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VC correlation analysis on the overnight and daytime return in Japanese stock market

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HIGHLIGHTS

- Weak negative correlation between overnight and daytime return was observed in Japan Stock Market.
- VC correlation amplified this weak negative correlation between overnight and daytime return.
- A linear scale relationship between the standard correlation and VC correlation was observed.

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ABSTRACT

While most financial engineering and econophysics studies have focused in daytime trading, much less investigation has been devoted to the non-trading or night periods. In this work, the correlation between overnight and daytime return (correlation ND) and the correlation between daytime return and following over night return (correlation DF) were investigated, which led to several findings. First, a weak negative correlation between overnight and daytime return (correlation ND) was observed in Japanese Stocks Market. Secondly, the application of Volatility Constrained correlation (VC correlation) method led to a significant amplification of this signal which benefits for increasing predictability of day time return compared to standard correlation. Furthermore, the analysis of the amplified signal derived from VC correlation for each stock revealed a linear scale relationship between the standard correlation and VC correlation. Therefore, this result indicates that by using the VC correlation, stronger correlation effect can be observed. Taking together, these findings suggest that the combination of VC approach with financial trading data over night paves the way to improve market predictability.

1. Introduction

Predictability in financial markets is a long-term research goal of economists, computer scientists and physicists in the last decade which has been strongly fueled by the widely availability of stock market time series data [1–3]. A large variety of statistical and computational approaches have been done to uncover patterns and stylized facts that may lead to predict market tendencies [4–11]. Correlation analysis between various markets are studied in [12–21]. Most of this research has focused on trading periods (i.e. day time).

However, in stock markets, there are two types of sessions: trading periods and non-trading periods. In non-trading time, the Japanese stock market is closed. However, during Japanese night, the European and US stock markets are open and news that occur in non-trading time may severely affect, as overnight effect, to the Japanese markets opening in the following day.

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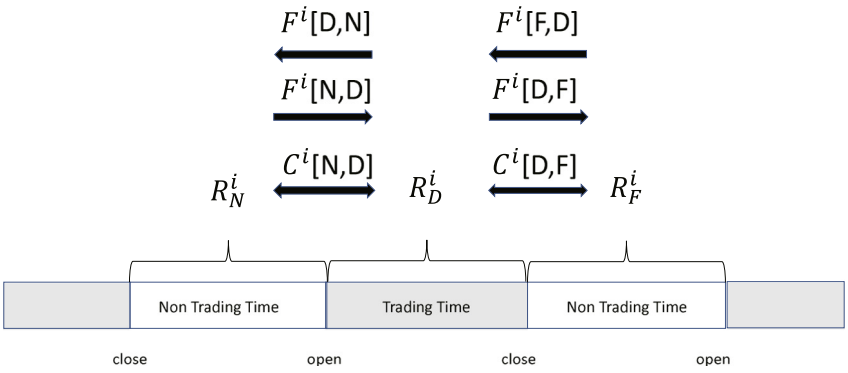

Fig. 1. Illustration of N (overnight), D (daytime), F (Following overnight).

Wang et al. investigated the two components of the total daily return (close-to-close), the overnight return (close-to-open) and the daytime return (open-to-close) of the 2215 New York Stock Exchange (NYSE) stocks for the 20 year period from 1988 to 2007 [22]. The results showed that the overnight return and daytime return tend to be anticorrelated. Tsai et al. also studied the daytime return and the overnight return in Taiwan Stock Exchange (TWSE) [23]. Their research lead to the finding that a large magnitude of overnight return implies a higher probability that the sign of the following daytime return is opposite of the sign of overnight return. These results improve the predictability of the following day time return.

In [24], the Volatility Constrained correlation (VC correlation) method was introduced as a new technique to identify the directionality of the influence in financial markets. By using this method, we could identify which market influences the other market (e.g. American market influences to Japanese markets were verified with that method).

In this work, we analyze the correlation between daytime return and overnight return in stocks of Japanese Nikkei 225. There are two types of correlation between daytime return and overnight return. One type (Correlation ND (Night to Day)) is the relation between the overnight return and the following daytime return. The other type (Correlation DF (Day to Following night)) is the daytime return and the following overnight return. (See Fig. 1). Although the correlation ND is well investigated in many studies, the correlation DF has attracted less attention. Therefore, here we focus not only on the first type but also the other type correlations.

First, we investigate the correlation ND and correlation DF that uses standard correlation coefficient (Pearson product-moment correlation coefficient). For the correlation ND, we find that, in average, the overnight return is weakly correlated with the following daytime return in almost all years in Japanese stock market, which is consistent with the results in different markets [22,23]. However, we find an exception in 2015 year, in which the negative correlation vanishes. On the other hand, in the correlation DF, the daytime return and the following overnight return have no clear correlation consistently for all years.

Second, when we apply VC correlation, instead of the Pearson correlation coefficient, for both correlation ND and DF. In both correlations (ND and DF), absolute value of VC correlation, is larger than that of the standard correlation. In other words, the correlation is amplified in both correlation ND and DF. This result in correlation ND is consistent with the result in [23] in which they used different methodology. Furthermore, the VC correlation enables us to identify the directionality of the influence. In correlation ND, we find that the directionality determined by VC correlation is the same as time causality direction from night session to the following daytime session, as expected.

Next, we investigate the correlation ND and DF of each stock rather than the averaged property. For both correlation ND and DF, our findings show that the VC correlation of each stock is more linearly amplified than that of the standard correlation by near factor two.

Furthermore, both the correlation ND and DF for one year is positively correlated with the correlation of the next year (i.e. correlation of correlation is positive). This implies that, for each stock, the tendency of the correlation of one year is transmitted to the correlation in the next year. For example, the correlation for one year between overnight return and following daytime return (correlation ND) is positive (resp. negative), then the next year correlation is likely to be positive (resp. negative).

2. Data

The data we used is price time series of 225 stocks that are listed in Japanese Nikkei 225 index. The data includes daily opening and closing prices of 225 stocks from 2000 to 2015. For some stocks, we use modified opening and closing price because of stock split.

The stocks for Japanese Nikkei 225 are occasionally replaced by new companies. In this work, we used the price data of the stocks listed in Nikkei 225 as of 2015. Therefore, for each year computation, if some stocks are replaced from 2000 to 2014, we excluded them and used the rest of the stocks in the computation.