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The properties of realized correlation: Evidence from the French, German and Greek equity markets

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ABSTRACT

In this paper I examine the properties of four realized correlation estimators and model their jumps. The correlations are between the French, German and Greek equity markets. Using intraday data I first construct four state-of-the-art realized correlation estimators which I then use to testing for normality, long-memory, asymmetries and jumps and also to modeling for jumps. Jumps are detected when the realized correlation is higher than 0.99 and lower than 0.01 in absolute values. Then the realized correlation is modeled with the simple Heterogeneous Autoregressive (*HAR*) model and the Heterogeneous Autoregressive model with Jumps (*HAR* – *J*).

1. Introduction

The correlation between asset returns is important in risk management, portfolio optimization, trading strategies, option pricing and structured finance.[1] The non-parametric estimators of volatility can be also applied to the correlation. The use of high frequency data improves the precision of both volatility and correlation estimation. The realized volatility estimator can be also employed in the computation of covariances and correlations between two assets leading to the analogous concept of realized covariance and realized correlation. The properties of both volatility and correlation are such (e.g. normality, persistence, long memory and jumps) that one has to be quite careful both in modeling and forecasting then.

In this paper, I model the realized correlation between (i) the *DAX* and *CAC*40 indices, (ii) the General Index of the Athens Stock Exchange (*GD*) and *DAX* index, and (iii) the *GD* and *CAC*40 indices using high frequency intraday data and four realized volatility estimators. I examine these correlations for normality in their distribution, through descriptive statistics. Then, the long-memory (*d*-values) of these correlations is estimated together with asymmetries. The correlations are then tested for jumps. Jumps are detected when realized correlations are higher or lower in their absolute values than two thresholds. The realized correlations, as well as their jumps series, are subsequently modeled using the class of the Heterogeneous Autoregressive (*HAR*) models.

The differences between the U.S. and European equity markets are huge. As it concerns the average daily turnover, the NASDAQ and the NYSE Group were first (for 2005 and 2006), the Athens Stock Exchange was last, with the American SE just above it. It comes not as a surprise that, for the years 2005 and 2006, the domestic market capitalization, was higher for the NASDAQ and NYSE Group exchanges, first and second, respectively, whereas the Deutsche Borse was third, the Euronext fourth, the American SE fifth and the Athens Stock Exchange last. The number of listed-companies in the exchanges reveals the role that they play locally and also internationally: the higher the number of internation-

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[1] Realized correlation is valuable to the issuers of structured equity products, who have short exposure to equity correlation. So, in order to make offset this exposure dealers buy correlation from hedge funds through correlation swaps as well as many variance swaps.

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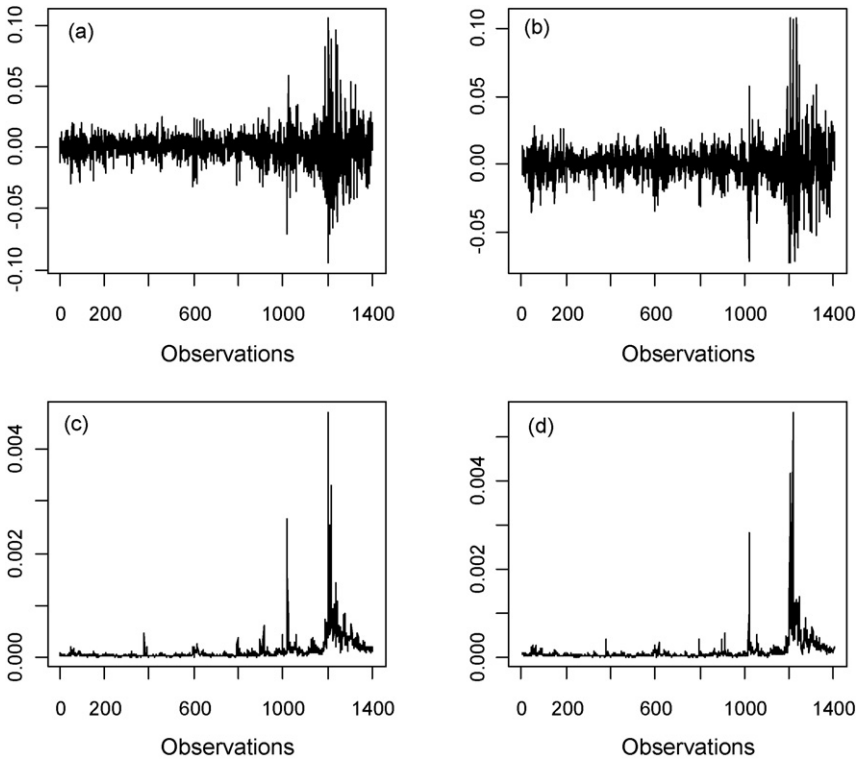

Fig. 1. (a) Return series for French market; (b) return series for German market; (c) volatility series for French market; (d) volatility series for German market.

alised companies the more important the international role of the exchange. The most populated – with regard to listed companies and internationalized exchanges – are the NASDAQ and the NYSE Group followed by the Euronext, the Deutsche Borse, the American SE and the Athens Stock Exchange. Thus, it is apparent that the American exchanges are more internationalized than their European counterparts. These differences between the U.S. and European equity markets made me use the realized correlation estimates between three European (German, French and Greek) equity markets.

The realized correlation depends on the theory of realized volatility (Andersen, Bollerslev, Frederiksen, & Nielsen, 2010) and the bootstrapping of realized volatility (Goncalves & Meddahi, 2009). In order to get the realized correlation, it is assumed that the two assets are sampled simultaneously. The sampling frequency that is mostly used in the literature is that of per 5 min. I choose the specific frequency, because it balances between the advantages of the numerous intraday observations and the bias from the market microstructure noise. I focus on four realized correlation estimators: the realized correlation estimator, the realized bipower variation correlation estimator, the realized Parkinson range-based correlation estimator and the realized optimal correlation estimator. The first estimator was proposed by Andersen, Bollerslev, Diebold, and Labys (1999) the first. The naive realized correlation estimator has been analyzed under various frameworks (Christiansen & Ranaldo, 2007; Ferland & Lalancette, 2006; Wang,

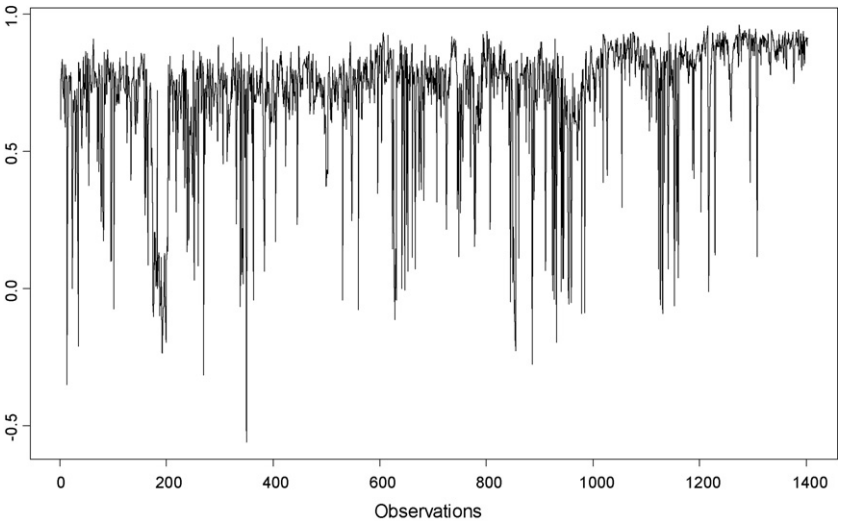

Fig. 2. Correlation series for French and German markets.