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System-wide tail comovements: A bootstrap test for cojump identification on the S&P 500, US bonds and currencies☆

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ABSTRACT

This paper studies bivariate tail comovements on financial markets that are of crucial importance for the world economy: the S&P 500, US bonds, and currencies. We propose to study that form of dependence under the lens of cojump identification in a bivariate Brownian semimartingale with idiosyncratic jumps, as well as cojumps. Whereas univariate jump identification has been widely studied in the high-frequency data literature, the multivariate literature on cojump identification is more recent and scarcer. Cojump identification is of interest, as it may identify comovements which are not trivially visible in a univariate setting. That is, price changes can be small relative to local variation, but still abnormal relative to local covariation. This paper investigates how simple parametric bootstrapping of the product of assets' intraday returns can help detect cojumps in a multivariate Brownian semimartingale with both idiosyncratic jumps and cojumps. In particular, we investigate how to disentangle idiosyncratic jumps from common jumps at an intraday level for pairs of assets. The

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approach is flexible, trivial to implement, and yields good power properties. It allows to shed new light on extreme dependence at the world economy level. We detect cojumps of heterogeneous size which are partly undetected with a univariate approach. We find an increased cojump intensity after the crisis on the S&P 500-US bonds pair before a return to normal.

1. Introduction

The most recent financial crisis has emphasized the risk of extreme comovements. Events such as bailout plan announcements, corporate or government defaults, natural calamities, to name just a few, may create large jumps and cojumps in financial asset prices. But given the continuous flow of economic information, some news may have economy-wide relevance without being as extreme as those just listed, potentially causing smaller cojumps. Having an accurate understanding of the resulting tail comovements in financial markets, and being able to hedge against them is of critical importance.

Whereas univariate jump identification has been widely studied in the high-frequency data literature, the multivariate literature on cojump identification is more recent and scarcer. This paper proposes a cojump test based on a bootstrap procedure in order to investigate whether abnormal comovements exist and can be detected beyond mere simultaneous occurrences of univariate jumps. That is, we investigate whether we can find market comovements which cannot necessarily be identified otherwise with a univariate approach. We study these movements on key markets for the world economy: the S&P 500, US bonds, and currencies.

To identify abnormal comovements, we study the potential benefits of parametric bootstrapping methods to detect intraday cojumps in two asset prices. Under a multivariate Brownian semimartingale with idiosyncratic jumps and common jumps, we exploit high-frequency data to estimate jump-robust covariance matrices and simulate null distributions of returns' product under different scenarios through a bootstrapping procedure.

The intuition behind our approach is simple. In a univariate setting, when a jumps occurs, the observed intraday return is likely to lie outside the region of returns generated by the diffusive part only. Likewise, in a multivariate setting, when a cojump occurs on two or more asset prices, the observed return product (i.e. in the bivariate case, the intraday return of asset 1 $\times$ that of asset 2) is likely to lie outside the region of returns product generated by the diffusive part and potentially the idiosyncratic jump part. Therefore, to detect cojumps, we use a simple statistic: the product of observed intraday returns whose distribution under the null is generated through simulations. This approach is an extension of Bollerslev et al. (2008) to a bivariate setting, and can also be seen as a multivariate extension of Lee and Mykland (2008).

Under the assumption of neither idiosyncratic jumps, nor cojumps, and assuming a Brownian semimartingale, the distribution of the return product is the normal-product distribution. Under the null of idiosyncratic jumps only, we elaborate on the normal product distribution to include idiosyncratic jumps. The use of these distributions has the advantage of reducing the multivariate jump detection problem to a univariate one that is trivial to implement and simulate.

We pay particular attention to the impact of jumps on cojump detection. Indeed, large idiosyncratic jumps tend to inflate any test statistic up to a level where a cojump could be wrongly detected. We show how simulating idiosyncratic jumps allow to discriminate between common and individual jumps. Moreover, to tackle this issue, we show how the combination of univariate and multivariate techniques can be informative regarding the nature of the discontinuity, i.e. whether it is an idiosyncratic one or a common one.

We illustrate our approach in two empirical applications: we study to what extent stocks (through the S&P 500 index) and US bonds actually cojump. The empirical question raised in this paper is whether abnormal comovements can be detected beyond obvious simultaneous large jumps. This