Applied Financial Economics ›

Volume 19, 2009 - Issue 13

Original Articles

Extreme dependence in the NASDAQ and S&P 500 composite indexes

John W. Galbraith & Serguei Zernov

Pages 1019-1028 | Published online: 15 Jun 2009

Cite this article https://doi.org/10.1080/09603100802360032

Abstract

Dependence among large observations in equity markets is usually examined using second-moment models such as those from the GARCH or SV classes. Such models treat the entire set of returns, and tend to produce similar estimates on different major equity markets, with a sum of estimated GARCH parameters, for example, slightly below one. Using dependence measures from extreme value theory, however, it is possible to characterize dependence among only the largest (or largest negative) financial returns; these alternative characterizations of clustering have important applications in risk management. In this article we compare the NASDAQ and S&P in this way, and implement tests which can be used for the null hypothesis of the same degree of extreme dependence. Although GARCH-type characterizations of second-moment dependence in the two markets produce similar results, the same is not true in the extremes: we find significantly more extreme dependence in the NASDAQ returns.

More generally, the study of extreme dependence may reveal contrasts which are obscured when examining the conditional second moment.

Previous article
View issue table of contents
Next article

Acknowledgements

The authors thank the Fonds québécois de la recherche sur la société et la culture (FQRSC), the Social Sciences and Humanities Research Council of Canada (SSHRC) and the Institut de Finance Mathématique de Montréal (IFM2) for support of this research. We are grateful to John Maheu and Serguei Novak for valuable comments.

Notes

[1] Extreme events are defined with respect to each market, as the largest negative (or positive) returns on that market.

[2] Note that this is distinct from cross-sectional dependence in extreme events across markets.

[3] Another key definition for understanding extreme behaviour is that of regular variation at infinity. The distribution function $F_X(x)$ (assumed to be common to all observations) of a random variable $X \in R$ is said to be regularly varying at ∞ if there exists $\alpha > 0$ such that

α is referred to as the tail index, or index of regular variation. It follows that $(1 - F_X(x)) = O(x^{-\alpha})$ as $x \to \infty$, where $1 - F_X(x) = P(X > x)$. Therefore, α describes the rate of decay of probability mass in the tail of the distribution.

[4] The asymptotic variance of θ, which would facilitate inference, does not seem to have been established. Weissman and Novak (1998) do not propose consistent estimators for the asymptotic variances appearing in the asymptotic normal distributions of and , but indicate that such estimators are under investigation. Ferro and Segers (2003) suggest a bootstrap procedure for inference on or .

[5] Note that if we were to choose a common numerical threshold instead, the higher variance of returns on the NASDAQ would imply a greater total number of exceedances, guaranteeing that the blocks method would show a greater mean cluster size for that market, since the number of blocks is the same for each market.

[6] We do not present here results on the tail indices of the two markets. However, a variety of different estimates, and statistical inference using the test of Loretan and Phillips (1994), show no discernible difference in the two tail indices.

[7] An estimated two-sided p-value of zero implies that no bootstrap replication of the processes yielded a statistic, , as low as the hypothesized value.

[8] The analysis in Longin (2000) also suggests that ignoring dependence in the data leads to underestimating the VaR, but concludes that the impact of dependence is not statistically significant at the daily frequency, and that the measures of dependence are smaller again at lower frequencies, for the sample that Longin considered (S&P 500 from January 1962 to December 1993). We have already concluded that there is significant extreme dependence in both asset returns and that the dependence is significantly stronger in the NASDAQ series. This difference in the conclusions results in part from the application of recent developments in estimation, and consequent differences in estimated values of the extremal index: Longin (2000) estimates for the daily S&P 500 series, while with interexceedance times we estimate θ to be in the neighbourhood of 0.4–0.5 for S&P 500 and of 0.2–0.3 for the NASDAQ series (again, Fig. 1(a) and b).