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Testing excess returns on event days: Log returns vs. dollar returns

Tiago Duarte-Silva *, Maria Tripolski Kimel *

Charles River Associates, 200 Clarendon Street, Boston, MA 02116, United States

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ABSTRACT

The results of academic and practitioners' event studies are often translated from excess log returns into excess dollar returns. The prior literature argues for a difference between the statistical significance of excess log returns and that of excess dollar returns. In contrast, we show analytically and using simulations that specifying event study hypotheses in terms of excess dollar returns is equivalent to specifying them in terms of excess log returns. The prior literature's result was due to a bias in the estimator of expected excess dollar returns, an incorrect assumption that it is approximately normally distributed, and a misapplication of the delta method.

1. Introduction

The literature on event studies has long established the properties of excess returns and tests of their statistical significance.[1] However, it is useful in certain settings to examine excess dollar returns. For example, researchers are often interested in assessing the total gains from an acquisition. These are measured by summing the dollar returns of bidder and target upon the acquisition announcement. However, this sum lacks a test of its statistical significance. In addition, comparing bidders' and targets' gains when the two firms using excess returns is of limited use when the firms are of different sizes

* Corresponding author. Tel.: +1 617 425 3000.
E-mail addresses: tduarte@crai.com (T. Duarte-Silva), mkimel@crai.com (M. Tripolski Kimel).

[1] Returns should be understood as price plus dividend, divided by the previous day's price. Excess return is the difference between an observed return and the respective expected return, which is typically measured by a regression model.

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(e.g., Malatesta, 1983; Asquith et al., 1990). A statistical test of excess dollar returns would avoid this problem. Other applications of such a statistical test include the analysis of fund management skills (e.g., Grinblatt and Titman, 1993). As Berk and Binsbergen (2012) argue, the correct measure of managerial skill is the product of excess return and assets under management. This measure controls for the fact that obtaining a 10% excess return on a $100 million portfolio is very different from obtaining that same excess return on a $10 billion portfolio.

A common practitioner use of event studies involving excess dollar returns is in analyzing the impact of disclosure events on prices in the context of securities litigation (see, e.g., Francis et al., 1994). In typical Section 10(b) cases in securities litigation, plaintiffs allege that a company misrepresented or failed to disclose material information and therefore the prices of the company's common stock at the time of plaintiffs' transactions were inflated. The per-share damages to plaintiffs are computed based on inflation in the company's common stock at the time of transactions. The stock price inflation is measured on an alleged disclosure day i by comparing the decline in the stock price P_i from the value it could have had absent the disclosure event according to a regression model. The statistical question of interest, therefore, is whether this decline is due to random chance or to the materiality of the information disclosed.

When the regression model used to measure expectations is based on returns, returns and excess returns are assumed to be normally distributed. In this situation, the statistical significance of excess dollar returns is assessed via the statistical significance of excess returns. This is accurate because excess dollar returns equal excess returns multiplied by the previous day's price. So, conditionally on the previous day's price, excess dollar returns are normally distributed and the significance of excess dollar returns equals the significance of excess returns.

However, the distribution of returns is skewed, as for example prices cannot be negative. The event study literature avoids this problem by assuming that returns are log normally distributed and setting up the regression model on log returns. In such a situation the log returns, and hence the excess log returns, follow a normal distribution (Campbell et al., 1997).

But under a regression based on log returns, the distribution of excess dollar returns is not as easily derived because they are not a linear function of excess log returns. Few studies have examined the properties of excess dollar returns under log-normally distributed returns, Saha and Ferrell (2011) being the first to derive a test of their statistical significance. In addition to correcting the prior literature's specification of expected log returns, they add to the literature in assessing whether the statistical significance of excess log returns equates to that of excess dollar returns. Using an approximation, they obtain a t-statistic of excess dollar returns and observe that it differs from the more commonly used t-statistic of excess log returns. It follows that the statistical significance of a day's excess log return does not necessarily imply that the same day's excess dollar return is also statistically significant, as they demonstrate through a numerical example.

In this paper, we examine that claim. As part of this analysis, we start by investigating how the hypothesis of non-materiality of new information could be written through a statistical model of log returns and equivalently through the definition of *ex post* excess log returns as is used in financial literature. We derive a similar hypothesis by looking at *ex post* excess dollar returns and show through algebraic manipulations that the two hypotheses are identical, that is, testing the materiality of the information disclosed on an event day based on *ex post* excess log returns should lead to the same conclusion as when using the *ex post* excess dollar returns. This runs counter to Saha and Ferrell's (2011) main finding that testing materiality using excess log returns leads to different results from using excess dollar returns. We analyze why this is the case, finding that the latter test uses a biased estimator of the mean of excess dollar returns, and that Saha and Ferrell's (2011) application of the delta method to approximate excess dollar returns' distribution should have taken account of additional variables. Moreover, the delta method may not be even suitable for deriving the standard error of the excess dollar returns as it assumes an approximately normal distribution of the excess dollar returns. We show by simulation that the distribution of the excess dollar returns is skewed.

The rest of the paper is organized as follows. In Section 2 we present the traditional statistical model of returns. In Section 3 we investigate the similarity between testing the significance of excess log returns and testing the significance of excess dollar returns. In Section 4 we examine Saha and Ferrell's (2011) approach to testing excess dollar returns, analytically and via simulations. Section 5 concludes.

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