# Earnings Forecasts from Firm-Level Regressions: Implications for Research and Practice

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# Overview

Are analyst forecasts of earnings more accurate or more value-relevant than forecasts from statistical models of earnings?

- How can statistical models incorporate the same information set analysts use?
- How do we evaluate the performance of a given earnings forecast?
- When are earnings forecasts likely to perform poorly?

# Preview of Results

1. Analyst forecasts are more accurate at shorter horizons, but statistical forecasts outperform at longer horizons
2. Analyst forecasts underperform statistical forecasts in the period prior to Reg-FD, consistent with a less favorable information environment
3. No clear relation between *ex ante* uncertainty and relative forecast performance
4. Analyst forecasts perform better in high-tech, manufacturing, and healthcare
5. Statistical forecasts associated with marginally better contemporaneous returns

# Motivation: Demands for Forecasts of Earnings

- Valuation
- Implied cost of capital
- Equity risk premium estimates
- Returns-earnings relations
- Predictability studies

# Motivation: Problems with Analyst Forecasts

**Survey responses to the question:**
How important are the following to your compensation?

| Responses | Average Rating | Significantly Greater Than | % of Respondents Who Answered: Very Important (5 or 6) | % of Respondents Who Answered: Not Important (0 or 1) |
|---|---|---|---|---|
| (1) Your industry knowledge | 4.95 | 3-9 | 72.18 | 1.93 |
| (2) Your standing in analyst rankings or broker votes | 4.73 | 5-9 | 66.85 | 4.97 |
| (3) Your accessibility and/or responsiveness | 4.73 | 5-9 | 63.54 | 2.21 |
| (4) Your professional integrity | 4.69 | 5-9 | 63.99 | 3.60 |
| (5) Your written reports | 4.17 | 7-9 | 38.95 | 2.76 |
| (6) Your relationship with management of the companies you follow | 4.14 | 8-9 | 44.63 | 7.16 |
| (7) The profitability of your stock recommendations | 3.94 | 9 | 35.08 | 5.52 |
| (8) Your success at generating underwriting business or trading commissions | 3.65 | -- | 44.20 | 20.17 |
| (9) The accuracy and timeliness of your earnings forecasts | 3.59 | -- | 24.10 | 7.76 |
| Total possible N = 363 | | | | |

*Table 8 from Brown, Call, Clement, and Sharp. JAR. (2014)*

# Motivation: Problems with Analyst Forecasts

- Misaligned incentives of analysts
- Biased in general (usually over-optimistic)
- Limited historical availability (late 1980s onward)
- Limited current availability (large, public firms)
- Poor performance at long horizons

# A Brief History of Earnings Forecasting Research

- 1960s
  - Random walk models
- 1970s
  - ARIMA time-series models
- 1980s
  - Incorporating extra information beyond past earnings (eg price)
  - Using analyst forecasts
  - Comparing analysts to time series models
- 1990s
  - Incorporating management forecasts ("guidance")
  - Assessing biases of analyst forecasts

# A Brief History of Earnings Forecasting Research

- 2000s
  - SP Kothari:

    *"...[earnings forecating] literature is fast becoming extinct. The main reason is the easy availability of a better substitute: analysts' forecasts are available at a low cost in machine-readable form for a large fraction of publicly traded firms"*
- 2010s (Today)
  - We can do better.

# Contribution

1. Most closely related to Bradshaw et al (2012); Hou, van Dijk, and Zhang (2012); Ball, Ghysels, and Zhou (2014).
2. Methodological innovations in data treatment, model building, and forecast evaluation
   - Appropriately map the forecasts to the earnings figures forecast by analysts
   - Build forecasts at a firm-level rather than from cross-sectional averages
   - Use a market-based evaluation of forecast performance
3. Demonstrates potential gains to market participants from using statistical forecasts over analyst forecasts

# Methodology: Earnings Forecasts

Which "earnings" figure to use?

- Annual "pro-forma" EPS forecasts from IBES
- Forecasts of one-, two-, and three-year ahead earnings (FY1, FY2, FY3, resp.)
- Forecasts are made on the base-year announcement date

# Methodology: Forecasting Framework

- Begin with firm-level, first-order autoregressive model and build out:

$$E_{i,t+\tau} = \alpha_{i,0} + \alpha_{i,1} E_{i,t} + \eta_{i,t+\tau}, \tag{1}$$

  where $\tau = 1, 2, 3$.

- Add predictor variables to capture firm, market, and economy-wide information

$$E_{i,t+\tau} = \beta_{i,0} + \beta_{i,1} E_{i,t} + \sum_{k=2}^{\kappa} \beta_i^{(k)} X_{i,t}^{(k)} + \varepsilon_{i,t+\tau} \tag{2}$$

# Methodology: Performance Evaluation

- Prior studies use bias, absolute error, or mean-square prediction error
- I use MSPE and buy-and-hold returns
- Buy-and-hold returns calculated on portfolios ranked by divergence between model and analyst forecasts

# Methodology: Choosing Predictors

- Short earnings histories necessitate parsimony
- Use prior literature and in-sample correlation to motivate variable selection
- Be willing to sacrifice in-sample performance for potential out-of-sample performance

# Methodology: Choosing Predictors

- Firm-level data:
  - Earnings, indicator for negative earnings, assets, sales, ROE, dividends, changes in accruals
  - Macroeconomic variables: unemployment, gdp, inflation (ppi)
  - Market-based data: price-earnings ratio, year-over-year change in stock price, one year stock price return

# Methodology: Choosing Predictors

| | mean | med |
|---|---|---|
| $EPS_{t-1}$ | 0.6694 | 0.7516 |
| $\Delta Sales$ | 0.7678 | 0.8687 |
| ROE | 0.7535 | 0.8151 |
| sales | 0.7444 | 0.8100 |
| return | 0.7418 | 0.7834 |
| $\Delta Price$ | 0.7313 | 0.7866 |
| $\Delta AR$ | 0.7195 | 0.7980 |
| $\Delta AP$ | 0.7190 | 0.7868 |
| Inflation (PPI) | 0.7032 | 0.7696 |
| GDP | 0.7046 | 0.7792 |
| Unemployment | 0.7065 | 0.7794 |
| AP | 0.6963 | 0.7648 |
| AR | 0.6925 | 0.7646 |
| Accruals | 0.6923 | 0.7505 |
| Dividends | 0.6953 | 0.7653 |
| assets | 0.6877 | 0.7636 |
| PE Ratio | 0.6843 | 0.7462 |
| Negative Earnings | 0.6797 | 0.7575 |

Table: Estimated $R^2$ values from regressions of the form $EPS_t = \alpha_0 + \alpha_1 EPS_{t-1} + \alpha_2 X_{t-1} + \varepsilon$.

# Methodology: Forecast Estimation

- Regression necessitates relatively long estimation windows.
- For firms with at least 15 years of earnings history, use the full feature set:

$$\begin{aligned} E_{t+\tau} = \beta_0 + \beta_1 E_t + \beta_2 assets_t + \beta_3 return_t \\ + \beta_4 NegativeEarnings_t + \beta_5 PE_t \\ + \beta_6 \Delta Sales_t + \beta_7 PE_t + \beta_8 \Delta AP_t + \\ \beta_9 \Delta AR_t + \beta_{10} U_t \\ + \beta_{11} GDP_t + \beta_{12} INFLATION_t + \varepsilon \end{aligned} \tag{3}$$

- For short-history firms, fall-back on the AR(1) model.
- Do not require firms to have positive base-year earnings

# Forecast Evaluation

Relative MSPE by forecast target year

| Year | 1-Year Ahead | 2-Years Ahead | 3-Years Ahead |
|---|---|---|---|
| 1993 | 0.76 | 0.08 | - |
| 1994 | 0.9 | 0.11 | - |
| 1995 | 3.81 | 1.04 | - |
| 1996 | 24.83 | 0.17 | 0.00 |
| 1997 | 15.33 | 0.00 | 0.49 |
| 1998 | 1.17 | 1.23 | 1.81 |
| 1999 | 8.71 | 0.93 | 1.83 |
| 2000 | 2.45 | 1.66 | 0.38 |
| 2001 | 2.01 | 1.25 | 0.09 |
| 2002 | 0.27 | 0.16 | 0.11 |
| 2003 | 3.8 | 0.7 | 0.59 |
| 2004 | 0.83 | 0.46 | 0.64 |
| 2005 | 0.27 | 0.69 | 0.02 |
| 2006 | 1.84 | 0.84 | 0.55 |
| 2007 | 2.37 | 0.97 | 0.77 |
| 2008 | 1.67 | 1.2 | 0.21 |
| 2009 | 0.69 | 0.55 | 0.63 |
| 2010 | 1.29 | 0.57 | 0.45 |
| 2011 | 1.6 | 0.79 | - |
| 2012 | 3.13 | 1.12 | - |
| 2013 | 2.01 | | - |
| Average | 3.80 | 0.76 | 0.61 |

Table: Mean squared prediction error of model forecast, mean analyst (MEANEST) forecast. Forecasts are of FY1, FY2, and FY3 earnings.

# Forecast Evaluation

Two Questions commonly posed of analyst forecasts

1. Does private information give analysts an advantage? (Gintschel and Markov [2004])
2. Does the amount of *ex ante* uncertainty decrease forecast performance?
3. Does industry affect forecast performance?

# Results

**Relative forecast accuracy after Regulation Fair Disclosure: the effect of private information on forecast performance.**

| Forecast horizon | Pre-Reg FD | Post-Reg FD |
|---|---|---|
| 1-Year Ahead | 3.21 | 1.57 |
| 2-Year Ahead | 0.67 | 1.00 |
| 3-Year Ahead | 0.43 | 0.46 |

Table: Relative mean squared prediction error comparison of "model" and "consensus" earnings forecasts.

# Results

**Relative forecast accuracy between high and low analyst forecast dispersion: the effect of ex ante uncertainty on forecast performance.**

| Forecast horizon | Low Dispersion | High Dispersion |
|---|---|---|
| 1-Year Ahead | 1.92 | 1.84 |
| 2-Year Ahead | 1.03 | 0.97 |
| 3-Year Ahead | 0.42 | 0.54 |

Table: Relative mean squared prediction error comparison of "model" and "consensus" earnings forecasts.

# Results

## Industries

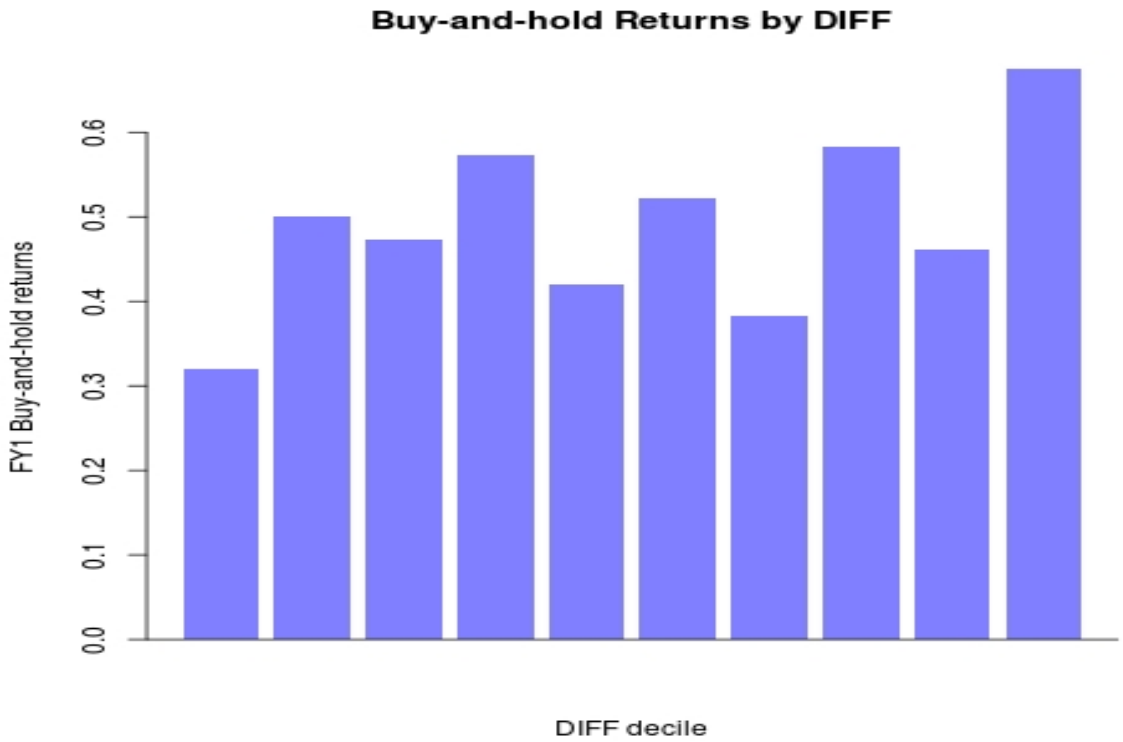
| | 1-Year Ahead | 2-Years Ahead | 3-Years Ahead |
|---|---|---|---|
| High-tech | 1.2 | 1 | 0.9 |
| Manufacturing | 2.2 | 1.1 | 0.4 |
| Wholesal/Retail | 0.9 | 0.9 | 0.4 |
| Healthcare | 1.4 | 1.1 | 0.8 |
| Enrgy/Oil/Gas | 0.9 | 0.7 | 0.2 |
| Con Durables | 4.5 | 1.7 | 0.4 |
| Cons Non-Durables | 0.4 | 1.2 | 0.6 |
| other | 2 | 0.9 | 0.3 |

Table: Relative mean squared prediction error comparison of "model" and "consensus" earnings forecasts by Fama-French Industries.

# Results

**Buy and hold returns based on divergence between model and analyst forecasts**

$$BAHR_{t+\tau} = \alpha_0 + \alpha_1 DIFF_i + \varepsilon. \tag{4}$$



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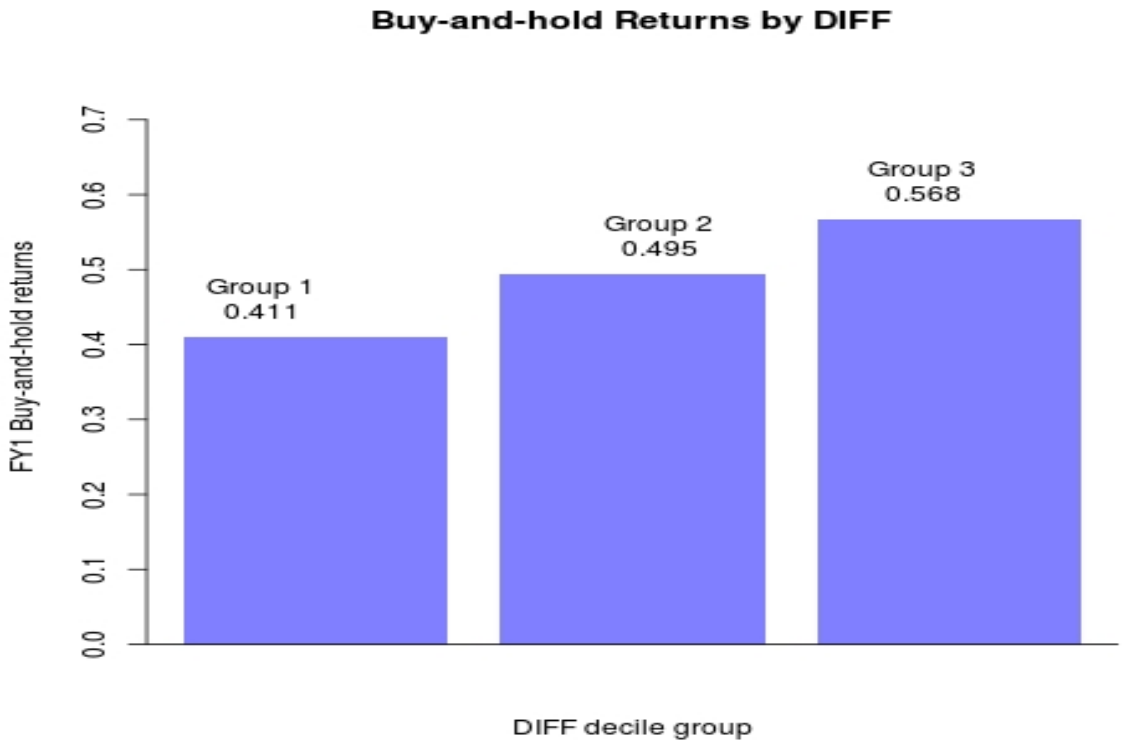

# Summary of Results

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# Conclusions and Extensions

Analyst forecasts of earnings suffers from three flaws:

1. Relatively simple to implement statistical models can beat analyst forecasts in terms of accuracy
2. It is possible and useful to incorporate a wider information set than previous earnings into such models
3. Statistical models may give market participants who use them an advantage over those who rely on analyst forecasts

Further Questions

- Unanswered: what do investors actually use to form expectations of firms' earnings?
- Unanswered: do more accurate earnings forecasts from statistical models lead to better estimates of implied cost of capital or equity risk premia?

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Thank you!

# Summary Statistics

| | mean | med | min | max | stdev |
|---|---|---|---|---|---|
| EPS | 1.671 | 1.270 | -13.940 | 89.610 | 2.429 |
| EPS Growth | 0.148 | 0.131 | -246.500 | 549 | 6.659 |
| Total Assets | 11189.937 | 2859.255 | 0.808 | 797769 | 36046.376 |
| Accruals | -0.034 | -0.037 | -5.224 | 1.864 | 0.115 |
| Dividends | 4.294 | 0.333 | 0 | 18000 | 257.570 |
| Dividend Payer | 0.241 | 0 | 0 | 1 | 0.428 |
| Negative Earnings | 0.042 | 0 | 0 | 1 | 0.201 |
| Delta Price | 0.095 | 0.050 | -2.033 | 9.529 | 0.510 |
| return | 0.004 | 0.049 | -3.501 | 2.354 | 0.428 |
| PE Ratio | 75.219 | 25 | -57200 | 151250 | 1896.962 |
| GDP | 0.047 | 0.048 | -0.032 | 0.124 | 0.024 |
| ROE | 0.739 | 0.159 | -312.626 | 5822.013 | 58.999 |
| Unemployment | 0.062 | 0.056 | 0.038 | 0.108 | 0.018 |
| Inflation (PPI) | 0.003 | 0.003 | -0.053 | 0.030 | 0.011 |
| ales | 9900.868 | 2735.200 | -7.237 | 470171 | 27674.290 |
| AR | 1900.042 | 363.594 | 0 | 418777 | 12828.263 |
| AP | 980.353 | 182.422 | 0 | 149813 | 4173.909 |
| Age | 18.231 | 17 | 5 | 32 | 8.479 |
| $\Delta Sales$ | 1023.698 | 203 | -172892 | 278188 | 7136.501 |
| $\Delta AR$ | 169.321 | 24.626 | -40708 | 60942 | 1778.590 |
| $\Delta AP$ | 98.385 | 12.103 | -83588 | 71555 | 1376.945 |

Table: Summary statistics of EPS and independent variables. $Age$ is number of years company is in the sample.

# Methodology: Choosing Predictors

| | mean | med | min | max | stdev |
|---|---|---|---|---|---|
| $EPS_{t-1}$ | 0.8365 | 0.8903 | -0.1384 | 1.2728 | 0.2621 |
| assets | 0.0316 | 0.0225 | -0.8275 | 0.3838 | 0.0877 |
| Accruals | 1.0163 | 0.1647 | -27.7192 | 50.3953 | 5.7010 |
| Dividends | -3.3222 | 0.0219 | -868.1679 | 21.1498 | 56.1218 |
| Negative Earnings | 0.5258 | 0.2546 | -4.6542 | 7.1198 | 1.4530 |
| $\Delta Price$ | 0.4812 | 0.2580 | -1.1649 | 5.5304 | 0.7044 |
| return | 0.5376 | 0.2766 | -1.1905 | 9.9263 | 0.8845 |
| PE Ratio | -0.0044 | -06 | -0.2647 | 0.0760 | 0.0213 |
| GDP | 3.9724 | 1.8984 | -37.5517 | 144.6891 | 13.6927 |
| ROE | 1.9134 | 0.8492 | -7.8009 | 18.1838 | 3.3770 |
| Unemployment | -1.0157 | 0.1596 | -192.9481 | 678 | 21.0969 |
| Inflation (PPI) | 10.4296 | 4.8584 | -108.8861 | 157.9932 | 22.9823 |
| sales | 0.6885 | 0.4160 | -2.7407 | 7.1705 | 1.0305 |
| AR | 0.0598 | 0.0324 | -0.7462 | 0.6187 | 0.1225 |
| AP | 0.0656 | 0.0444 | -0.9054 | 0.6850 | 0.1384 |
| $\Delta Sales$ | 04 | 01 | -0.0018 | 0.0066 | 08 |
| $\Delta AR$ | 0.0014 | 04 | -0.0107 | 0.0359 | 0.0041 |
| $\Delta AP$ | 0.0020 | 06 | -0.0202 | 0.0523 | 0.0069 |

Table: Estimated coefficients from regressions of the form $EPS_t = \alpha_0 + \alpha_1 EPS_{t-1} + \alpha_2 X_{t-1} + \varepsilon$.