-Level Measures of Price Informativeness

The figure shows the value of quarterly aggregate level price informativeness measures BIAS, ABS_BIAS, STD and RMSE, from 1975Q1 to 2009Q4. See Appendix B and Tables B.1 through B.3 for variable definitions.

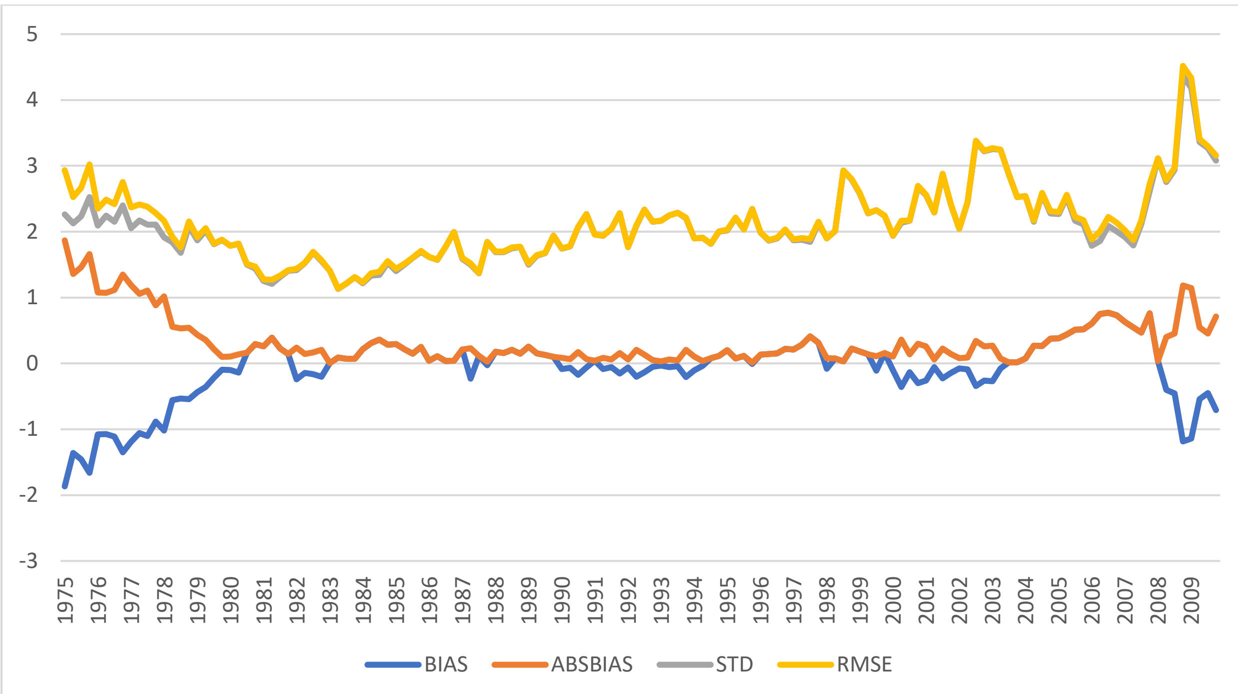

Figure 2
Time-series Graph of Economy-Level Measures of Price Informativeness (Detrended)

Figure 2a shows the quarterly aggregate level detrended price informativeness measures *BIAS* and *ABS_BIAS* from 1975Q1 to 2009Q4; Figure 2b shows the quarterly aggregate level detrended price informativeness measures *STD* and *RMSE*, from 1975Q1 to 2009Q4. We detrend the raw values of the variables by separately regressing each of them on $TIME\_TREND_t$, and then using the residuals from these regressions as our variables of interest. See Appendix B and Tables B.1 through B.3 for variable definitions.

Figure 2a: *BIAS* and *ABS_BIAS*

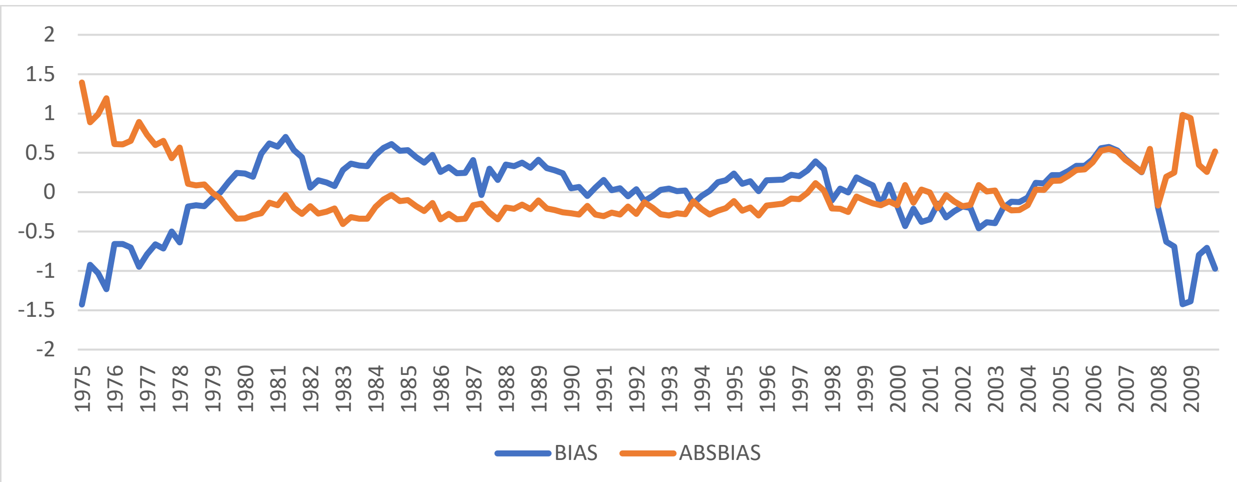

Figure 2b: *STD* and *RMSE*

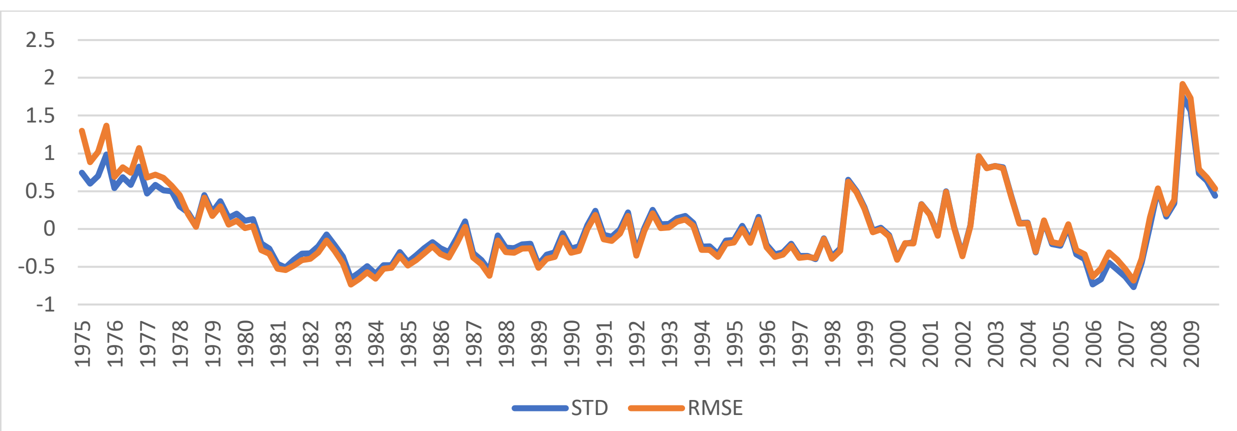

Table B.1
Variables Used to Calculate $DIFF_{i,t}^{T}$ and Description of $ERR_{i,t}^{T}$

Variable	Definition and source
$P_{i,t}$	Equity market value of firm i at the end of quarter t. Source: Compustat.
$X_{i,t}$	Earnings of firm i for quarter t. Source: Compustat.
$D_{i,t}$	Dividend paid by firm i in quarter t. Source: Compustat.
$B_{i,t}$	Equity book value of firm i at the end of quarter t. Source: Compustat.
$R_{a,b}^{c}$	The gross holding period return on a riskless zero coupon bond that will be issued on date b in order to satisfy the terms of a contract entered into on date a. This bond matures on date c. We use yields on US treasury bonds obtained from: https://www.quandl.com/data/FED/SVEN1F.
$ACE_{i,t}^{T}$	$\sum_{k=1}^{T}\left\{X_{i,t+k}+\left(R_{t,t+k}^{t+T}-1\right)\times D_{i,t+k}\right\}$ (i.e., aggregate cum dividend earnings for quarters $t+1$ through $t+T$).
$DIFF_{i,t}^{T}$	$\frac{P_{i,t}-\left(\frac{ACE_{i,t}^{T}}{R_{t,t}^{t+T}-1}\right)}{P_{i,t}}$. In our economy-level (firm-level) tests we measure $DIFF_{i,t}^{T}$ at the end of quarter t (the second quarter of fiscal year $t+1$).
$ERR_{i,t}^{T}$	The residual from a regression of $DIFF_{i,t}^{T}$ on a set of firm-specific characteristics. In our economy-level (firm-level) tests, this regression excludes (includes) industry fixed effects and year fixed effects.

Table B.2
Variables Used in Economy-level Time-series Tests

Variable	Definition and source
$BIAS_t^T$	$\frac{1}{N_t}\sum_{i=1}^{N_t} ERR_{i,t}^T$ (i.e., signed bias for quarter t). N_t is the number of observations with non-missing values of $ERR_{i,t}^T$ in quarter t.
$ABS\_BIAS_t^T$	$\lvert BIAS_t^T \rvert$ (i.e., the absolute value of the bias for quarter t).
STD_t^T	$\sqrt{\frac{1}{N_t}\sum_{i=1}^{N_t}\left(ERR_{i,t}^T - BIAS_t^T\right)^2}$ (i.e., imprecision for quarter t).
$RMSE_t^T$	$\sqrt{(BIAS_t^T)^2 + (STD_t^T)^2}$ (i.e., root mean square error for quarter t).
$SENT_t$	Baker and Wurgler (2007) sentiment index for the last month of quarter t. Source: http://people.stern.nyu.edu/jwurgler/.
ABS_SENT_t	$\lvert SENT_t \rvert$.
$LNMV_t$	$\ln\left(\sum_{i=1}^{N_t} P_{i,t}\right)$. Source: Compustat.
BP_t	$\sum_{i=1}^{N_t} B_{i,t} / \sum_{i=1}^{N_t} P_{i,t}$. Source: Compustat.
EP_t	$\sum_{i=1}^{N_t} X_{i,t} / \sum_{i=1}^{N_t} P_{i,t}$. Source: Compustat.
$GDPGROW_t$	Growth in GDP for quarter t (percentage change, seasonally adjusted annual rate). Source: https://fred.stlouisfed.org/series/CPGDPAI.
$CONGROW_t$	Growth in real per capita consumption for quarter t. Source: https://fred.stlouisfed.org/series/PCEC96.
$INDPROD_t$	Industrial production index for quarter t. Source: https://fred.stlouisfed.org/series/INDPRO.
$INDGROW_t$	Growth in industrial production index for quarter t.
$UNEMP_t$	Unemployment rate for the last month of quarter t. Source: https://data.bls.gov/timeseries/lns14000000.
$SPVOL_t$	Standard deviation of daily S&P 500 index returns for the last month of quarter t. Source: CRSP.
$EXPINF_t$	Expected monthly inflation (log relative of the US Consumer Price Index) at the end of quarter t. Estimated using the interest rate model in Fama and Gibbons (1984). Sources: https://fred.stlouisfed.org/tags/series?t=cpi, CRSP.
$CHEXPINF_t$	The monthly change in $EXPINF_t$, measured at the end of quarter t.
$UNEXPINF_t$	Unexpected inflation (i.e., the difference between actual monthly inflation and $EXPINF_t$) measured at the end of quarter t. Source: CRSP for actual monthly inflation data.
$REALINT_t$	The real interest rate (the 30-day T-bill rate minus monthly inflation) at the end of quarter t. Source: CRSP.
$RISKPREM_t$	The difference between the yield on Baa rated bonds and long-term government bonds (20-year maturity) at the end of quarter t. Sources: https://fred.stlouisfed.org/series/BAA, CRSP.
$TERMST_t$	The difference between the yield on long-term government bonds (20-year maturity) and the 30-day T-bill rate at the end of quarter t. Source: CRSP.
$VWRET_t$	The value-weighted return on NYSE, NASDAQ and AMEX stocks for quarter t. Source: CRSP.

Table B.3
Variables Used in the First-stage Regressions and the Firm-level Cross-sectional Tests

Variable	**Definition and source**
$ABS\_ERR_{i,t}^{T}$	$\lvert ERR_{i,t}^{T}\rvert$.
$VOL_{i,t}$	In our economy-level (firm-level) tests this is the average of the daily volatility of firm $i's$ stock returns for the 21 trading days ending on the last trading day of quarter t (second quarter of fiscal year $t+1$). Source: CRSP.
$SDFUTROE_{i,t}$	Forecast of the standard deviation of return on equity for fiscal year $t+1$ per Chang et al. (2018). Source: Authors of Chang et al. (2018).
$FOLLOWING_{i,t}$	Indicator variable that equals one if the firm had analyst following during fiscal year t and zero otherwise. Source: I/B/E/S.
$LNNUMFCST_{i,t}$	Log of one plus the number of analysts with outstanding forecasts at the end of fiscal year t. Source: I/B/E/S.
$DQ_{i,t}$	Disclosure quality index per Chen et al. (2015). Source: Authors of Chen et al. (2015).
$FOG_{i,t}$	Fog index as defined in Li (2008). Source: http://webuser.bus.umich.edu/feng/.
$SIZE10K_{i,t}$	Log of the 10K file-size per Loughran and McDonald (2014). Source: https://sraf.nd.edu/.
$GUIDANCE_{i,t}$	Indicator variable that equals one if the firm issued earnings guidance during fiscal year t and zero otherwise. Source: I/B/E/S Guidance.
$LNNUMGUID_{i,t}$	Log of one plus the number of times the firm issued earnings guidance during fiscal year t. Source: I/B/E/S Guidance.
$INSTITHOLD_{i,t}$	Ratio of total shares held by institutions divided by total firm shares outstanding at the end of fiscal year t. Source: Thomson Reuters 13f Database.
$BASPR_{i,t}$	Average of the daily bid-ask spread scaled by price for the 21 trading days ending on the last trading day of the second quarter of fiscal year $t+1$. Source: CRSP.
$LNMV_{i,t}$	$\ln(P_{i,t})$. In the economy-level (firm-level) tests, $P_{i,t}$ is measured at the end of quarter t (the second quarter of fiscal year $t+1$). Source: Compustat.
$BP_{i,t}$	$B_{i,t}/P_{i,t}$. In the economy-level (firm-level) tests $P_{i,t}$ is measured at the end of quarter t (the second quarter of fiscal year $t+1$). Source: Compustat.
$EP_{i,t}$	$X_{i,t}/P_{i,t}$. In the economy-level (firm-level) tests $P_{i,t}$ is measured at the end of quarter t (the second quarter of fiscal year $t+1$). Source: Compustat.
$DIRT_{i,t}$	$\{(B_{i,t+T}-B_{i,t})-\sum_{\tau=1}^{T}(X_{i,t+\tau}-D_{i,t+\tau})\}/P_{i,t}$. In the economy-level (firm-level) tests $P_{i,t}$ is measured at the end of quarter t (the second quarter of fiscal year $t+1$). Source: Compustat.
$RDSALES_{i,t}$	The ratio of R&D expense to sales for fiscal year t. Source: Compustat.
$FROE_{i,t}$	Forecast of the mean of return on equity for fiscal year $t+1$ per Chang et al. (2018). Source: Authors of Chang et al. (2018).

Table B.3 (Continued)

Variable	Definition and source
$RET_{i,t}$	In the economy-level (firm-level) tests, firm $i's$ stock return for quarter t (the one-year period ending on the last day of the second quarter of fiscal year $t+1$).
$BETA_{i,t}$	Firm-specific equity beta. Estimated using a 60-month rolling window regression of monthly returns on the monthly return on the market. In the economy-level (firm-level) tests, it is measured at the end of quarter t (the second quarter of fiscal year $t+1$). Sources: CRSP.
$HML_{i,t}$	Firm-specific Fama and French HML factor loading. Estimated using a 60-month rolling window regression of the firm's monthly return on the monthly factors. In the economy-level (firm-level) tests, it is measured at the end of quarter t (the second quarter of fiscal year $t+1$). Sources: CRSP, http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.
$SMB_{i,t}$	Firm-specific Fama and French SMB factor loading. Estimated using a 60-month rolling window regression of the firm's monthly return on the monthly factors. In the economy-level (firm-level) tests, it is measured at the end of quarter t (the second quarter of fiscal year $t+1$). Sources: CRSP, http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.
$MOM_{i,t}$	Firm-specific Fama and French MOM factor loading. Estimated using a 60-month rolling window regression of the firm's monthly return on the monthly factors. In the economy-level (firm-level) tests, it is measured at the end of quarter t (the second quarter of fiscal year $t+1$). Sources: CRSP, http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.
$ROE_{i,t}$	$X_{i,t}/B_{i,t}$. Source: Compustat.
$ROA_{i,t}$	$X_{i,t}/AT_{i,t}$. $AT_{i,t}$ is the total assets at the end of quarter t. Source: Compustat.
$MARGIN_{i,t}$	$X_{i,t}/SALEQ_{i,t}$. $SALEQ_{i,t}$ is the sales for quarter t. Source: Compustat.
$LEVERAGE_{i,t}$	$AT_{i,t}/B_{i,t}$. $AT_{i,t}$ is the total assets at the end of quarter t. Source: Compustat.

Table 1
Economy-level Analysis: Descriptive Statistics of Quarterly Price Informativeness Measures and Economy-level Variables

This table shows descriptive statistics for the variables used in the economy-level analysis. Panels A and C present statistics for the unadjusted variables. Panels B and D present statistics for detrended variables. We detrend all unadjusted variables in this analysis by separately regressing each of them on $TIME\_TREND_t$, and then using the residuals from these regressions as our detrended variables of interest. See Appendix B and Tables B.1 through B.3 for variable definitions.

Panel A: Raw Price Informativeness Measures

Variable	Mean	St. Dev.	Min	25^{th}perc	Median	75^{th}perc	Max
BIAS	-0.089	0.489	-1.867	-0.212	0.009	0.202	0.769
ABS_BIAS	0.333	0.367	0.005	0.098	0.206	0.404	1.867
STD	2.079	0.551	1.130	1.758	2.019	2.278	4.360
RMSE	2.130	0.576	1.134	1.765	2.041	2.375	4.517

Panel B: Detrended Price Informativeness Measures

Variable	Mean	St. Dev.	Min	25^{th}perc	Median	75^{th}perc	Max
BIAS	0.000	0.444	-1.427	-0.174	0.102	0.303	0.702
ABS_BIAS	0.000	0.358	-0.405	-0.232	-0.146	0.104	1.394
STD	0.000	0.443	-0.770	-0.322	-0.095	0.221	1.751
RMSE	0.000	0.498	-0.736	-0.359	-0.155	0.193	1.919

Panel C: Raw Determinants and Controls

Variable	Mean	St. Dev.	Min	25^{th}perc	Median	75^{th}perc	Max
SENT	0.120	0.909	-2.200	-0.245	0.185	0.630	2.830
ABS_SENT	0.678	0.615	0.000	0.215	0.515	0.855	2.830
LNMV	14.968	1.100	12.554	14.115	14.981	16.057	16.485
BP	0.558	0.210	0.242	0.391	0.507	0.758	1.032
EP	0.016	0.010	-0.029	0.011	0.014	0.021	0.040

Table 1 (Continued)

Panel C: Raw Determinants and Controls (Continued)

Variable	Mean	St. Dev.	Min	25th perc	Median	75th perc	Max
GDPGROW	6.553	4.224	-7.700	4.500	5.950	8.750	25.200
CONGROW	0.523	0.645	-2.528	0.168	0.586	0.878	1.883
INDPROD	72.511	19.159	41.610	54.535	66.070	92.515	105.130
INDGROW	0.284	0.989	-3.159	-0.165	0.333	0.894	2.350
UNEMP	6.326	1.544	3.900	5.200	5.950	7.300	10.800
SPVOL	0.009	0.005	0.004	0.006	0.008	0.010	0.033
EXPINF	0.010	0.009	-0.007	0.005	0.008	0.014	0.039
CHEXPINF	0.000	0.003	-0.013	-0.002	0.000	0.002	0.013
UNEXPINF	0.000	0.007	-0.032	-0.004	0.000	0.004	0.018
REALINT	0.004	0.010	-0.019	-0.002	0.003	0.009	0.043
RISKPREM	9.501	2.682	5.863	7.565	8.872	10.595	17.200
TERMST	0.009	0.061	-0.175	-0.030	0.000	0.049	0.212
VWRET	0.009	0.039	-0.120	-0.011	0.016	0.034	0.107

Panel D: Detrended Determinants and Controls

Variable	Mean	St. Dev.	Min	25th perc	Median	75th perc	Max
SENT	0.000	0.864	-1.867	-0.397	-0.006	0.562	2.477
ABS_SENT	0.000	0.578	-0.888	-0.381	-0.080	0.263	2.325
LNMV	0.000	0.252	-0.919	-0.086	-0.008	0.114	0.567
BP	0.000	0.125	-0.200	-0.090	-0.004	0.072	0.390
EP	0.000	0.006	-0.034	-0.004	-0.001	0.005	0.016
GDPGROW	0.000	3.454	-10.446	-1.952	-0.004	1.848	15.140
CONGROW	0.000	0.633	-3.201	-0.330	0.046	0.362	1.192
INDPROD	0.000	5.069	-15.594	-3.300	0.751	4.352	10.085
INDGROW	0.000	0.986	-3.557	-0.430	0.041	0.615	2.066
UNEMP	0.000	1.388	-1.902	-0.977	-0.127	0.449	4.732
SPVOL	0.000	0.005	-0.007	-0.003	-0.001	0.001	0.022
EXPINF	0.000	0.007	-0.013	-0.004	-0.001	0.003	0.022
CHEXPINF	0.000	0.003	-0.012	-0.001	0.000	0.002	0.013
UNEXPINF	0.000	0.007	-0.034	-0.004	0.000	0.004	0.017

Table 1 (Continued)

Panel D: Detrended Determinants and Controls (Continued)

Variable	Mean	St. Dev.	Min	25thperc	Median	75thperc	Max
REALINT	0.000	0.010	-0.022	-0.006	0.000	0.005	0.041
RISKPREM	0.000	1.821	-3.605	-0.929	-0.197	0.511	5.579
TERMST	0.000	0.091	-0.348	-0.060	0.001	0.049	0.391
VWRET	0.000	0.039	-0.132	-0.021	0.006	0.024	0.098

Table 2
Economy-level Analysis: Univariate Correlations between Detrended Price Informativeness Measures

This table shows univariate correlations between detrended price informativeness measures used in the economy-level analysis. We detrend all unadjusted variables in this analysis by separately regressing each of them on $TIME\_TREND_t$, and then using the residuals from these regression as our variables of interest. See Appendix B and Tables B.1 through B.3 for variable definitions. Pearson correlations are shown in the bottom diagonal and Spearman correlations in the top diagonal. The table shows the correlation coefficients with their corresponding p-values below in brackets.

	BIAS	ABSBIAS	STD	RMSE
BIAS		-0.320	-0.783	-0.790
		(0.00)	(0.00)	(0.00)
ABSBIAS	-0.652		0.268	0.353
	(0.00)		(0.00)	(0.00)
STD	-0.828	0.504		0.989
	(0.00)	(0.00)		(0.00)
RMSE	-0.869	0.636	0.985	
	(0.00)	(0.00)	(0.00)	

Table 3
Economy-level Analysis: Univariate Correlations between Detrended Price Informativeness Measures and Macro Variables of Interest

This table shows univariate correlations between detrended price informativeness measures and macro variables of interest used in the economy-level analysis. We detrend the raw values of the variables by separately regressing each of them on $TIME\_TREND_t$, and then using the residuals from these regressions as our variables of interest. See Appendix B and Tables B.1 through B.3 for variable definitions. The table shows the correlation coefficients with their corresponding p-values below in brackets.

	PEARSON				SPEARMAN			
	BIAS	ABS_BIAS	STD	RMSE	BIAS	ABS_BIAS	STD	RMSE
SENT	0.625	-0.616	-0.618	-0.670	0.537	-0.484	-0.581	-0.615
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
ABS_SENT	-0.472	0.487	0.281	0.346	-0.404	0.460	0.232	0.266
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)

Table 4
Economy-level Analysis: Univariate Correlations between Detrended Price Informativeness Measures and Macro Control Variables

This table shows univariate correlations between detrended price informativeness measures and macro control variables used in the economy-level analysis. We detrend the raw values of the variables by separately regressing each of them on $TIME\_TREND_t$, and then using the residuals from these regressions as our variables of interest. See Appendix B and Tables B.1 through B.3 for variable definitions. The table shows the correlation coefficients with their corresponding p-values below in brackets.

	PEARSON				SPEARMAN			
	BIAS	ABS_BIAS	STD	RMSE	BIAS	ABS_BIAS	STD	RMSE
LNMV	0.440	-0.492	-0.464	-0.494	0.256	-0.331	-0.355	-0.357
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
BP	-0.201	0.328	0.224	0.234	-0.060	0.286	0.115	0.112
	(0.02)	(0.00)	(0.01)	(0.01)	(0.48)	(0.00)	(0.18)	(0.19)
EP	0.127	0.187	-0.039	-0.016	0.182	0.227	-0.068	-0.044
	(0.13)	(0.03)	(0.65)	(0.85)	(0.03)	(0.01)	(0.42)	(0.60)
GDPGROW	-0.063	0.136	0.091	0.110	-0.074	0.130	0.111	0.137
	(0.46)	(0.11)	(0.29)	(0.19)	(0.39)	(0.12)	(0.19)	(0.11)
CONGROW	0.008	0.041	-0.070	-0.039	0.006	0.055	-0.083	-0.064
	(0.92)	(0.63)	(0.41)	(0.65)	(0.95)	(0.52)	(0.33)	(0.45)
INDPROD	0.087	0.176	-0.106	-0.054	0.007	0.342	-0.040	0.013
	(0.31)	(0.04)	(0.21)	(0.52)	(0.94)	(0.00)	(0.64)	(0.88)
INDGROW	0.089	-0.110	-0.053	-0.089	0.007	0.072	-0.050	-0.066
	(0.30)	(0.20)	(0.54)	(0.30)	(0.93)	(0.40)	(0.56)	(0.44)
UNEMP	-0.303	0.138	0.276	0.264	-0.178	-0.025	0.172	0.137
	(0.00)	(0.10)	(0.00)	(0.00)	(0.04)	(0.77)	(0.04)	(0.11)
SPVOL	-0.220	0.062	0.191	0.177	-0.163	0.017	0.131	0.113
	(0.01)	(0.47)	(0.02)	(0.04)	(0.05)	(0.85)	(0.12)	(0.18)
EXPINF	0.225	0.070	-0.154	-0.137	0.232	0.166	-0.118	-0.099
	(0.01)	(0.41)	(0.07)	(0.11)	(0.01)	(0.05)	(0.16)	(0.24)
CHEXPINF	0.075	-0.057	-0.106	-0.109	0.026	0.056	-0.068	-0.059
	(0.38)	(0.50)	(0.21)	(0.20)	(0.76)	(0.51)	(0.43)	(0.49)

Table 4 (Continued)

	PEARSON				SPEARMAN			
	BIAS	ABS_BIAS	STD	RMSE	BIAS	ABS_BIAS	STD	RMSE
UNEXPINF	-0.093	-0.107	0.003	-0.010	-0.170	-0.072	0.073	0.058
	(0.28)	(0.21)	(0.97)	(0.91)	(0.05)	(0.40)	(0.39)	(0.50)
REALINT	0.251	-0.207	-0.185	-0.208	0.302	-0.251	-0.269	-0.293
	(0.00)	(0.01)	(0.03)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
RISKPREM	0.436	-0.402	-0.393	-0.441	0.494	-0.355	-0.482	-0.538
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TERMSTR	-0.044	-0.001	0.176	0.156	-0.040	-0.043	0.159	0.151
	(0.60)	(0.99)	(0.04)	(0.07)	(0.64)	(0.61)	(0.06)	(0.07)
VWRET	-0.009	0.101	0.025	0.039	0.032	0.085	-0.017	-0.000
	(0.92)	(0.23)	(0.77)	(0.65)	(0.70)	(0.32)	(0.85)	(1.00)

Table 5
Economy-level Analysis: Regression Results

This table shows the results of the estimation of the following regressions:

$$BIAS_t \ (or \ ABS\_BIAS_t \ or \ STD_t \ or \ RMSE_t) = \beta_0 + \beta_1 SENT_t + \beta_2 ABS\_SENT_t + \sum_{y=1}^{10} \gamma_{y,t} \, CONTROL_{y,t} + \varepsilon_t$$

$CONTROL_{y,t}$ is one of the ten control variables. All of the variables are detrended. See Appendix B and Tables B.1 through B.3 for variable definitions. The table shows coefficient values and corresponding t-statistics between brackets. Significance levels are indicated as follows: *** p<0.01, ** p<0.05, * p<0.1.

Variables	(1) BIAS	(2) ABS_BIAS	(3) STD	(4) RMSE
SENT	0.230***	-0.139***	-0.170***	-0.204***
	(4.96)	(-3.44)	(-2.71)	(-3.38)
ABS_SENT	-0.321***	0.239***	0.165**	0.226***
	(-6.79)	(5.82)	(2.59)	(3.67)
LNMV	0.199	-0.797***	-0.598**	-0.872***
	(0.94)	(-4.34)	(-2.10)	(-3.17)
BP	0.328	-0.258	-0.578	-0.855*
	(0.96)	(-0.87)	(-1.25)	(-1.92)
EP	8.219*	-0.636	-1.882	-2.551
	(1.79)	(-0.16)	(-0.30)	(-0.43)
INDPROD	0.001	0.025***	0.004	0.013
	(0.16)	(3.48)	(0.38)	(1.24)
UNEMPLOY	-0.098***	0.018	0.064*	0.075**
	(-3.45)	(0.73)	(1.68)	(2.04)
SPVOL	-19.008***	2.259	21.311***	22.420***
	(-3.79)	(0.52)	(3.15)	(3.43)
EXPINF	0.761	1.707	-1.083	-1.016
	(0.18)	(0.46)	(-0.19)	(-0.18)
REALINT	3.786	5.486**	-1.583	-0.332
	(1.45)	(2.41)	(-0.45)	(-0.10)

Table 5 (Continued)

Variables	(1) BIAS	(2) ABS_BIAS	(3) STD	(4) RMSE
RISKPREM	0.057**	-0.032	-0.059*	-0.067**
	(2.55)	(-1.63)	(-1.97)	(-2.30)
TERMSTR	0.166	-0.099	0.917*	0.869*
	(0.46)	(-0.31)	(1.87)	(1.83)
Adj. R-squared	0.765	0.726	0.570	0.682
Num. Obs.	140	140	140	140
Sample Period	1975Q1-2009Q4	1975Q1-2009Q4	1975Q1-2009Q4	1975Q1-2009Q4

Table 6
Firm-level Analysis: Descriptive Statistics

This table shows descriptive statistics for the variables used in the firm-level analysis. See Appendix B and Tables B.1 through B.3 for variable definitions.

Panel A: Price Informativeness Measure

Variable	Mean	St. Dev.	Min	25th perc	Median	75th perc	Max	Num. Obs.
ERR	0.660	2.022	-5.222	-0.391	0.357	1.321	11.453	60828
ABS_ERR	1.160	1.325	0.000	0.319	0.723	1.468	11.256	60828

Panel B: Determinants

Variable	Mean	St. Dev.	Min	25th perc	Median	75th perc	Max	Num. Obs.
FOLLOWING	0.545	0.498	0.000	0.000	1.000	1.000	1.000	60828
LNNUMFCST	1.099	1.583	0.000	0.000	0.693	2.485	5.971	60828
DQ	0.603	0.102	0.248	0.537	0.587	0.661	0.924	53431
FOG	19.442	1.893	0.000	18.532	19.336	20.252	42.037	26403
LNSIZE10K	13.392	1.021	7.170	12.515	13.422	14.173	18.320	22839
GUIDANCE	0.253	0.435	0.000	0.000	0.000	1.000	1.000	39718
LNNUMGUID	0.475	0.924	0.000	0.000	0.000	0.693	4.605	39718
VOL	0.030	0.019	0.006	0.016	0.024	0.037	0.104	60828
SDFUTROE	0.111	0.101	0.006	0.046	0.074	0.144	0.548	60828
INSTITHOLD	0.374	0.276	0.000	0.129	0.337	0.584	1.000	60828
BASPR	0.032	0.040	0.000	0.007	0.019	0.041	0.222	60828

Panel C: Control Variables

Variable	Mean	St. Dev.	Min	25th perc	Median	75th perc	Max	Num. Obs.
LNMV	5.271	2.023	1.254	3.753	5.159	6.683	10.263	60828
BP	0.637	0.466	0.062	0.310	0.525	0.827	2.585	60828
EP	0.014	0.131	-0.709	0.001	0.045	0.076	0.223	60828
RET	0.154	0.581	-0.773	-0.200	0.057	0.357	2.763	60828
DIRT	0.374	0.915	-0.880	-0.042	0.089	0.460	5.555	60828
RDSALES	0.349	1.566	0.000	0.000	0.000	0.085	12.790	60828

Table 6 (Continued)
Panel C: Control Variables (Continued)

Variable	Mean	St. Dev.	Min	25th perc	Median	75th perc	Max	Num. Obs.
FROE	0.062	0.190	-0.669	0.002	0.105	0.173	0.481	60828
BETA	1.307	0.447	-0.069	0.994	1.246	1.659	2.000	60828
SMB	0.008	0.009	-0.011	0.001	0.007	0.014	0.040	60828
HML	0.005	0.014	-0.029	-0.003	0.000	0.013	0.034	60828
MOM	-0.001	0.006	-0.026	-0.004	-0.001	0.002	0.014	60828

Table 7
Firm-level Analysis: Univariate Correlations

This table shows univariate correlations between the firm-level price informativeness measures and other variables used in the firm-level cross-sectional analysis. See Appendix B and Tables B.1 through B.3 for variable definitions. The table shows the correlation coefficients with their corresponding p-values below in brackets.

	Pearson	Spearman
Variable	ABS_ERR	ABS_ERR
FOLLOWING	-0.045	-0.042
	(0.00)	(0.00)
LNNUMFCST	-0.064	-0.061
	(0.00)	(0.00)
DQ	0.075	0.074
	(0.00)	(0.00)
FOG	0.019	0.020
	(0.00)	(0.00)
LNSIZE10K	0.028	0.024
	(0.00)	(0.00)
GUIDANCE	-0.016	-0.026
	(0.00)	(0.00)
LNNUMGUID	-0.024	-0.032
	(0.00)	(0.00)
VOL	0.214	0.236
	(0.00)	(0.00)
SDFUTROE	0.255	0.273
	(0.00)	(0.00)
INSTITHOLD	-0.069	-0.082
	(0.00)	(0.00)
BASPR	0.120	0.086
	(0.00)	(0.00)
LNMV	-0.203	-0.202
	(0.00)	(0.00)
BP	0.205	0.131
	(0.00)	(0.00)

Table 7 (Continued)

	Pearson	Spearman
Variable	ABS_ERR	ABS_ERR
EP	-0.253	-0.180
	(0.00)	(0.00)
RET	-0.136	-0.167
	(0.00)	(0.00)
DIRT	0.231	0.172
	(0.00)	(0.00)
RDSALES	0.087	0.093
	(0.00)	(0.00)
AVGFUTROE	-0.262	-0.272
	(0.00)	(0.00)
BETA	0.056	0.054
	(0.00)	(0.00)
SMB	-0.080	-0.077
	(0.00)	(0.00)
HML	0.004	0.013
	(0.35)	(0.00)
MOM	0.011	0.003
	(0.01)	(0.51)

Table 8

Firm-level Analysis: Regressions

This table shows the results of the estimation of the following regressions:

$$ABS\_ERR_{i,t} = \alpha_i + \beta_{y,i,t} AC\_IP + \sum_{y=1}^{4} \gamma_y DETERMINANTS_{y,i,t} + \sum_{y=1}^{9} \delta_{y,i,t}\, CONTROL_{y,i,t} + \theta_I + \vartheta_y + \varepsilon_{i,t}$$

AC_IP is excluded in column 1 and each of the subsequent columns takes on the value of one of the following 7 variables: *FOLLOWING, LNNUMFCST, DQ, FOG, SIZE10K, GUIDANCE,* and *LNNUMGUID*. $DETERMINANTS$ is a vector of the following 4 variables: *VOL, SDFUTROE, INSTITHOLD and BASPR*. *CONTROL* is a vector of 11 control variables. θ_I is industry fixed effects, and ϑ_y is year fixed effects. Standard errors are clustered by industry and year. See Appendix B and Tables B.1 through B.3 for variable definitions. The table shows coefficient values and corresponding robust t-statistics between brackets. Significance levels are indicated as follows: *** p<0.01, ** p<0.05, * p<0.1.

VARIABLES	(1) BASELINE	(2) FOLLOWING	(3) LNNUMFCST	(4) DQ	(5) FOG	(6) LNSIZE10K	(7) GUIDANCE	(8) LNNUMGUID
AC_IP		-0.038*	-0.048***	-0.697***	0.004	0.038	-0.016	-0.013
		(-1.98)	(-5.68)	(-4.06)	(0.41)	(1.51)	(-0.34)	(-0.50)
VOL	4.967***	4.914***	4.939***	4.685***	4.978***	4.265***	4.697***	4.693***
	(7.64)	(7.38)	(7.43)	(6.77)	(6.96)	(4.42)	(6.69)	(6.67)
SDFUTROE	1.784***	1.789***	1.745***	1.715***	1.743***	1.805***	1.697***	1.696***
	(16.29)	(16.67)	(16.83)	(15.17)	(8.99)	(8.59)	(11.77)	(11.88)
INSTITHOLD	-0.142**	-0.121*	-0.109*	-0.154**	-0.140	-0.179**	-0.139*	-0.137*
	(-2.33)	(-2.10)	(-2.02)	(-2.37)	(-1.34)	(-2.22)	(-1.91)	(-1.91)
BASPR	0.500*	0.442	0.585*	0.361	0.561**	0.531	0.291	0.299
	(1.82)	(1.56)	(2.11)	(1.21)	(2.45)	(1.03)	(1.00)	(1.01)
LNMV	-0.050***	-0.050***	-0.035***	-0.054***	-0.054***	-0.045**	-0.054***	-0.053***
	(-4.80)	(-5.00)	(-3.97)	(-5.80)	(-3.78)	(-2.75)	(-4.54)	(-4.43)

Table VIII (Continued)

VARIABLES	(1) BASELINE	(2) FOLLOWING	(3) LNNUMFCST	(4) DQ	(5) FOG	(6) LNSIZE10K	(7) GUIDANCE	(8) LNNUMGUID
BP	0.410***	0.409***	0.413***	0.400***	0.441***	0.496***	0.481***	0.481***
	(13.77)	(13.72)	(13.75)	(10.81)	(7.19)	(8.58)	(8.79)	(8.77)
EP	-0.114	-0.120	-0.138*	-0.167**	0.080	0.124	-0.010	-0.011
	(-1.46)	(-1.60)	(-1.80)	(-2.28)	(0.62)	(1.00)	(-0.19)	(-0.21)
RET	-0.211***	-0.211***	-0.209***	-0.206***	-0.241***	-0.245***	-0.227***	-0.227***
	(-9.85)	(-9.84)	(-9.54)	(-9.46)	(-6.84)	(-5.66)	(-7.35)	(-7.54)
DIRT	0.363***	0.360***	0.366***	0.377***	0.442***	0.451***	0.427***	0.427***
	(19.56)	(18.65)	(19.08)	(22.51)	(8.39)	(10.12)	(10.45)	(10.36)
RDSALES	-0.010	-0.009	-0.009	-0.011	-0.029	-0.035**	-0.022	-0.023
	(-1.40)	(-1.20)	(-1.20)	(-1.58)	(-1.68)	(-2.30)	(-1.66)	(-1.66)
FROE	-0.183	-0.168	-0.154	-0.130	-0.514**	-0.554***	-0.293*	-0.292**
	(-1.67)	(-1.59)	(-1.39)	(-1.13)	(-3.02)	(-3.70)	(-2.20)	(-2.21)
BETA	0.153**	0.152**	0.152***	0.170**	0.163*	0.155*	0.169**	0.168**
	(3.04)	(3.07)	(3.15)	(3.20)	(2.13)	(2.10)	(2.97)	(2.93)
SMB	-0.202	-0.169	0.021	-0.882	2.092	3.893	0.339	0.347
	(-0.16)	(-0.14)	(0.02)	(-0.57)	(0.89)	(1.76)	(0.16)	(0.16)
HML	-0.663	-0.649	-0.413	0.023	-2.782	-2.112	-0.512	-0.515
	(-0.67)	(-0.67)	(-0.41)	(0.02)	(-1.33)	(-0.74)	(-0.38)	(-0.38)
MOM	-2.042	-2.125	-1.787	-2.470	-6.633	1.039	-2.285	-2.299
	(-0.82)	(-0.86)	(-0.73)	(-0.97)	(-0.90)	(0.18)	(-0.65)	(-0.66)
Observations	60,828	60,828	60,828	53,431	26,403	22,839	39,718	39,718
R-squared	0.252	0.252	0.254	0.247	0.236	0.241	0.239	0.240
Adj. R-squared	0.251	0.251	0.253	0.246	0.235	0.239	0.239	0.239