How Do Fundamental Matters?
Stock Market Responses to Earning Announcements

Malick Sy, Yi Tang, Liuren Wu

RMIT, Fordham University, and Baruch College

11/24/2015
Overview: How do fundamentals matter?

- Fundamental question: Do fundamentals matter in security pricing?
  - Such as earning announcements and accounting reports

- Weak evidence (Literature is long...)
  - R-squares from regressing price changes against earning surprises, and earnings response coefficients (ERC) estimates are low

- Positive (anecdotal) evidence:
  - Commentators talk a lot about earnings.
  - Investors pay a lot attention to earning announcements/calls

- Explanations:
  - Missing variables: Different components of income, balance sheet, and cash flow... all matter for valuation, but to different degrees for different types of firms.
  - Noisy measurements, disagreements on consensus/surprises
  - Nonlinearities: The relation is not linear

- Always a joint test of the particular specification...
Overview: \textit{How do fundamentals matter?}

- One can always add the missing variables and specify a nonlinear relation.
- Many studies do these...
- but practical difficulties abound in estimating such a relation
  - Regressors are measured with error — which lowers the slope estimates
    - People don’t agree on “consensus,” nor on “surprise.”
    - People don’t even agree on what measures/specifications are the relevant ones: earnings or free cashflow? EBIT or EBITDA? DCF or AEM or RIM?
  - For one individual company, there are simply not enough quarterly observations to estimate an accurate relation.
    - Ten years of history only generate 40 observations, a small sample even for a univariate regression ...
  - Most regressions are done via cross-sectional pooling, assuming that the same response function applies to different types of firms,
    - but we know/see that responses are stronger for certain firms than others.
- We know fundamentals do matter. The question is how to capture/estimate the fundamental contribution accurately.
Overview: *How do fundamentals matter?*

- Investors agree on the overall importance of the earning announcements.
- They may disagree on the meaning of the announced numbers:
  - How to define the surprise – over previous quarter earning or analysts prediction of this quarter’s earning?
  - When analysts disagree (they do), how to compute the consensus (mean/median/weighted? IBES/CIQ/Bloomberg(I or II)?)
  - How (easy it is) to adjust reported number to make it compatible?
  - How do the earnings surprise compare with the sales, EBIT/EBITDA, balance sheet (such as leverage) adjustments, liquidity situation, and future guidelines?

**Implications:**

- It is difficult to specify the right regression that accounts for both theoretical and data issues
- It is difficult to identify the specification with limited information
We measure the contribution of fundamentals not by the R-squares or slopes of any particular regression specification, but by its variance contribution to the stock return.

- How much more does the stock price move, regardless of direction or reason, during earning days than during non-earning days?

- It captures the significance of the fundamental surprise, without defining the exact meaning and direction of the surprise(s), or how the surprises enter the pricing relation.

On average, stock price movements during earning days generate about 8 business days worth of non-earning day return variance.

We use the *Earnings day Variance Ratio* (EDR), the ratio of earnings day stock return squared to the return variance of the previous month, to capture the time-series and cross-sectional variation of fundamentals contribution.
EDR as a measure of fundamentals contribution

with more accuracy, and much higher time-series and cross-sectional resolution that ERC regressions

- EDR captures the magnitude variation of fundamentals contribution
  - EDR is high when various surprises measures are large in magnitude.
  - EDR is persistent: Predict future EDR with past EDRs.
  - Option-implied forward-looking EDR predicts future EDR.

- EDR varies systematically with firm characteristics
  - EDR is larger for companies with higher future growth, lower book to market ratio, but lower leverage...

- Applications: An accurate and timely way of capturing cross-sectional variation in earnings responses
  - Predicting EDR is important for option pricing: Volatility forecasts need to adjust for earnings day and its impacts
  - Post earning drift effect is stronger for firms with higher EDRs.
  - Momentum is stronger for companies with lower predicted EDR...
Data and empirical design

- Focus on the universe included in the S&P 1500 index, firms with extremely small market caps are excluded.
  - Further filtered for data matching, liquidity (trading volume), stock price level

- Data sources:
  - Bloomberg: Stock price, earning dates/times, comparable EPS, consensus estimates
  - OptionMetrics: Stock price, stock returns, option implied volatilities
  - Capital IQ: Stock price, fundamentals,

- Sample period: January 2003- December 2013, 2769 business days, 2,824,553 day-company observations

- Adjustments: Announcements that happen after market are attributed to the next business day.
Earnings response is weak in an ERC regression

- Earning response regression: \( R_{t,i} = \alpha + \beta \ln \left( \frac{CEPS_{t,i}}{EEPS_{t,i}} \right) + e_{t,i} \)

- \( R, CEPS, EEPS \) denote the log daily stock return, comparable announced EPS, the consensus EPS estimate.
- 39,308 observations for the pooled regression by requiring both \( EEPS \) and \( CEPS \) being strictly positive.
- The earnings response coefficient (ERC) is estimated at \( \beta = 0.041 \).
- The R-squared for the pooled regression is 4.09%.
- Without an intercept, the slope estimate is 0.0405, and the R-squared is 4.09%.

- The sign is correct (fundamentals matter), but the estimates (both slope and \( R^2 \)) of the effects are low
- The (long) literature has been trying to increase the \( R^2 \) estimates by adding extra variables, accounting for nonlinearities, separating out loss firms and/or specific industries...
Earnings day variance contribution is huge

<table>
<thead>
<tr>
<th>Days Around</th>
<th>-5</th>
<th>-4</th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ann. Variance</td>
<td>0.15</td>
<td>0.14</td>
<td>0.13</td>
<td>0.14</td>
<td>0.16</td>
<td>1.09</td>
<td>0.24</td>
<td>0.15</td>
<td>0.14</td>
<td>0.13</td>
<td>0.13</td>
</tr>
<tr>
<td>Variance Ratio</td>
<td>1.07</td>
<td>1.01</td>
<td>0.97</td>
<td>0.99</td>
<td>1.18</td>
<td><strong>7.91</strong></td>
<td>1.77</td>
<td>1.10</td>
<td>0.99</td>
<td>0.96</td>
<td>0.93</td>
</tr>
</tbody>
</table>

- Return variance during non-earning business days averages around 0.14, corresponding to a volatility estimate of 37%.
- Return variance during earning days average at 1.09, **7.9** times the non-earning day average variance — **Fundamentals matter!**
  - The average variance is 18% higher than average one day before the announcement — timing issues?
  - The average variance is 77% higher than average one day after. It takes time to fully digest the meaning of the announcement.
Economic significance of earnings day variance contribution

One earnings day generates one and half weeks worth of volatility:

- Four days in a year (less than 2% of the time) generate $\sim 13\%$ of the annual return variation.

- Large impacts on short-term option pricing:
  - Imagine two options contracts with one week to expire, one with an upcoming earnings announcement and the other without.
  - The implied volatility from the one with an upcoming earnings announcement will be $2.4$ times larger than the one without.
Earnings day variance ratio (EDR) as a more accurate, timely measure of fundamental contribution

- Earnings day is economically/statistically significant in its stock return variance contribution,
  - even though we may not know the specification that links each element of the earnings day announcement (and earnings call), possibly also the general market conditions (e.g., what related firms have announced their earnings and how they do...), to the stock return
- We propose to use EDR to replace ERC as a more accurate and timely measure of earnings day fundamentals contribution
  - EDR is defined as the ratio of earnings day stock return squared to the return variance over the previous month.
  - EDR and ERC capture similar information on average
  - EDR can be estimated more accurately using much less data
    - It can be estimated accurately at firm level (instead of pooling) using a much shorter sample (e.g., one year)
    - One can also use stock options to infer market-expected EDR for the upcoming earnings day
The distribution of EDR is positively skewed. $\log(EDR)$ looks more normal.

There are many earnings days with little response: 31% of the time EDR is less than one.

There are also over 31% cases with EDR higher than 8, 27.5% cases with EDR higher than 10.

Average of EDR is 13.
EDR increases with magnitude of earning surprises

- Circles denote absolute earnings surprise magnitude \((AES \equiv \| \ln(CEPS/EEPS) \|)\) at 5% quantile intervals.
- EDR increases with the earnings surprise magnitude.
- The conclusion is similar to that from the ERC regression: Larger surprise leads to larger responses.
EDR increases with other surprises
Predicting next EDR with past EDRs

While it is difficult to estimate the ERC regression accurately with a few observations, we can predict future EDRs with past EDRs of each firm.

- Correlation between future EDR and averages of past realizations (in logs)

<table>
<thead>
<tr>
<th>Average over quarters</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Variance Ratio</td>
<td>0.10</td>
<td>0.14</td>
<td>0.15</td>
<td>0.17</td>
<td>0.18</td>
<td>0.18</td>
<td>0.18</td>
<td>0.18</td>
</tr>
<tr>
<td>Ratio of Average Variance</td>
<td>0.10</td>
<td>0.14</td>
<td>0.15</td>
<td>0.17</td>
<td>0.17</td>
<td>0.18</td>
<td>0.18</td>
<td>0.18</td>
</tr>
</tbody>
</table>

- The last EDR can predict the next EDR with 10% correlation.
- Average EDR over the past year can predict the EDR with 17% correlation.
- Effective prediction does not rely on overly long history (or pooling).

Implication: Investors respond more to certain firms than to others

- Either because these firms tend to surprise more.
- Or because these firms’ surprise mean more.
Predicting EDR with historical variance term structure

Before each earnings announcement, we can construct a one-year to one-month historical variance ratio (HHVR) and use this historical variance term structure to predict the next EDR realization:

- One-year historical variance includes 4 earnings announcement days. One-month historical variance includes none.
- The ratio presents an estimate of the average earnings day contribution.
- Let $n$ denote the number of normal business days worth of contribution from each earnings day, $HHVR = \frac{252+4(n-1)}{252}$.
- Predictive orrelation between future EDR and HHVR (in logs): 19%.

Average HHVR right before earnings is 2.8 $\rightarrow n = 115$. 
Before each earnings announcement, we can also construct a one-month option-implied to historical variance ratio (IHVR):

- One-month implied variance includes expectation about the magnitude of the stock market response to the upcoming earnings announcement.
- Let $n$ denote the number of normal business days worth of contribution from each earnings day, \( IHVR = \frac{21+(n-1)}{21} \), if we ignore variance risk premium.
- Predictive correlation between future EDR and IHVR (in logs): 26%.

Average HHVR right before earnings is 2.46 $\rightarrow n = 32$. 

![Graph showing the relationship between log(HHVR) and log(IHVR)]
Implications

- Investors pay close attention to earnings announcements and earnings calls and respond strongly to surprises.
  - Even though we may not know exactly how/why they respond.
- Compared to ERC regressions, EDR presents a much more accurate measure of how the response strength varies over time and across different firms.
- It allows us to study how the strength of stock market response varies across firms with different characteristics ... and possibly why.
  - We know firms with larger surprises respond more, but we also observe investors respond more to certain firms than others, regardless of size of surprise.
Loss firms tend to have the weakest response.

- Hayn (1995): Due to liquidation option, losses are not expected to perpetuate.

- Once EP is over 4%, EDR tends to decline with EP, potentially due to earnings growth differences.
The higher the expected earnings growth rate, the stronger the response.  
Firms with high earnings yield tend to have lower growth rate, correlation $-20\%$.  
Amir & Lev (96): earnings are less informative for high-growth firms...
• Residual income model: Lower book value implies higher contribution from excess earnings and hence higher response to earnings.
• High growth firms tend to have lower book-to-market ratios.
Earnings response variation with financial leverage

- Lower response for highly leveraged firms.
- Dhaliwal, Lee, Fargher (1991)
Earnings response variation with credit rating

- Lower response for lower-rated firms.
- Plummer, Tse (1999)
Earnings response is stronger for smaller firms...

- not because small firms receive more attention ...
- not because small firms have higher volatility, either
Earnings day volatility does increase with normal-day volatility, but not proportionally so.
We know stock price moves more when the surprise is larger, whatever the surprise is.

This observation, by itself, is not that helpful, except telling us that fundamentals matter.

We have also learned that we can predict the strength of stock market response, before we know the size/direction of the surprise, based on firm characteristics, past incidences, and forward expectations embedded in options. — This can be useful.

Enhancing this prediction is important for option pricing. To price options, one needs to know the number of holidays, number of normal business days, and number of event days (such as earnings), as well as the relative variance contribution from each type of days — before one ventures into jump diffusion/stochastic volatility.

It can also be helpful on answering fundamental-related questions:

- Why do investors respond more to certain firms than others?
- Given our prediction on different responses, how does it change our reaction to earnings-related studies: such as earnings momentum, post earnings drift, earnings quality.
Post earning drift is stronger when EDR is high
Momentum is weaker for companies with stronger PEDR

PEDR is average of EDR over the past two years
Concluding remarks

- Do fundamentals matter? — They do, but not always in the way you think they do.

- Why are ERC estimates much lower than expected?
  - Prices respond to surprises, not changes.
  - Investors do not agree on consensus, nor surprises.
  - Many elements of accounting reports can affect people’s expectation of the inputs for stock valuation.
  - A linear regression is a very crude approximation of many layers...

- Why do we do then?
  - Come up with a valuation specification that captures the combined effects of the many noisy elements ...
  - Or do not come up with anything at all — Just measure the ex post magnitude of the stock response (EDR), whatever the cause.

- EDR seems to be persistent and predictable, and show systematic variations
  - Before building the perfect model, it is also useful to understand why investors respond more to certain firms than others.
  - It may even have some interesting implications about ...