Long-Horizon Event Study BHAR Approach

An event study is often referred as a statistical analysis of market reaction over a short time period, mostly over days. Conventionally, an event analysis is considered as a long-horizon event study when it involves an event window of one year or more. The lengthy event window makes event analysis with long horizon more challenging than its short-run counterpart. Therefore, contrary to the little difference for short horizons, it could make risk adjustment based on historical estimates significantly biased. In addition, the estimates of abnormal returns in long run are highly sensitive to model choice. This is due to the fact that the systematic errors that arise with imperfect expected return proxies are compounded over long horizons.

Despite lack of methods that are perfectly immune to risk adjustment errors or model misspecification, two approaches have commonly been employed to measure long-run abnormal stock returns after corporate events: the buy-and-hold abnormal return (BHAR) method, and the calendar time portfolio method (Jensen's alpha). The advantage of the BHAR method is that it reflects the true magnitude of returns of an investment strategy, while the advantage of the calendar time portfolio method is that it controls well for cross-sectional dependence among sample firms and is less sensitive to a poorly specified asset pricing model. For this piece of WRDS Research Analytics, we will focus on the first approach.

The BHAR method is based on the difference between buy-and-hold returns of event firms and the characteristic-based matched portfolios. Conceptually, this measure calibrates the average return from a strategy of buying in all firms that complete an event and shorting otherwise similar nonevent firms within a given period. Among extensive literature in this field, Barber and Lyon (1997) and Kothari and Warner (1997) are the first empirical works to focus on this characteristic-based matching approach, and their framework has been widely used.

The two measurement problems of the characteristic-based matching BHAR approach need to address are 1) how to calculate abnormal performance in long run, and 2) how to find a proper benchmark to calibrate the performance abnormality of event firms. There are two common ways to measure abnormal performance of a stock over a given period:

Cumulative Abnormal Return (CAR):

$$CAR_{it} = \sum_{t=1}^{T}(R_{it} - E(R_{it})), \text{ and}$$

Buy-and-Hold Abnormal Return (BHAR):

$$BHAR_{it} = \prod_{t=1}^{T}(1 + R_{it}) - \prod_{t=1}^{T}(1 + E(R_{it})) \qquad (1).$$

In a short-horizon event study, the difference between CAR and BHAR is mostly negligible. In contrast this difference could be significant enough to distort the empirical results in a long-run event study. By using annual CARs and BHARs calculated using monthly abnormal returns, Barber and Lyon (1997) demonstrate that the BHAR tends to be slightly lower than CAR, but becomes dramatically greater than the annual CAR when annual BHAR increases beyond 28%. Since CAR is a summation of monthly (daily) abnormal returns (AR), a test of the null hypothesis, mean CAR is equal to zero, is empirically closer to a test of the null hypothesis that the pooling mean of ARs among event firms is equal to zero. It is, therefore, not an ideal test of the null hypothesis for a typical long-term event study, namely whether the mean long-term abnormal return is equal to zero.

As mentioned above, in long-horizon event studies, historical risk estimates are not as reliable as those in short-run. It is, therefore, crucial to select normality benchmark on the basis of post-event, not the historical estimates on certain asset pricing models, such as Fama and French factor models. BHAR approach measures post-event normality of an event firm by using an otherwise similar nonevent benchmarks. The benchmarks are characteristic-based matching portfolios, which are largely selected in accordance with Fama and French (1993) categorizations. Even though this matching approach may lack a sound economic rationale, this setting is suitable for an event study that is designed to measure the incremental impact of an event on security price performance. In the other words, as long as the price performance associated with similar characteristics is applicable to all stocks sharing those characteristics, the performance associated with the event itself must be distinguishable from that associated with other known determinants of performance.

Matching Portfolio Approach:

A standard way to create a matching portfolio, such as Barber and Lyon (1997), is the following:

1. From each July to the following June, all CRSP common stocks are split into size decile portfolios according to the market capitalization of common stocks listed in NYSE at the previous June.
2. Within each size decile, firms are sorted into quintiles on the basis of their book-to-market ratios prior to or in the December in the year before. This lag treatment allows for delays in the reporting of financial statements.
3. The benchmark portfolios should exclude event firms, but they include all securities that can be assigned to a characteristic-based matched portfolio.

There are two ways to calculate long-run return of the size and book-to-market reference portfolios. First, in each period, each portfolio is assumed to be fully rebalanced and then compound mean stock returns in a portfolio over a given investment horizon (*rebalancing*):

$$\prod_{t=1}^{T}(1+E(R_{it})) = \prod_{t}^{T}\left(1+\sum_{i=s}^{n_t} w_{it}R_{it}\right) \qquad (2),$$

where t is the period of investment, R_{it} is the return on security i, n_t is the number of securities in period t, and w_{it} is either $1/n_t$ or a value-weight factor of security i in period t. In order to avoid the situation in which recent observations are over weighted compared to early observations, cross-sectional event study usually takes equal-weight approach, unless the inflation and stock market conditions can be jointly adjusted over a long horizon. For a series of unscheduled events over a long horizon, it is also empirically unrealistic to assume that a preannouncement capital allocation, i.e. weighting each event by the market cap of event firms, is applicable. Therefore, the equal-weight portfolio returns are inherently preferred for detecting long-run abnormal returns, especially within this characteristic-based matching frame-work.

There are a few problems associated to this approach.

- Ritter (1991) documents that firms that go public underperform an equally weighted market index. Over long horizons, this periodical rebalance approach may understate expect return proxies by allowing new firms entering into the benchmark portfolio, and therefore bias BHARs positively (*new listing bias* in Barber and Lyon 1997).

- As well documented, periodic equal-weight portfolio rebalancing leads to an inflated return of the reference portfolio over a long run. In addition, equal-weight rebalancing keeps selling past winners and buying past losers, while the returns of firms are compounded without rebalancing. Therefore, equal-weight portfolio tends to bias BHARs negatively (*rebalancing bias* in Barber and Lyon 1997).
- On the other hand, value-weight portfolio is biased towards the largest market cap stocks, meanwhile value-weight rebalancing can be considered as an active investment strategy that keeps buying past winners and selling past losers. In these senses, a long-horizon value-weight portfolio tends to bias BHARs positively.

As suggested by Mitchell and Stafford (2000), an easy solution to avoid above mentioned problems is to form the benchmark portfolios at a given period, such as t=1, namely portfolios will never change their constituents.

Following a similar logic, the second way of calculating the long-horizon returns on a reference portfolio is to first compounding the returns on securities constituting the portfolio and then averaging across securities:

$$\prod_{t=s}^{T}(1+E(R_{it})) = \sum_{i=s}^{n_t}(w_{is}\prod_{t=1}^{T}(1+R_{it})) \qquad (3),$$

where t is again the period of investment, R_{it} is the return on security i, n_i is the number of securities, w_{it} is, however, either $1/n_s$ or a value-weight factor of security i at initial period s. The return on this portfolio represents a passive equal- or value-weighted investment in all securities constituting the reference portfolio in period s. Therefore this approach will not involve any newly listed security subsequent to period s, or any monthly rebalancing of the portfolio. An unresolved issue in the calculation of this approach is that the value weights of each event observation based on market capitalizations must be adjusted, so that more recent observations would not be overweighed.

Long-Run Buy-and-Hold Abnormal Return Web Queries.

This *WRDS Long-Run Buy-and-Hold Abnormal Return Analytics* provides BHAR calculated by using benchmark portfolio returns with annual rebalance (Equation 2) and without annual rebalance (Equation 3). Though, as mentioned above, equal-weighted setting is preferred for event study in general, both equal- and value- weighted benchmarks are applied to offer certain flexibility for cross-sectional analysis. In this setting, a 2 x 2 combination of BHAR results will be calculated and reported for each event window.

MINWIN is the minimal number of post-event trading months that are required for a firm to be included in the long run event study sample. MAXWIN is the maximum number of post-event trading months that the underlying algorithm includes in its calculation. In contrast to MINWIN case, the firms with less than MAXWIN post-event trading months are not going to be dropped, unless those numbers are smaller than MINWIN. MONTH (default are 12 24 and 36) are the selected numbers of months that are used to calculate and report BHAR. When there are missed monthly returns within the given monthly window, the correspondent matched portfolio returns are used to replace the missed returns.