The Influence of Corporate Risk Exposures on the Accuracy of Earnings Forecasts*

Wayne Guay
The Wharton School
University of Pennsylvania
guay@wharton.upenn.edu

David Haushalter
Susquehanna International Group, LLP
haushalt@sig.com

Bernadette Minton
Fisher School of Business
Ohio State University
minton_15@cob.osu.edu

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Abstract

We examine how corporations' exposures to interest rates, exchange rates, and commodity prices are related to investors' and analysts' expectations about firms' earnings. The results indicate that investors and analysts encounter difficulties estimating the earnings effects of the risk exposures that companies face. Stock returns around earnings announcements are associated with the magnitude of both recent quarter and lagged shocks to interest rates, exchange rates and commodity prices, especially for firms with large ex-ante exposures to these risks. Although intra-quarter revisions to analysts' forecasts do incorporate information about the earnings effects of the risk shocks, analysts' earnings forecasts do not fully resolve the uncertainty created by either recent quarter and lagged shocks. Overall, the results suggest that analysts resolve between 25%-60% of the total uncertainty created by interest rate, exchange rate, and commodity price shocks. The results are consistent with arguments that corporate financial risk exposures are not transparent to investors or analysts, and support recent research arguing that firms' hedging strategies consider this source of earnings uncertainty.

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1. Introduction

A widely accepted concept in financial economics is that outsiders have imperfect information about corporations' operations. A rich body of theoretical work explores the role of imperfect information and asymmetric information between insiders and outsiders on a corporation's financial policies. Bhattacharya (1979) demonstrates that imperfect information affects a corporation's dividend policy. Myers and Majluf (1984) argue that imperfect information can influence the choice of capital structure. Demarzo and Duffie (1995) show that imperfect information can impact a firm's choice of a hedging policy. In addition, recent empirical studies, including Minton and Schrand (1999), Gebhart, Lee, and Swaminathan (2001), Lang, Lins and Miller (2002), and Easley, Hvidkjaer and O'Hara (2002), document that the uncertainty caused by imperfect and asymmetric information has an impact on a firm's cost of capital and valuation. An extensive empirical literature documents that firms consider these informational costs when establishing disclosure practices. Additionally, regulators, including the SEC and FASB, recognize these uncertainties and have responded by instituting a wave of mandates requiring corporations to increase their disclosures.[1] Yet, despite the theoretical, empirical, and regulatory attention to imperfect information, a basic issue that is not particularly well understood is what types of information shocks create uncertainty for investors, how much uncertainty do the shocks generate, and how investors resolve the uncertainty over time.

In this paper, we provide evidence on investor uncertainty regarding one aspect of firms' operations: financial risk exposures. Using a broad sample of large firms between 1990 and 1999, we investigate whether, and to what extent, recent interest rate (IR), exchange rate (FX) and

[1] For example, between 1990 and 1998 the FASB issued Statements of Accounting Standards Nos. 105, 107, 119, and 133 all aimed at improving risk-related disclosures about financial instruments such as derivative securities. In 1997, the SEC issued Financial Reporting Release No. 48 requiring forward-looking quantitative disclosures about the risk of loss due to unfavorable changes in interest rates, exchanges rates, and commodity prices.

commodity price (COM) shocks increase uncertainty in both investors' and sell-side analysts' expectations about corporate earnings, and how this uncertainty is resolved over time.

We structure our research design to examine the following sequence of events: 1) investors and analysts observe publicly available IR, FX and COM shocks during a quarter *t* and the previous quarters *t-1, t-2, t-3.* 2) At or near the end of quarter *t*, investors and analysts use their information about firms' risk exposures to form expectations about how these contemporaneous and lagged shocks are likely to affect firms' earnings in quarter *t*. 3) The firm's earnings for quarter *t* are reported in quarter *t+1* and analysts' forecast errors and investors' surprise (i.e., earnings announcement return) are observed.

Our results indicate that both investors and analysts encounter difficulties incorporating the effects of IR, FX, and COM shocks into their expectations. We document that recent quarter and lagged quarterly shocks to IR, FX, and COM generate uncertainty about accounting earnings that investors do not resolve prior to the earnings announcement date. Specifically, for firms with large (i.e., largest decile) ex-ante exposures to IR, FX, and COM, the absolute value of excess stock returns around earnings' announcements increases with the magnitude of recent quarter and lagged IR, FX, and COM shocks. These results indicate that IR, FX, and COM shocks affect earnings for several quarters into the future, and that these shocks not only create investor uncertainty about earnings in the most recent quarter, but also continue to create investor uncertainty about earnings for several quarters into the future. This error in investors' expectations likely stems from either investors having incomplete information about firms' risk exposures (and therefore incomplete information about how an observed shock will affect firms' earnings) or investors' failure to utilize available information about firms' risk exposures, or both.

Although the results indicate that IR, FX, and COM shocks create investor uncertainty, we expect investors actively work to resolve the uncertainty created by these shocks and that the

observed residual uncertainty is net of these attempts to resolve the uncertainty. Because we cannot directly observe how investors revise their expectations about earnings over time, we analyze analysts' earnings forecasts as a proxy for these expectations. Although analysts' forecasts might be a biased and noisy proxy for investors' expectations, we presume that the bias and noise is not a function of changes in IR, FX and COM. Consistent with the announcement return results, we document that the errors in analysts' forecasts and the dispersion in analysts' forecasts are significantly correlated with both recent and lagged IR, FX and COM shocks. Moreover, these correlations are stronger for firms with larger ex ante risk exposures. With respect to the magnitude of uncertainty created by these shocks, we find that for firms with large ex ante exposures, typical IR, FX and COM shocks can increase the absolute median analyst forecast error by roughly 8%-10% (by comparison, the sample mean forecast error is 31%).

To investigate how analysts resolve uncertainty over time, we examine the process by which analysts update their earnings forecasts to incorporate information about IR, FX and COM shocks. First, we document that analysts' forecast revisions within a given quarter are related to both intra-quarter and lagged changes in the shocks. This evidence is consistent with analysts actively trying to incorporate the impact of price shocks in making their forecasts and that it takes analysts several quarters to resolve the earnings uncertainty caused by a given price shock. Second, we find that analysts' forecasts and revisions do resolve a portion of the uncertainty caused by these price shocks. We document that the improvement in analysts' end of period forecasts over forecasts derived from a seasonal random walk time-series model is at least partially due to analysts ability to resolve uncertainty related to IR, FX and COM shocks. As some indication of the magnitude or proportion of uncertainty resolved, we find that compared to forecasts derived from a seasonal random walk time-series model, analysts' end of period forecasts resolve roughly 25%-60% of the expected total uncertainty caused by typical IR, FX and COM shocks equal to the sample means

(the percentage reduction depends on the types and magnitudes of a given firm's exposures). We also find some evidence that analysts intra-quarter forecast revisions resolve a portion of the uncertainty due to IR, FX and COM shocks that exists at the beginning of the quarter.

Our findings have implications for two streams of research. First, our study has implications for the literature that investigates the role of hedging in increasing the flow of information to investors. In particular, Demarzo and Duffie (1995) argue that hedging can reduce the amount of noise in corporate earnings and therefore reduce the asymmetry of information between managers and investors. An implicit assumption in their model is that outsiders encounter difficulty interpreting the impact of risks that corporations can hedge away. Our results support this assumption in that we show that investors and analysts do not resolve the impact of potentially hedgable risks related to IR, FX and COM. The results are also consistent with recent empirical studies that examine the association between the use of derivatives and earnings uncertainty. For example, recent studies including Gezcy, Minton, and Schrand (1997), Barton (2001), Brown (2001), Dadalt, Gay, and Nam (2002), and Pincus and Rajgopal (2002) find that corporations' use of derivatives is associated with earnings volatility, the number of analysts following, and the accuracy of analysts' forecasts.

The second area of related research is the growing body of literature attempting to understand how accounting standards and firms' disclosure practices provide financial statement users with information about how to assess firms' risks.[2] Important empirical questions not addressed by this literature, and at least partially addressed in this paper include, how much uncertainty is created by these risk exposures, how much of the uncertainty is resolved by market participants, and how much residual uncertainty remains. Our results suggest that these risk exposures account for a substantial amount of earnings uncertainty and that a significant fraction of

this uncertainty is resolved by market participants via existing disclosure requirements and practices only after a period of several quarters. Our findings indicate that recent efforts by regulators and accounting standard setters to improve firm disclosures about risk exposures are indeed focused on an existing area of information uncertainty.[3] While our tests focus specifically on uncertainty due to risk exposures, we believe that our approach to identifying investor and analyst uncertainty is quite general and can be applied to other aspects of firms' operating, investing, and financing activities where information asymmetries are predicted to exist.

The paper proceeds as follows. Section 2 describes the sample selection and macroeconomic risk exposures. Section 3 reports the results on the associations between IR, FX and COM shocks and earnings announcement returns, analyst forecast errors, and analyst forecast revisions. We also provide evidence on the proportion of uncertainty resolved by analysts. Section 4 concludes.

2. Sample selection and macro risk variables

2.1 Data selection

Our data consist of a broad sample of non-financial firms over the period 1990 to 1999. The initial sample consists of 10,000 firm-years (40,000 firm-quarters), and comprises the largest 1,000 non-financial, non-utility firms, ranked by Compustat sales each year between 1990 and 1999. We focus on large firms to increase the likelihood that the majority of our sample firms have a consistent analyst following. Before ranking firms, we exclude firms in regulated industries, financial firms, and subsidiaries of foreign firms. We also require I/B/E/S data on analysts'

[2] For example, see Collins and Venkatachalam (1996), Wong (2000), Hodder (2001) Hodder, Koonce, and McAnally (2001), Barth, Beaver, and Landsman (1996), and Eccher, Ramesh, and Thiagarajan (1996).

[3] We note that our results do not speak to whether additional disclosure requirements would or should resolve additional uncertainty. Increased disclosure will only augment outsiders' information set if managers possess undisclosed information about these exposures and we provide no evidence on this question. Further, we can not eliminate the possibility that a portion of the remaining uncertainty about risk exposures is due to outsiders inability to efficiently process all the available information.

forecasts, a minimum of eighteen months of CRSP return data to estimate firm-specific IR, FX and COM exposures, and a minimum of five consecutive quarters of earnings to compute control variables. These data restrictions reduce the sample size to 24,796 firm-quarters (some tests require additional variables that reduce the sample to as few as 22,024 firm-quarters).

2.2 Macro risk variables

Our analysis focuses on three types of macroeconomic risks exposures: interest rates (IR), foreign exchange rates (FX), and commodity prices (COM). Our data on changes in interest rates come from weekly observations of the yield on three-month Treasury bills, reported in the Federal Reserve's Statistical Release (see http://www.federalreserve.gov/releases/H15/data.htm). We use the raw – percentage point - changes in these rates in the regressions. Changes in the foreign exchange rate come from the Major Currencies Index reported in the Federal Reserve's Statistical Release. This index is a trade-weighted average of the foreign exchange values of the U.S. dollar against currencies that circulate widely outside the country of issue. The countries/regions of issuance include Canada, Euro Area, Japan, United Kingdom, Switzerland, Australia, and Sweden. The countries/regions whose currencies are most heavily weighted are Canada, Euro Area, and Japan (see http://www.federalreserve.gov/pubs/bulletin/1998/1098lead.pdf). We measure the change in exchange rates as the percentage change in the value of this index. Changes in commodity prices come from weekly observations of the Goldman Sachs Commodity Excess Return Index. This index is a weighted average of five sub-indexes including an energy commodity index (e.g., oil, natural gas, and heating oil), a precious metals index (e.g., gold and silver), a livestock index (e.g., hogs and cattle), an agriculture index (e.g., wheat and soy beans), and an industrial metal index (e.g., tin and aluminum). The weights placed on these sub-indexes as part of the Goldman Sachs Commodity Index varies throughout time. However, the energy index generally makes up at least half of the value of the Goldman Sachs Index (for a detailed description of this index see

http://www.gs.com/gsci/). Similar to our exchange rate change measure, we measure the change in the commodity prices as the percentage change in the value of the commodity index.

[Insert Table 1]

The descriptive statistics about the time-series properties for macro risk exposures are presented in Table 1. The interest rate data reflect quarterly percentage point changes in the three-month yield on Treasury securities and the commodity price and the exchange rate data reflect the quarterly percentage changes in the value of the respective index.

Of the three price series, COM appears to be somewhat more variable than IR and FX. The coefficient of variance (standard deviation scaled by mean) of both current quarter and lagged COM is just greater than one compared to just under one for IR and two-thirds for FX. The maximum COM shock over the sample period is about five standard deviations greater than the mean compared to about four standard deviations greater than the mean for IR and FX. However, the relative volatilities of these shocks are not necessarily an indication of which price series has a greater effect on firms' cash flows or earnings, or which price series is more or less fully incorporated into investors expectations and analysts' forecasts. Similarly, the length of time it takes for the IR, FX, and COM shocks to have an effect on earnings is not clear. For example, several quarters could pass before an change in the price of a commodity used as input in a company's operations shows up in cost of goods sold. The magnitude and timing of these lag effects are an additional source of uncertainty that investors and analysts may or may not fully understand given their information set. Because of the uncertainty about the timing effects, we examine both current quarter and lagged shocks. We measure lagged shocks as the changes in IR, FX, and COM over the three quarters preceding each quarterly observation.

3. Empirical analysis and results

Our null hypothesis is that IR, FX, and COM price shocks are unrelated to investor uncertainty about earnings. Our alternative hypothesis is that these shocks increase investor uncertainty. Conditional on rejecting the null hypothesis, we seek to investigate whether and how investors work to reduce this uncertainty.

3.1 Analysis of investor uncertainty based on earnings announcement returns

Our analysis begins with an examination of the extent to which firms' risk exposures affect investors' ability to forecast firms' earnings. We expect that if investors have imperfect information about firms' risk exposures, earnings announcements contain new information about the impact of recent IR, FX and COM shocks on firm performance. In this case, we predict that the magnitude of the market reaction to earnings announcements is relatively greater when there are greater shocks to IR, FX and COM, and for firms with greater exposures to IR, FX and COM risk.

We measure the market reaction to earnings announcements as the absolute value of the abnormal returns during the three-day window around the announcement of a company's quarterly earnings. The abnormal returns are estimated using a market model. We estimate the parameters of the model for a 200 day window ending 50 trading days before the earnings announcement date.

[Insert Table 2]

The descriptive statistics for the abnormal returns and the control variables in the analysis are presented in Table 2. Consistent with extant empirical research, the mean (median) abnormal stock return for the three-day window around earnings' announcements is 3.47% (2.33%).

Because there are cross sectional differences in companies' IR, FX, and COM risk exposures, we include proxies for the extent to which a company faces these exposures in our analysis. The proxies for these exposures are firm-specific beta estimates from regressions of

monthly stock returns on monthly changes in IR, FX, and COM over a thirty-six month rolling window. We estimate each of these betas separately for each firm for each reporting quarter in the sample period. For example, if the reporting quarter ends in March 1993, the regressions are estimated using the 36 months prior to the beginning of the reporting quarter. In this example, the 36-month window would go from January 1990 to December 1992. Under the assumption that investors estimate firms' risk exposures with error, we expect that these betas are unbiased, though noisy, proxies for each firm's risk exposures. Because we expect these exposure estimates are noisy, we construct an indicator variable for each macroeconomic exposure set equal to 1 if the absolute value of a given estimated beta coefficient is in the top decile of the overall sample, and 0 otherwise.[4]

Our objective is to isolate firm-specific uncertainty due to IR, FX and COM shocks. Thus, we also include variables to control for short-term macro-level sources of uncertainty that may be correlated with these price shocks. To control for the influence of a shock to the overall level of economic activity in the United States, we include the absolute quarterly change in Gross National Product (GNP) in our tests. The change in Gross National Product is consistently positive during our sample period. In fact, it is positive for every quarter during our sample period. Therefore, we demean the change in GNP variable (i.e., subtract the sample period mean change in quarterly GNP) before taking the absolute value to obtain a more reasonable measure of a shock to the normal change in GNP. The absolute value of the average deviation of the GNP from the average quarterly GNP during the sample period is 0.40%.

As an additional measure of general macro-level uncertainty within the economy that is likely to affect forecast errors, we include stock market volatility as a control variable. Stock

[4] Alternatively, when we use exposure indicator variables set equal to 1 if the absolute value of a given estimated beta coefficient is in the top quartile of the overall sample, and 0 otherwise, the results are largely consistent with the tabulated findings.

market volatility is measured as the standard deviation of daily returns on CRSP's value weighted index during the quarter. On average, the standard deviation of daily stock returns during the sample period for CRSP's value-weighted index is 0.70%.

We examine the association between abnormal stock returns around earnings announcements and the proxies for IR, FX, and COM with the following regression:

$$\begin{aligned} Abs(EAR)_t = {} & \alpha + \beta_1 Abs(\Delta IR)_t + \beta_2 Abs(\Delta IR)_t * \text{Large IR Exp} \\ & + \beta_3 Abs(\Delta FX)_t + \beta_4 Abs(\Delta FX)_t * \text{Large FX Exp} \\ & + \beta_5 Abs(\Delta Com)_t + \beta_6 Abs(\Delta Com)_t * \text{Large COM Exp} \\ & + \beta_7 Abs(\Delta IR)_{t-3,\,t-1} + \beta_8 Abs(\Delta IR)_{t-3,\,t-1} * \text{Large IR Exp} \\ & + \beta_9 Abs(\Delta FX)_{t-3,\,t-1} + \beta_{10} Abs(\Delta FX)_{t-3,\,t-1} * \text{Large FX Exp} \\ & + \beta_{11} Abs(\Delta Com)_{t-3,\,t-1} + \beta_{12} Abs(\Delta Com)_{t-3,\,t-1} * \text{Large COM Exp} \\ & + \beta_{13} Abs(\text{Deviation in GNP})_t + \beta_{14} \text{Market Volatility}_t + error_t \end{aligned} \quad (1)$$

where, $Abs(EAR)_t$ is the absolute value of the abnormal returns during the three-day window around the announcement of a company's quarter *t* earnings; $Abs(\Delta IR)_t$ is the absolute value of the percentage point change in the three-month yield on treasury securities measured from the beginning to the end of the quarter *t* for which earnings are reported; $Abs(\Delta FX)_t$ is the absolute value of the percentage change in the Major Currency index measured from the beginning to the end of the quarter *t* for which earnings are reported; $Abs(\Delta Com)_t$ is the absolute value of the percentage change in the Goldman Sachs Commodity Index measured from the beginning to the end of the quarter *t* for which earnings are reported; $Abs(\Delta IR)_{t-3,\,t-1}$, $Abs(\Delta FX)_{t-3,\,t-1}$, and $Abs(\Delta Com)_{t-3,\,t-1}$ are the respective price shocks over the three quarters preceding quarter *t*; $Abs(\text{Deviation in GNP})_t$ is the absolute value of the difference between the change in GNP in

quarter *t* and the average quarterly change in GNP over the sample period; and Market Volatility$_t$ is the standard deviation of daily returns for the CRSP Value Weighted Index during the quarter *t*.

We use absolute values for our measures of announcement returns and price shocks because we have no predictions about whether a given shock to IR, FX and COM is expected to result in a positive or negative announcement return. As such, our regressions are designed only to determine whether shocks to IR, FX and COM increase the difficulty that investors face with respect to accurately estimating earnings.

[Insert Table 3]

Table 3 presents the regression estimates of Equation (1). Because neither our null or alternative hypotheses predicts a negative relation between investor uncertainty and the price shocks, in our empirical tests, we draw inferences about the significance levels of the regressions coefficients based on one-sided t-tests. Empirically, absolute current and lagged shocks are correlated (e.g., the correlation between the absolute value of current period and three quarter lagged shocks is 0.50 for interest rates and 0.19 for commodity prices). Therefore, we first report two reduced form estimates of Equation (1). Column (1) only includes current period shocks. Column (2) only includes the three quarter lagged shocks. Column (3) reports the estimates for the full specification of Equation (1), with both current period and three quarter lagged shocks. We estimate the regressions using the full-pooled sample period from 1990 to 1999. Because we have multiple time-series observations per firm and clustering across reporting quarters, we calculate t-statistics based on Huber-White robust standard errors, which are a generalization of the White (1980) standard errors that are robust to both serial correlation and heteroskedasticity (Rogers, 1993). The absolute announcement return variable is winsorized at the 99th percentile value to minimize the effect of extreme observations.

Overall, the results show that for firms with larger ex ante risk exposures, investors do not fully anticipate the firm-specific effects of changes in IR, FX and COM. Specifically, in Columns (1) and (2), the coefficients on current and lagged IR, FX and COM changes for firms in the top deciles of exposures are all positive and significant. In Column (3), the results for the full specification are similar to the results in Columns (1) and (2) except that the current IR interactive variable is no longer significant.

The magnitudes of the regression coefficients also are economically significant. For example, consider the coefficient of 0.151 on the variable that interacts current period FX shock with the large FX exposure indicator variable. This coefficient indicates that a typical FX shock equal to the sample mean, 0.028, increases the absolute magnitude of the announcement return by 0.42% for firms with large ex ante FX risk exposures. The other significant coefficients in Table 3 generate expected announcement return effects of similar magnitude, between 0.3% and 0.6%. To help put these values in perspective, the average absolute announcement return is 3.5% in the full sample and 4.0% for firms with at least one large ex ante risk exposure.

3.2 Regressions of analyst forecast errors on IR, FX and Commodity price changes

The results in Table 3 indicate that changes in IR, FX, and COM increase the uncertainty that investors face in predicting the earnings of companies with substantial exposures to these risks. In this section, we use analysts' earnings forecasts as a proxy for investors earnings expectations and first confirm that analysts also face uncertainty about the earnings effects of IR, FX and COM shocks. In Sections 3.3 and 3.4, we proceed to investigate whether, and to what extent, analysts actively incorporate firm-specific information about the earnings effects of risk exposures into their estimates.

We obtain analysts' forecasts of quarterly earnings from I/B/E/S and calculate the median forecast error for each observation as the difference between the actual quarterly earnings per share and the median analyst earnings forecast in the last month prior to the end of the quarter. We select this end of quarter cut-off point for analysts' forecasts to mitigate the likelihood that the forecast reflects any earnings pre-announcements by the firms (see Skinner and Sloan, 2001 for a discussion of this issue). In the tests that follow, we use the absolute value of the median forecast error as a measure of the earnings uncertainty that is unresolved by the analysts. For comparability across firm-years, we scale the median forecast error and forecast revision by the absolute value of actual earnings for each quarter.[5] The average of the absolute median analyst forecast error scaled by reported earnings for each quarter are shown in Figure 1. These quarterly values range from 17% to 115% and show a somewhat declining trend over the sample period.

We begin our investigation of the association between exposures and analysts' forecasts by estimating regressions similar to those reported in Table 3. For these regressions, the dependent variable is the absolute median analyst forecast error. Similar to Equation (1), the independent variables consist of the absolute changes in IR, FX, and COM during the recent quarter, interaction terms between the price changes and top decile exposure indicator variables, and macro risk controls for absolute changes in GNP and the standard deviation in daily market returns during the quarter.

We expect that analysts' forecasts deviate from actual earnings for firm-specific reasons beyond the uncertainty caused by IR, FX, and COM exposures and other short-term macro-level sources of uncertainty. Therefore, we include two additional control variables in these regressions. First, the precision of consensus forecasts is likely increasing in the number of analysts making

[5] In general, the results are qualitatively similar when we scale the error by stock price. The results are also robust to removing observations with small denominators (e.g., absolute reported earnings per share of less than $0.03 or $0.05.)

forecasts. Fewer (more) analysts following a given firm suggest more (less) noisy estimates of consensus and more (less) volatile forecast errors. In our tests, we control for the number of analysts that comprise a given consensus earnings estimate.

Second, we expect that the magnitude of analyst forecast errors and the likelihood that a firm misses the consensus forecast is on average greater for firms in uncertain business environments, or for firms that make little effort to "manage" earnings.[6] To control for the aggregate impact of these factors, we compute average firm-specific historical magnitudes of forecast errors. We estimate this variable with absolute forecast errors during the four quarters preceding each quarterly observation. One measurement issue with this variable is that lagged forecast errors are likely to be influenced by the lagged IR, FX, and COM shocks that we examine in our tests. Because our interest in including this variable is to control for *firm-specific* factors that are associated with forecast errors, we first regress the lagged average forecast error measure on changes in current and lagged IR, FX and COM shocks. We use the residuals from this regression as a control variable to capture firm-specific factors that influence analyst forecast errors and to purge the historical forecast error of its correlation with the macro price changes.

[Insert Table 4]

The descriptive statistics for the forecast error and the additional control variables are presented in Table 4. All variables are winsorized at the 99th percentile values to minimize the effect of extreme observations. The average absolute value of the scaled median analyst forecast error is 31% (i.e., on average the median forecast error is slightly less than 1/3 of the earnings). However, the distribution is skewed and the median forecast error is about 8% of the earnings. The average of

[6] As noted above, Burgstahler and Eames (1999), Degeorge, Patel, and Zeckhauser (1999), and Skinner and Sloan (2001) and others report evidence that some firms actively try to avoid deviations between analysts' forecasts and reported earnings. For example, managers may try to manage reported earnings through accounting accruals or may try to guide analysts toward the expected reported earnings number.

number of analysts following a company is 8.33 and the median is 7.00. The mean (median) absolute median forecast error for the four quarters prior to a quarterly observation is 34% (12%), similar to the statistics for the one quarter forecast error.

We investigate the association between errors in analysts' forecasts and price and rate shocks using the following regression specification:

$$\begin{aligned} Abs(FE)_t = \alpha &+ \beta_1 Abs(\Delta IR)_t + \beta_2 Abs(\Delta IR)_t * \text{Large IR Exp} \\ &+ \beta_3 Abs(\Delta FX)_t + \beta_4 Abs(\Delta FX)_t * \text{Large FX Exp} \\ &+ \beta_5 Abs(\Delta Com)_t + \beta_6 Abs(\Delta Com)_t * \text{Large COM Exp} \\ &+ \beta_7 Abs(\Delta IR)_{t-3,\,t-1} + \beta_8 Abs(\Delta IR)_{t-3,\,t-1} * \text{Large IR Exp} \\ &+ \beta_9 Abs(\Delta FX)_{t-3,\,t-1} + \beta_{10} Abs(\Delta FX)_{t-3,\,t-1} * \text{Large FX Exp} \\ &+ \beta_{11} Abs(\Delta Com)_{t-3,\,t-1} + \beta_{12} Abs(\Delta Com)_{t-3,\,t-1} * \text{Large COM Exp} \\ &+ \beta_{13} Abs(\text{Deviation in GNP})_t + \beta_{14} \text{Market Volatility}_t \\ &+ \beta_{15} Log(\#Analysts)_t + \beta_{16} \text{Average } Abs(\text{Forecast Error})_{t-4,t-1} + error_t \end{aligned} \quad (2)$$

where, $Abs(FE)_t$ is the absolute value of actual reported earnings per share minus the median analyst forecast in the last month prior to the end of the quarter for which earnings are reported, all scaled by the absolute value of actual reported earning per share; $Log(\#Analysts)_t$ is the logarithm of the number of analysts making forecasts in the last month prior to the end of the quarter for which earnings are reported; and Average $Abs(\text{Forecast Error})_{t-4,t-1}$ is the absolute value of the average residual forecast error described above for the four quarters preceding quarter t. The other variables included in this regression are as defined in Equation (1).

An important aspect of the empirical design is the timing of our variable measurement. Our forecast error measure is based on the median analyst forecast measured in the last month prior to the end of the quarter. The forecasts are generally compiled by I/B/E/S through about the middle of

this last month. As discussed above, we use this measure to mitigate the impact of earnings pre-announcements on the analysts' forecasts. Our measures of price shocks reflect changes in IR, FX and COM from the beginning of the quarter through the end of the quarter for which earnings are being forecast. Therefore, with the exception of price changes during the last two weeks of the quarter, analysts can observe these price changes and incorporate them into their forecasts as they see fit.

To ensure that our results are not influenced by price shocks that occur in the last two weeks of the quarter, we rerun all of our tests using current quarter price shock measures computed over the first two and a half months of the current quarter (i.e., excluding price shocks during the last two weeks of the current quarter). All results are robust to this alternative variable measurement procedure.

Table 5 presents the regression estimates of the associations between absolute analyst forecast errors and shocks to IR, FX and COM. Similar to Table 3, we first estimate the specification including only the current period shocks (Column (1)), and then including only three quarter lagged shocks (Column (2)). Column (3) reports the estimates for the full specification. As in Table 3, we calculate t-statistics based on Huber-White robust standard errors.

[Insert Table 5]

Consistent with the earnings announcement return results in Table 3, the results in Table 5 indicate that analysts' forecasts do not fully resolve the uncertainty created by IR, FX and COM shocks on firms' earnings. The magnitudes of analysts' quarterly forecast errors increase with current quarter IR and FX shocks, with somewhat greater predicted errors for firms with larger IR and FX exposures, respectively. The forecast errors also increase with lagged shocks (prior three quarters) to IR, FX, and COM, with greater predicted errors for firms with larger COM exposures.

This indicates that even after observing a shock to IR, FX, or COM, one, two or three quarters ago, analysts still encounter difficulties mapping the effects of these shocks into current period earnings.

The magnitudes of the regression coefficients in Table 5 show that the price shocks have an economically significant effect on analyst forecast errors. For example, consider the coefficient of 0.057 on current period IR shocks in Column (3). This coefficient indicates that, on average, a typical IR shock equal to the sample mean of 0.322 increases the absolute magnitude of the forecast error by 1.8 percentage points for the full sample. Similarly, the coefficient of 1.285 on current period FX shocks indicates that, on average, a typical FX shock equal to the sample mean of 0.028 increases the absolute magnitude of the forecast error by 3.6 percentage points for the full sample. These effects are substantially larger for firms with large ex ante IR and FX exposures. For companies in the top decile of IR exposure, the incremental coefficient on the IR shock variable is 0.149. For companies in the top decile of FX exposure, the incremental coefficient on the FX shock variable is 0.874. Therefore, for these large exposure firms, on average, a typical IR shock increases the absolute magnitude of the forecast error by an additional 6.6 percentage points and a typical FX shock increases the magnitude of the error by approximately 6.0 percentage points. The effects are of similar magnitude for shocks to lagged COM. These magnitudes can be compared to the sample mean absolute median analyst forecast of 31%.

Our two firm-specific control variables, analyst following and the average historical forecast error, are significantly related to quarterly analysts' forecast errors. Consistent with prior empirical research, the magnitudes of analyst forecast errors are negatively related to analyst following. Not surprisingly, there is also a positive and significant association between absolute analysts' forecast errors and absolute lagged forecast errors. The deviation of quarterly GNP growth from the average growth over the sample period exhibits a marginal positive association with forecast errors.

In untabulated regressions, we find that a majority of the explanatory power in these regressions comes from the firm-specific control variables. This suggests that, on average, firm-specific and industry-risks, such as operating risks, accounts for considerably more of the cross-sectional variation in analysts' uncertainty than financial risk exposures (untabulated F-tests do confirm that the joint effect of adding the recent and lagged changes in IR, FX, and COM and the variables indicating large exposures significantly increases the explanatory power of these regressions). However, one important difference between financial and non-financial sources of uncertainty in analyst estimates is that a company may have significantly greater ability to manage their financial risks as compared to their operating risks.

Finally, we also estimate similar regressions (untabulated) in which we use the dispersion of analysts' forecasts as the dependent variable in our analysis, rather than the forecasts errors. We measure the dispersion in forecasts as the ratio of standard deviation in the forecasts to the absolute value of the earnings and consider this to be an alternative proxy for the amount of uncertainty among analysts about a company's earnings. The results are very similar to the regression results in Table 5 using the analysts' forecast errors. In particular, consistent with analysts encountering difficulty interpreting the impact of changes in IR, FX, and COM on earnings, we find that the standard deviation in the analysts forecasts are significantly associated with both current and lagged price and rate shocks.

3.3 Revisions to analysts' forecasts

The results presented in Table 5 indicate that analysts' forecast errors increase with IR, FX and COM shocks. However, presumably analysts recognize this source of uncertainty and may engage in efforts to resolve it. In this section, we investigate whether and to what extent analysts revise their earnings forecasts in response to the IR, FX, and COM shocks that they have recently

observed during the quarter, and whether these revisions incorporate new information about how past price and rate shocks are likely to affect current period earnings.

To investigate this issue, we examine the association between intra-quarter revisions in analysts' estimates from the first to the last month of the quarter and changes in IR, FX, and COM during the quarter. The intra-quarter revision in analysts' estimates is defined as the Abs(Median Forecast_{fm} - Median Forecast_{fm-2}) scaled by the absolute value of actual reported earnings per share, where Median Forecast_{fm} is the median forecast in the last month prior to the end of the quarter for which earnings are reported, and Median Forecast_{fm-2} is the median forecast during the first month of the quarter for which earnings are reported.

The intra-quarter revision regressions are presented in Table 6, and are similar to those presented in Table 5, except that the dependent variable is the forecast revision rather than the forecast error and that the absolute lagged forecast error control variable is not included in this specification. As in Tables 3 and 5, we first report regressions for current shocks and lagged shocks separately in Columns (1) and (2), and then report the full specification in Column (3).

[Insert Table 6]

The analysis reported in Table 6 shows that the magnitude of the forecast revisions increase with the magnitude of the IR, FX, and COM shocks. Specifically, the magnitudes of the revisions are significantly positively related to current quarter IR shocks for firms with large IR exposures, current quarter FX shocks, lagged IR and COM shocks, and lagged COM shocks for firms with larger commodity price exposures. For example, the coefficients in Column (3) imply that a three quarter lagged COM shock equal to the sample average induces a forecast revision in the current quarter equal to about 6.1% (1.8%) of actual earnings per share for firms with large (non-large) COM exposures. Similarly, an IR or FX shock equal to the sample average implies a forecast revision of about 3.1% and 2.0% for large IR exposure firms and the full sample of FX exposures,

respectively. These revision magnitudes can be put in perspective by comparison with the sample average absolute mean forecast revision of 21.8% of actual earnings (untabulated).

An important aspect of the results in Table 6 is their comparison to the results in Table 5. In particular, the majority of the exposures that are associated with intra-quarter revisions in analysts' forecasts are also associated with errors in the end of the period analysts' forecast. For example, the results in Tables 5 and 6 show that magnitudes of the forecast errors as well as revisions in forecasts are associated with current period IR and FX shocks and lagged COM shocks. Note, however, that documented relations between forecast revisions and price shocks do not imply that analysts' revisions *improve* their forecasts. Taken together, these results indicate that analysts recognize the financial exposures that firms face and attempt to incorporate the earnings effects price shocks on these exposures into their forecasts, but that considerable uncertainty about these shocks is unresolved by the analysts.[7]

3.4 Incremental informativeness of analysts' forecasts

The regressions in Tables 5 and 6 provide evidence that analysts attempt to incorporate the effects of price shocks into their forecasts but that analysts do not fully resolve the uncertainty created by these shocks. However, the failure of analysts to fully resolve the uncertainty is not entirely surprising. To perfectly map a given IR, FX or COM shock into earnings requires detailed and accurate information about the firm-specific sensitivity of earnings to IR, FX and COM shocks.

[7] Our tests do not investigate the reasons that analysts revise their forecasts. One possibility is that analysts observe current period IR, FX and commodity price shocks as well as other firm-specific operating and financial information, and then use their expertise to construct revised forecasts that incorporate how previous and current price shocks are expected to affect current period earnings. Another possibility is that managers provide analysts with guidance about how current and previous shocks to IR, FX and commodity prices are likely to affect current period earnings. Although we do not discriminate between these non-mutually exclusive possibilities, we find in untabulated tests that the documented positive relations between absolute forecast errors and price shocks is weaker for firms with a greater analyst following. Assuming that the amount of management guidance does not increase with the number of analysts following the firm, this result suggests that management guidance is not the sole source of information that leads to revisions.

For example, to anticipate how a shock to FX will affect a corporation's earnings requires detailed knowledge about all of the firm's currency-exposed contracts and currency hedging activities as well as the influence of this shock on competitive pressures, product demand, and input prices. Therefore, a related, and important question is whether and to what extent the analysts are able to *resolve a portion* of the total uncertainty caused by IR, FX and COM shocks.

We investigate the ability of analysts to resolve uncertainty related to financial risk exposures by comparing three competing measures of absolute forecast errors. The first measure is the analyst forecast error we employ in the previous tables, measured as the absolute difference between actual earnings per share and the end of quarter median analysts' forecast (hereafter, "end of period error"). The second measure is an analyst forecast error measured as the absolute difference between actual earnings per share and the beginning of quarter median analysts' forecast (hereafter, "beginning of period error"). Analysts beginning of period forecasts are made after observing lagged shocks but before observing the current period shocks. The third measure is a time-series model forecast error (hereafter, "time-series model error") measured as the absolute difference between actual earnings per share and earnings per share in same quarter of the previous fiscal year. This time-series model assumes that quarterly earnings follow a seasonal random walk. As in the previous tables, all absolute forecast errors are scaled by absolute actual earnings per share.

The mean and median values of the errors based on the beginning of period forecasts and the time series model forecasts are presented in Table 4. Not surprisingly, the absolute value of the errors using these alternative forecasts are greater than the errors using the end of the period forecasts. For example, the median forecast error using the time series model is 0.214 and is more than twice as large as the mean forecast error using the end of quarter model. The median forecast

error using the beginning of period forecast is 0.119, about 50% larger than the error using the end of period forecast.

Our primary interest is the extent to which this incremental improvement in the end of the period forecast can be explained by analysts incorporating information about current and lagged IR, FX, and COM shocks. Assuming analysts accurately map at least some of the impact of these shocks into their estimates, we expect to find a positive association between this incremental improvement in end of the quarter forecast error and the shocks.

We estimate regressions similar to Equation 1, except that the dependent variable is the incremental improvement in the analyst estimates rather than the earnings announcement return. The results for these regressions are presented in Table 7.

[Insert Table 7]

The dependent variable in Column (1) of Table 7 is the difference between the absolute median beginning of period forecast error and the absolute median end of period analyst forecast error. The significantly positive coefficients on lagged IR, FX, and COM shocks show that a portion of the improvement in analysts' end of period forecasts compared to beginning of period forecasts is due to the ability to incorporate current period earnings information that is related to lagged price shocks. There is also some evidence that for firms with large COM exposures, there is significant incremental uncertainty resolution due to the incorporation of information about lagged COM shocks.

Column (2) of Table 7 examines the improvement of the analysts' end of period forecast over forecasts based on the seasonal random walk time-series model. These results indicate that a portion of the improvement in analysts' end of quarter forecasts compared to time-series model forecasts is from analysts correctly incorporating the effects of lagged IR and COM shocks on earnings. For firms with large exposures to FX and COM, the improvement in the end of period

forecast is incrementally associated with both current quarter and lagged FX and COM price shocks.

Finally, Column (3) of Table 7 examines the improvement of the analysts' beginning of period forecast over forecasts based on the seasonal random walk time-series model. Because analysts' beginning of quarter forecast can only incorporate information about lagged price shocks (i.e., the current quarter shocks have not yet occurred at the time the beginning of quarter forecasts are made), we only include the lagged shock variables in the specification. The results provide at least weak evidence that for firms with large exposures, a portion of the improvement in analysts' beginning of period forecasts over the time-series model forecasts is due to the incorporation of current period earnings information that is related to lagged FX shocks and lagged COM shocks.

The results in Table 7 indicate that analysts correctly incorporate some of the earnings effects of changes in FX, IR, and COM into their forecasts. Therefore, analysts appear to have at least a noisy understanding of corporations' exposures to price and rate shocks and they update their forecasts accordingly. However, as shown in Table 5, even after analysts observe changes in these rates and prices, and revise their earnings' forecasts, a significant portion of their forecast errors is explained by IR, FX and COM shocks.

In light of the above discussion, a question of interest is what *proportion* of the total uncertainty caused by IR, FX and COM shocks is resolved by analysts. In Tables 8 and 9, we provide evidence to address this question. In Table 8, we estimate two regressions identical to that in Column (3) of Table 5 except that instead of using analysts end of period forecasts as the dependent variable, we use analysts beginning of period forecasts and the time-series model forecasts. We then use the coefficients from Column (3) of Table 5 and Columns (1) and (2) of Table 8 to estimate the expected incremental forecast error that would occur if an IR, FX or COM shock equal to the sample mean occurred. The incremental errors are calculated by multiplying the

IR, FX and COM coefficients by their sample mean respective shocks. For example, the coefficients related to current quarter IR shocks are multiplied by a sample mean shock equal to 0.322 (see Table 1). We then sum the expected incremental forecast errors for each coefficient to obtain an aggregate expected incremental forecast error.

[Insert Table 8]

The results are reported in Table 9. In Column (1), we use all twelve coefficients related to IR, FX and COM (i.e., the current and lagged coefficients and the top decile exposure coefficients for all three risk types) in estimating the incremental forecast error. In Columns (2), (3) and (4), only the six full-sample coefficients and the two top decile coefficient related to the respective shock are used in estimating the incremental forecast error (e.g., for Column (2), we use the six full-sample coefficients and the two IR top decile exposure coefficients).

The results indicate that the expected incremental absolute forecast error due to IR, FX and COM shocks is generally smallest for the analysts end of period forecasts and largest for the time-series model forecasts. For example, for a firm with top decile IR, FX and COM exposures, the expected incremental absolute time-series model forecast error given simultaneous shocks to IR, FX and COM equal to the sample mean is 49.8% of actual reported earnings per share. Using the end of period analyst forecast errors, these shocks are expected to result in an incremental error of 20.3%, or an improvement of about 60% compared to the time-series model. This compares to an observed sample mean end of period analyst forecast error of 47% (untabulated) for firms with all top decile IR, FX and COM exposures. However, given that few sample firms have top decile exposures of more than one type of risk, these figures overstate the expected incremental errors for the vast majority of the sample firms. To provide more representational evidence, in Columns (2), (3) and (4) of Table 9, we provide expected incremental errors for firms with only one top decile exposure. These results indicate that the analysts' end of period forecasts resolve between 25%-60%

of the risk-related uncertainty that exists in the time-series model forecasts, with the greater improvements coming from the resolution of uncertainty due to COM shocks.

[Insert Table 9]

Table 9 also provides evidence on the uncertainty resolved by analysts between their beginning of period forecasts and their end of period forecasts. The results suggest that the majority (roughly two-thirds) of the uncertainty resolution occurs by the beginning of the quarter, with only modest additional improvements occurring during the quarter. This suggests that much of the uncertainty resolution in our results is due to the current period earnings effects of lagged IR, FX and COM shocks.

Overall, the results in Table 7, 8, and 9 indicate that analysts do successfully resolve a significant proportion of the total uncertainty caused by IR, FX and COM current and lagged shocks and that much of this uncertainty resolution takes place well after the shock occurs, presumably because IR, FX and COM shocks continue to affect earnings for several quarters.

4. Conclusion

We find that investors and analysts have difficulty accurately incorporating the impact of observable price changes into their earnings estimates. In particular, our results show that the abnormal returns around earnings announcements and the errors in analysts' quarterly earnings forecasts are associated with both contemporaneous and lagged changes in interest rates, exchange rates, and commodity prices. The power of these correlations is the greatest for companies that face stronger ex ante exposures. We find that analysts recognize these exposures and revise their earnings forecasts in response to intra-quarter and lagged changes in IR, FX and COM shocks. Further, analysts' forecasts do appear to resolve a significant portion of the total uncertainty created by IR, FX and COM shocks.

Because analysts and investors encounter difficulty incorporating the effect of IR, FX and COM shocks into their estimates, the results suggest that companies may be motivated to reduce forecast errors and make core operations more transparent to investors by hedging these exposures. As such, the results are consistent with Demarzo and Duffie's (1995) prediction that firms hedge to reduce noise surrounding earnings thereby reducing the level of informational asymmetries between managers and outside investors. Moreover, these results provide a potential motivation for why many large well-funded companies with little debt, in other words companies that are very unlikely to face the market imperfections that much of the risk management literature focuses on, manage their financial risk exposures nonetheless.[8]

The results also suggest that corporate risk disclosures provide analysts and investors with some but not all information necessary to understand corporations financial risk exposures. Thus, our findings indicate that recent efforts by regulators and accounting standard setters to improve firm disclosures about risk exposures are indeed focused on an existing area of information uncertainty. Of course, the issue of whether additional disclosure could or should be required depends on whether managers are currently fully disclosing all the information that they have about firms' risk exposures and whether the potential incremental benefits from regulated disclosure outweigh competitive and computational costs of this disclosure.[9]

[8] There is rich theoretical literature showing how corporate risk management can increase shareholder value by reducing costs associated with market imperfections (such as bankruptcy costs, taxes, informational asymmetries, and managerial risk aversion). For a formal discussion of these arguments see Stulz (1984), Smith and Stulz (1985), Campbell and Kracaw (1990), Bessembinder (1991), Froot, Scharfstein and Stein (1993) and Mello and Parsons (2000), among others.

[9] Anecdotal evidence indicates that at least some firms are not fully disclosing information about their risk exposures. For example, on January 11, 2002 Ford Motor Corp reported that it was taking roughly a $1 billion charge to write down the value of its palladium holdings. Although Ford's management argued that it had disclosed the fact that it faced commodity exposures in its regulatory filings, Ford had not mentioned palladium in any of its financial statements within the past five years. For a discussion of this episode see "A Mismanaged Palladium Stockpile was Catalyst for Ford's Write-Off," Wall Street Journal, February 6, 2002.

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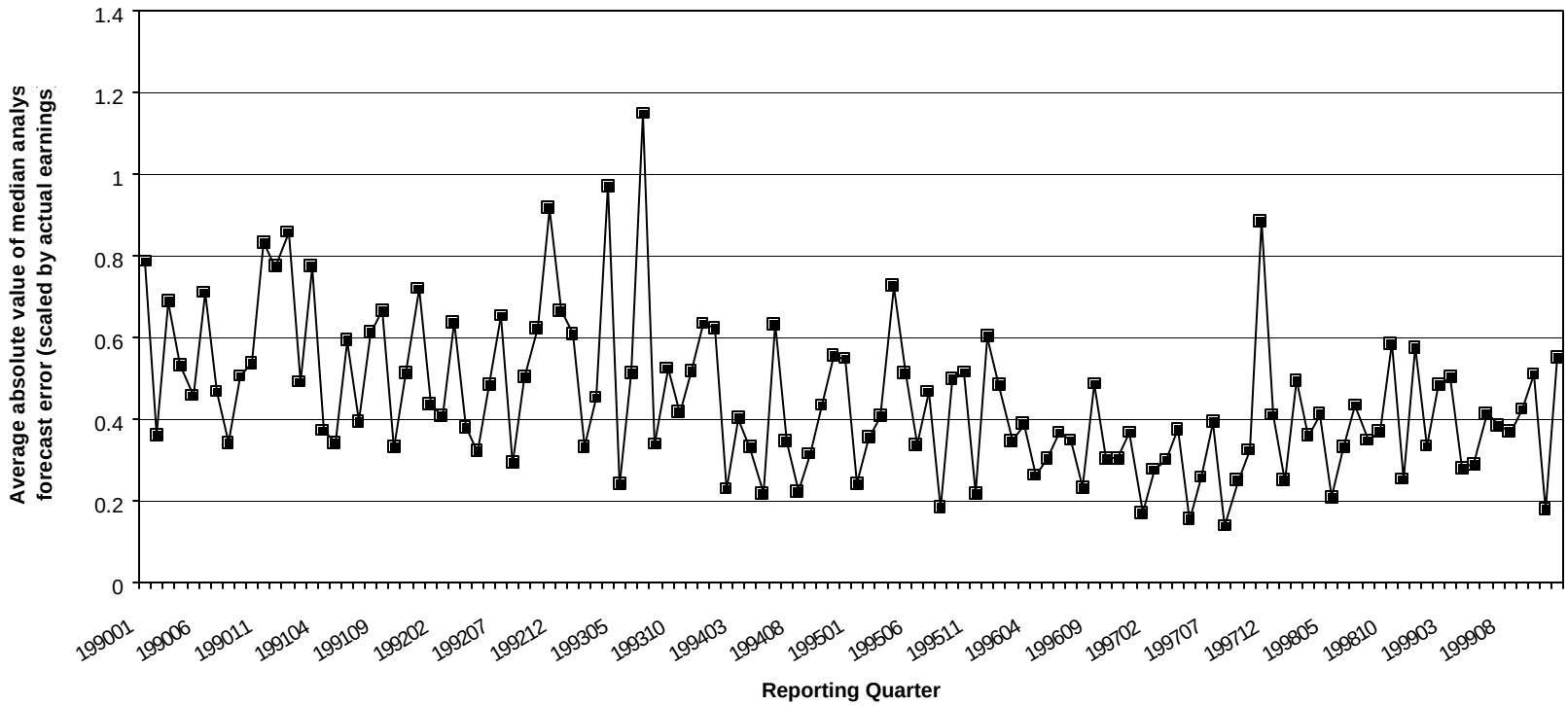
Figure 1
Summary of Analysts Forecast Errors
(Monthly Data, Jan. 1990 - Dec. 1999)



The sample consists of 24,796 firm-quarter observations from 1990-1999. The sample changes composition each year and consists of observations for 1000 largest non-financial, non-utility firms based on Compustat sales. The graph shows the ratio of the average absolute value of the median forecast error to the absolute value of the actual earnings for the median firm for each quarter. Analyst forecast error is the difference between the actual quarterly earnings and the median of analysts' forecasted quarterly earnings.

Table 1
Summary Statistics Macro Risk Exposures.

Summary statistics are based on the period from January 1990 to December 1999. The sample changes composition each year and consists of observations for 1000 largest non-financial, non-utility firms based on Compustat sales. The current quarter **Abs. change in interest rates** is the absolute percentage point change in the three-month yield during the quarter for which earnings are reported. The current quarter **Abs. change in currency rate** is the percentage change in the Federal Reserve's Major Currency Index for the quarter. The current quarter **Abs. change in commodity prices** is the absolute percentage change in the Goldman Sachs Commodity Excess Return Index for the quarter. The **three quarter lag change in interest rates, currency rates and commodity prices** is equal to the absolute cumulative change during the three quarters prior to the quarter for which earnings are reported.

	Mean	Median	Std. Dev.	Maximum
Macroeconomic risks				
Abs. change in interest rate				
Current quarter	0.322	0.260	0.277	1.430
Three quarter lag	0.791	0.470	0.788	3.590
Abs. change in currency rate				
Current quarter	0.028	0.024	0.020	0.103
Three quarter lag	0.072	0.059	0.049	0.246
Abs. change in commodity prices				
Current quarter	0.077	0.055	0.081	0.522
Three quarter lag	0.190	0.125	0.198	1.387

Table 2
Summary Statistics Announcement Returns and Control Variables used in the Regression Analysis.

The sample consists of 22,024 firm-quarter observations from 1990-1999. **Three day earnings announcement returns** is the absolute value of abnormal return for the three day window around the earnings announcement using a market model. The market model beta is estimated from day –250 through –50 relative to the earnings announcement date. The **three quarter lag change in interest rates, currency rates and commodity prices** is equal to the absolute cumulative change during the three quarters prior to the quarter for which earnings are reported. The **Absolute deviation in GNP** is the absolute value of the difference between the change in GNP in the quarter for which earnings are reported and the mean absolute quarterly change in GNP over the sample period from 1990-1999. **Stock Market volatility** is the standard deviation of daily returns for CRSP's Value Weighted Index during the quarter.

	Mean	Median	Std. Dev.	Maximum
Announcement Returns				
Absolute three day earnings announcement returns	3.47%	2.33%	3.61%	19.30%
Macroeconomic risks				
Absolute deviation in GNP	0.40%	0.30%	0.27%	1.18%
Stock market volatility	0.74%	0.70%	0.28%	1.82%

Table 3
Regressions of three-day earnings announcement returns on IR, FX and Commodity price changes

The sample consists of 22,024 firm-quarter observations from 1990-1999. The dependent variable is the absolute value of the abnormal three-day announcement return measured one day before the earnings announcement date through one day after the earnings announcement date. Each three-day return is an abnormal return adjusted for the market return using a market model beta estimated from day -250 through day -50 relative to the earnings announcement date. See Tables 1 and 3 for descriptions of the other independent variables. We calculate t-statistics based on Huber-White robust standard errors, which are a generalization of the White (1980) standard errors that are robust to both serial correlation and heteroskedasticity (Rogers, 1993). t-statistics are reported in the parentheses.

	Dependent variable: Absolute value of 3-day earnings announcement return		
Variables	(1)	(2)	(3)
Constant	0.026	0.025	0.025
	(11.79)***	(11.38)***	(11.08)***
Absolute value(change in interest rate)			
Current quarter	-0.001		-0.002
	(-0.618)		(-0.734)
Three quarter lag (3Q lag)		-0.000	-0.000
		(-0.75)	(-0.11)
Current*(Top *Decile* of interest rate exposure)	0.010		0.003
	(3.24)***		(0.51)
3Q lag*(Top *Decile* of interest rate exposure)		0.004	0.003
		(3.06)***	(1.44)*
Absolute value(change in currency rate)			
Current quarter	-0.025		-0.014
	(-1.26)		(-0.62)
Three quarter lag (3Q lag)		0.009	0.013
		(0.79)	(1.11)
Current*(Top *Decile* of currency exposure)	0.203		0.151
	(5.68)***		(3.62)***
3Q lag*(Top *Decile* of currency exposure)		0.066	0.028
		(5.37)***	(2.00)***
Absolute value(change in commodity prices)			
Current quarter	-0.000		-0.000
	(-0.05)		(-0.07)
Three quarter lag (3Q lag)		0.000	0.001
		(0.03)	(0.45)
Current*(Top *Decile* of commodity exposure)	0.088		0.063
	(3.02)***		(2.40)***
3Q lag*(Top *Decile* of commodity exposure)		0.034	0.019
		(3.62)***	(2.00)***
Absolute deviation in GNP	-0.092	-0.229	-0.218
	(-0.29)	(-0.67)	(-0.636)
Stock market volatility	1.259	1.260	1.245
	(3.40)***	(3.98)***	(3.46)***
No. of observations	22,024	22,024	22,024
Adjusted R^2	2.02%	1.92%	2.22%

*** (**) {*}denoted significance at the 1 (5) {10} percent significance level.

Table 4
Summary Statistics for Analyst Forecast Errors.

The sample consists of 24,796 firm-quarter observations from 1990-1999. **End of quarter median analyst forecast error** is the absolute value of difference between the actual reported earnings per share and the median analyst forecast in the last month prior to the end of the quarter for which earnings are reported, scaled by the absolute value of actual reported earnings per share. **Beginning of quarter median analyst forecast error** is the absolute value of the difference between actual reported earnings per share and the median analyst forecast in the first month of the quarter for which earnings are reported, scaled by the absolute value of actual reported earnings per share. The **seasonal random walk times-series model forecast error** is equal to the difference between absolute value of actual reported earnings per share and the actual reported earnings per share for the same quarter of the previous fiscal year, scaled by actual reported earnings per share. The **Number of Analysts** is the number of analysts making forecasts in the last month prior to the end of the quarter for which earnings are reported. The **Average analyst forecast error over prior four quarters** is the average absolute end of quarter analyst forecast over the four quarters prior to the quarter for which earnings are announced. In the regressions in Tables 2 and 3, this variable is orthogonalized with respect to current quarter and three quarter lag changes in interest rates, exchange rates and commodity prices. The absolute forecast error variables are winsorized at the 99% level.

	Mean	Median	Std. Dev.	Maximum
Measures of absolute forecasts errors				
End of quarter median analyst forecast error	0.308	0.082	0.727	5.170
Beginning of quarter median analyst forecast error	0.472	0.119	1.128	8.000
Seasonal random walk time-series model forecast error	0.703	0.214	1.626	11.700
Information variables				
Number of analysts	8.332	7.000	5.594	43.000
Average analyst forecast error over prior four quarters	0.343	0.119	0.645	3.961

Table 5
Regressions of absolute analyst forecast errors on IR, FX and Commodity price changes

The absolute value of analyst forecast error is the absolute value of the difference between actual reported earnings per share and the median analyst forecast in the last month prior to the end of the quarter for which earnings are reported, scaled by the absolute value of actual reported earnings per share. See Table 1 for definitions of the other independent variables. Firm-specific exposures to interest rates, currency rates, and commodity prices are estimated each year as the firm-specific estimated beta from regressions of monthly stock returns on the market return (value-weighted CRSP return) and monthly changes in interest rates, exchange rates, and commodity prices over a thirty-six month rolling window ending in the last month of the prior fiscal year. Top deciles of each type of exposure are based on the pooled sample of firm-specific exposures. We calculate t-statistics based on Huber-White robust standard errors, which are a generalization of the White (1980) standard errors that are robust to both serial correlation and heteroskedasticity (Rogers, 1993). t-statistics are reported in the parentheses.

	Dependent variable: Abs. analyst forecast error		
Variables	(1)	(2)	(3)
Constant	0.359	0.370	0.341
	(13.607)***	(13.176)***	(12.73)***
Abs. change in interest rate			
Current quarter	0.093		0.057
	(4.259)***		(2.33)***
Three quarter lag		0.035	0.015
		(4.215)***	(1.62)*
Current * (Top *Decile* of interest rate exposure)	0.172		0.149
	(2.816)***		(1.99)***
Three quarter lag * (Top *Decile* of interest rate exposure)		0.052	0.012
		(2.598)***	(0.49)
Abs. change in currency rate			
Current quarter	1.318		1.285
	(3.471)***		(3.29)***
Three quarter lag		0.307	0.316
		(2.168)***	(2.52)***
Current * (Top *Decile* of currency exposure)	0.480		0.874
	(0.996)		(1.49)*
Three quarter lag * (Top *Decile* of currency exposure)		-0.049	-0.240
		(-0.284)	(-1.19)
Abs. change in commodity prices			
Current quarter	-0.107		-0.109
	(-1.282)		(-1.65)
Three quarter lag		0.030	0.060
		(0.594)	(1.55)*
Current * (Top *Decile* of commodity exposure)	0.364		0.036
	(1.528)*		(0.21)
Three quarter lag * (Top *Decile* of commodity exposure)		0.245	0.230
		(5.555)***	(4.36)***
Absolute deviation in GNP	5.291	2.988	2.743
	(2.101)***	(1.156)	(1.34)*
Stock market volatility	0.557	0.796	-0.487
	(0.251)	(0.336)	(-0.21)
Log (number of analysts)	-0.073	-0.073	-0.072
	(-9.247)***	(-9.399)***	(-9.32)***
Avg. quarterly analyst forecast error	0.323	0.323	0.323
over prior four quarters	(23.114)***	(22.905)***	(22.87)***
No. of observations	24,796	24,796	24,796
Adjusted R^2	9.60%	9.57%	9.71%

*** (**) {*}denoted significance at the 1 (5) {10} percent significance level.

Table 6
Regressions of intra-quarter revisions in analyst forecasts on IR, FX and Commodity price changes

The Abs. intraquarter revision in the median analysts' forecast is the absolute value of the difference between the median analyst forecast at the beginning of the quarter and the median analyst forecast in the last month of the quarter for which earnings are reported, scaled by the absolute value of actual reported earnings per share. See Table 1 for a description of the other variables included in the regression. We calculate t-statistics based on Huber-White robust standard errors, which are a generalization of the White (1980) standard errors that are robust to both serial correlation and heteroskedasticity (Rogers, 1993). t-statistics are reported in the parentheses.

	Dependent variable: Abs. intraquarter revision in median analysts' forecast		
Variables	(1)	(2)	(3)
Constant	0.211 (8.97)***	0.221 (8.68)***	0.203 (7.82)***
Abs. change in interest rate			
Current quarter	0.040 (1.58)*		0.007 (0.22)
Three quarter lag		0.025 (2.24)***	0.018 (1.35)*
Current * (Top *Decile* of interest rate exposure)	0.107 (3.66)***		0.090 (2.18)***
Three quarter lag * (Top *Decile* of interest rate exposure)		0.037 (2.75)***	0.009 (0.52)
Abs. change in currency rate			
Current quarter	0.672 (1.64)*		0.718 (1.86)**
Three quarter lag		0.081 (0.53)	0.112 (0.68)
Current * (Top *Decile* of currency exposure)	0.732 (1.53)*		0.517 (0.83)
Three quarter lag * (Top *Decile* of currency exposure)		0.240 (1.48)*	0.116 (0.54)
Abs. change in commodity prices			
Current quarter	-0.072 (-0.77)		-0.066 (-1.02)
Three quarter lag		0.075 (1.95)**	0.095 (2.47)***
Current * (Top *Decile* of commodity exposure)	0.435 (1.92)**		0.093 (0.55)
Three quarter lag * (Top *Decile* of commodity exposure)		0.252 (5.19)***	0.228 (3.89)***
Absolute deviation in GNP	4.067* (1.53)	0.991 (0.34)	1.015 (0.37)
Stock market volatility	2.716 (1.00)	1.173 (0.50)	0.630 (0.25)
Log (number of analysts)	-0.047 (-7.76)**	-0.047 (-7.85)**	-0.045 (-8.06)***
No. of observations	23,873	23,873	23,873
Adjusted R^2	0.77%	0.95%	1.01%

*** (**) {*}denoted significance at the 1 (5) {10} percent significance level.

Table 7
Incremental informativeness of analysts' end of period forecasts versus analysts' beginning of period forecasts and time-series model forecasts

The dependent variable in column (1) is the difference between the absolute forecast error using the beginning of quarter median analyst forecast and the absolute forecast error using the median analysts' forecast in the last month prior to the end of the quarter for which earnings are reported; both of these forecast errors are scaled by the absolute value of actual reported earnings per share. The dependent variable in column (2) is the difference between the absolute forecast error using a time-series model forecast and the absolute forecast error using the median analysts' forecast in the last month prior to the end of the quarter for which earnings are reported; both of these forecast errors are scaled by the absolute value of actual reported earnings per share. The dependent variable in column (3) is the difference between the absolute forecast error using a time-series model forecast and the absolute forecast error using the median analysts' forecast at the beginning of the quarter for which earnings are reported. The time-series model forecast error is based on a seasonal random walk earnings model and is equal to the absolute value of actual reported earnings per share minus the actual reported earnings per share for the same quarter of the previous fiscal year, scaled by actual reported earnings per share. See Tables 1 and 3 for descriptions of the other variables included in the regression. We calculate t-statistics based on Huber-White robust standard errors, which are a generalization of the White (1980) standard errors that are robust to both serial correlation and heteroskedasticity (Rogers, 1993). t-statistics are reported in the parentheses.

	Dependent Variable:		
	Abs. error beg. period forecast minus Abs. error end of period forecast.	Abs. error Time-series minus Abs. error end of period forecast.	Abs. error time-series minus Abs. error beg. of period forecast.
Variables	(1)	(2)	(3)
Constant	0.078 (4.33)***	0.241 (5.06)***	0.108 (2.77)***
Absolute value(change in interest rate)			
Current quarter	-0.017 (-0.75)	-0.063 (-0.82)	
Three quarter lag (3Q lag)	0.021 (2.10)***	0.032 (1.52)*	-0.003 (-0.19)
Current*(Top *Decile* of interest rate exposure)	0.039 (0.56)	0.082 (0.59)	
3Q lag*(Top *Decile* of interest rate exposure)	0.011 (0.58)	0.051 (1.14)	0.016 (0.37)
Absolute value(change in currency rate)			
Current quarter	0.556 (1.68)**	-0.031 (-0.05)	
Three quarter lag (3Q lag)	0.189 (1.52)*	-0.021 (-0.08)	-0.138 (-0.63)
Current*(Top *Decile* of currency exposure)	0.324 (0.61)	1.813 (1.59)*	
3Q lag*(Top *Decile* of currency exposure)	0.087 (0.44)	0.583 (1.63)*	0.726 (2.38)***

(Table 7 continued next page.)

Table 7 (continued)

Absolute value(change in commodity prices)			
Current quarter	-0.059 (-1.43)	0.078 (0.74)	
Three quarters lag (3Q lag)	0.097 (3.63)***	0.141 (2.24)***	0.050 (1.01)
Current*(Top *Decile* of commodity exposure)	0.097 (0.53)	0.636 (1.43)*	
3Q lag*(Top *Decile* of commodity exposure	0.156 (2.55)***	0.477 (1.84)**	0.356 (1.51)*
Absolute deviation in GNP	-1.158 (-0.60)	-1.825 (-0.54)	-3.607 (-1.09)
Quarterly stock market volatility	1.158 (0.68)	5.050 (1.42)*	6.563 (2.19)***
No. of observations	22,799	22,799	22,799
Adjusted R^2	0.37%	0.34%	0.08%

*** (**) {*}denoted significance at the 1 (5) {10} percent significance level.

Table 8
Regressions of absolute analyst forecast errors on IR, FX and Commodity price changes: Using analysts' beginning of period forecasts and time-series model forecasts

The dependent variable in column (1) is the absolute forecast error using the beginning of quarter median analyst forecast scaled by the absolute value of actual reported earnings per share. The dependent variable in column (2) is the absolute forecast error using a time-series model forecast scaled by the absolute value of actual reported earnings per share. See Table 1 for definitions of the other independent variables. Firm-specific exposures to interest rates, currency rates, and commodity prices are estimated each year as the firm-specific estimated beta from regressions of monthly stock returns on the market return (value-weighted CRSP return) and monthly changes in interest rates, exchange rates, and commodity prices over a thirty-six month rolling window ending in the last month of the prior fiscal year. Top deciles of each type of exposure are based on the pooled sample of firm-specific exposures. We calculate t-statistics based on Huber-White robust standard errors, which are a generalization of the White (1980) standard errors that are robust to both serial correlation and heteroskedasticity (Rogers, 1993). t-statistics are reported in the parentheses.

	Dependent variable	
Variables	Abs. error beg. period forecast (1)	Abs. error Time-series forecast (2)
Constant	1.086	0.603
	(11.14)***	(10.51)***
Abs. change in interest rate		
Current quarter	-0.156	-0.001
	(-1.35)	(-0.01)
Three quarter lag	0.052	0.066
	(1.82)**	(3.13)***
Current * (Top *Decile* of interest rate exposure)	-0.109	0.164
	(-0.44)	(0.91)
Three quarter lag * (Top *Decile* of interest rate exposure)	0.091	0.044
	(0.98)	(0.67)
Abs. change in currency rate		
Current quarter	1.308	0.978
	(0.96)	(1.52)*
Three quarter lag	0.258	0.333
	(0.574)	(1.05)
Current * (Top *Decile* of currency exposure)	4.11	3.408
	(2.59)***	(2.29)***
Three quarter lag * (Top *Decile* of currency exposure)	-0.412	0.055
	(-0.62)	(0.13)
Abs. change in commodity prices		
Current quarter	-0.436	-0.132
	(-1.22)	(-0.65)
Three quarter lag	0.118	0.139
	(0.28)	(1.82)**
Current * (Top *Decile* of commodity exposure)	0.201	0.742
	(0.26)	(1.36)*
Three quarter lag * (Top *Decile* of commodity exposure)	0.536	0.704
	(2.47)***	(3.33)***

(Table 8 continued next page)

Table 8 (continued)

Absolute deviation in GNP	20.92 (1.10)	4.192 (0.92)
Stock market volatility	9.076 (0.86)	7.159 (1.46)*
Log (number of analysts)	-0.206 (-9.41)***	-0.071 (-4.00)***
Avg. quarterly analyst forecast error over prior four quarters	0.633 (17.46)***	0.604 (19.38)***
No. of observations	24,794	24,794
Adjusted R^2	5.11%	6.95%

*** (**) {*}denoted significance at the 1 (5) {10} percent significance level.

Table 9
Estimates of expected incremental forecast errors for IR, FX and COM shocks equal to sample means

The table provides estimates of the expected incremental forecast error that would occur if an IR, FX or COM shock equal to the sample mean occurred. The estimated incremental forecast errors are based on the regression coefficients in Column (3) of Table 5 and Columns (1) and (2) of Table 8. The incremental errors are calculated by multiplying the IR, FX and COM coefficients by their sample mean respective shocks. For example, the coefficients related to current quarter IR shocks are multiplied by a sample mean shock equal to 0.322 (see Table 1). We then sum the expected incremental forecast errors for each coefficient to obtain an aggregate expected incremental forecast error. In Columns (1), (2) and (3), the six full-sample coefficients on IR, FX and COM (i.e., the current and lagged coefficients) and the two top decile coefficients related to the respective shock are used in estimating the incremental forecast error (e.g., for Column (1), we use the six full-sample coefficients and the two IR top decile exposure coefficients). In Column (4), all twelve coefficients related to IR, FX and COM (i.e., the current and lagged coefficients and the top decile exposure coefficients for all three risk types) are used in estimating the incremental forecast error.

	Type of firm			
Type of forecast	High IR exposure only (1)	High FX exposure only (2)	High COM exposure only (3)	High IR, FX and COM exposure (4)
Time Series Model Forecast	0.207	0.219	0.310	0.498
Analyst Beg. Period Forecast	0.071	0.120	0.152	0.274
Analyst End Period Forecast	0.149	0.099	0.138	0.203