Methodology of Event Studies
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The daily rate of return on a stock is an indicator of the proportional change in the market value of a particular company over a very short time horizon. Media reports of quarterly earnings, acquisitions, alliances, dividends, new technologies, or other good and bad events affect investors’ decisions about the level of investment in a particular firm; these firm-specific changes drive the market price of the stock.

In addition to firm-specific factors, the general trend for the prices of all risky assets plays a role in the price of a stock. Sharpe (1964), who followed the work of Markowitz (1959), developed a market model of equilibrium asset prices under conditions of risk. Sharpe’s simple market model illustrates that expected excess return from asset $i$ is a function of the excess return on the market portfolio. In mathematical notation, we write:

$$E[R_i] - R_f = \beta_i (E[R_m] - R_f)$$  \hspace{1cm} (1)

where $R_i$ is the return of asset $i$, $R_f$ is the risk-free asset, $R_m$ is the return on the market portfolio, and $\beta_i$ is the coefficient measuring the relationship of asset $i$ to the market. The theories of the Capital Asset Pricing Model (CAPM) and the related Security Market Line (SML) have become part of the foundation of intermediate-level finance education (Bodie and Merton, 2000). A variety of applied studies have extended and tested the validity of this basic idea. In making the transition from theory to an empirical model, MacKinlay (1997) expresses the relationship as follows:

$$r_{it} = \beta_0 + \beta_i r_{mt} + \epsilon_{it}$$  \hspace{1cm} (2)

where $r$ is the rate of return of company $i$ in time $t$. The variable $r_{mt}$ is the rate of return on a well-diversified portfolio $m$. $\beta_0$ is a constant and $\beta_i$ is the coefficient for the market portfolio return. $\beta_i$ measures the volatility/risk of firm $i$, since it is compared with a well-diversified portfolio. The S&P 500 can be used as a proxy for the market portfolio return. Finally, $\epsilon_{it}$ is the error term.

The market model is used to analyze the statistical relation between the return on a company’s stock and the return on the market portfolio. The market model provides researchers with the foundation to test for abnormal returns due to an unexpected event. Under ordinary conditions, an individual stock is expected to move along with the rest of the market. Only news of unexpected events will likely drive a stock’s return outside of its historical relationship to the market. Hence, the event study approach tests for short-term movements in stock prices that are outside of the historical pattern, taking into account statistical errors in the estimates of the historical relationship.

The main statistical technique associated with a financial market event study is the confidence interval of a forecast. Technically, an abnormal return (AR) is defined as the
actual, after-event return \( r_{i,t+e} \), that falls outside of the confidence interval (CI), calculated from the forecast rate of return \( \hat{r}_{i,t+e} \) estimated prior to the event. The CI used to define statistical power of an AR is:

\[
CI = \hat{r}_{i,t+e} \pm t_{cv} \ast se(\hat{r}_{i,t+e})
\]

where \( t_{cv} \) is the critical value, \( se(\hat{r}_{i,t+e}) \) is the standard error of the regression and subscript \( t+e \) refers to the day of the event. Analysts choose the critical value for desired precision of the forecast. Assuming normally distributed errors, \( cv = 1.96 \) represents a .95 level of confidence. Define an abnormal rate of return (AR) as the difference between the actual return \( r_{i,t+e} \) minus the forecast rate of return \( \hat{r}_{i,t+e} \):

\[
AR_{it+e} = r_{i,t+e} - \hat{r}_{i,t+e}.
\]

An observed daily return, after an event, that is within the CI of the forecast is considered not statistically significant. The significant ARs are reported, at times in aggregated form (across time or across firms), and tested to determine the duration of the significant impact of an event.

Further refinements to this basic approach have explored the volatility in the firm’s returns, subsequent to the event of interest. Corhay et al (1996) and Wang et al (2002) use the market model that accounts for time-varying volatility effects, using a Generalized Autoregressive Conditional Heteroskedasticity (GARCH) specification. The market model may be adjusted for residuals that are conditional heteroskedastic, with the following GARCH \((p,q)\) specification for the simple market model:

\[
r_{it} = C_i + \beta r_{mt} + \sum \lambda_h r_{i,t-h} + \epsilon_{it}
\]

\[
\epsilon_{it} \sim N(0,h_{it,d}), \quad h_{it} = \alpha_{io} + \sum \alpha_{ik} \epsilon_{i,t-k}^2 + \sum \theta_{ij} h_{i,t-j}
\]

Equation (6) and (7) are the mean and variance equations, respectively. \( \psi_t \) is the information set at time \( t \) for firm \( i \) and \( h_{it-1} \) is the conditional variance. \( N \) is a student’s \( t \) distribution with \( d \) degrees of freedom, and with \( p > 0; \alpha_{ik} \geq 0, i=0,...,p; q>0; \theta_{ij} \geq 0, j=0,...q. \)
Hints for Success on a Financial Market Event Study, Estimated in Microsoft Excel.

Historical Stock price data may be obtained from finance.yahoo.com
Order the data in time, earliest first. (Sort, Ascending).
Match up dates on the two data series (your stock and the market portfolio)
Use rate of return in decimal form for the data to be estimated. Rate of
return is percentage change in price of the stock.

Run the regression for the market model. Your stock is dependent variable (left side).
Do not include the date of the event in the pre-event market model.

Forecast the stock price for the event day (and days after) based on the coefficients
in the pre-event model.

Approximate the forecast confidence interval with 1.96*Standard Error of the Regression.

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