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Intraday volatility spillovers between spot and futures indices: Evidence from the Korean stock market

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ABSTRACT

This study provides empirical evidence of the relationship between spot and futures markets in Korea. In particular, the study focuses on the volatility spillover relationship between spot and futures markets by using three high-frequency (10 min, 30 min, and 1 h time-scales) intraday data sets of KOSPI 200 spot and futures contracts. The results indicate a strong bi-directional causal relationship between futures and spot markets, suggesting that return volatility in the spot market can influence that in the futures market and vice versa. Thus, the results indicate that new information is reflected in futures and spot markets simultaneously. This bi-directional causal relationship provides market participants with important guidance on understanding the intraday information transmission between the two markets. Thus, on a given trading day, there may be sudden and sharp increases or decreases in return volatility in the Korean stock market as a result of positive feedback and synchronization of spot and futures markets.

1. Introduction

Since the introduction of futures markets, a large number of studies have examined the effects of futures trading on underlying spot prices, including the lead–lag relationship between spot and futures markets [1–4]. The lead–lag relationship between these two markers indicates how much they are closely related each other and how fast one market reflects new information from the other.

According to the efficient market hypothesis, any new information is quickly reflected in the underlying spot market and its futures market simultaneously, so that investors cannot make any profits using currently available information in these markets [5,6].[1] In reality, however, information can be disseminated in one market first and then transmitted to the other later as a result of market frictions such as transactions costs or market microstructure effects [13]. Some recent studies have suggested that futures markets play an important price discovery role for spot markets because of low transaction costs, the ready availability of short positions, low margins, and rapid execution [14]. Thus, futures prices may contain useful lead information on subsequent spot prices, including information not yet embedded in current spot prices.

In terms of the returns of these two markets, some studies have also provided similar results, indicating that, although futures returns have a bi-directional relationship with spot market returns, futures markets tends to lead the underlying spot markets, because the relationship from futures markets to spot markets is stronger [4,6,15–19].

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[1] On the contrary, recent several studies argue that this hypothesis might not be valid for the cases of transitional economics by showing that stock prices have long memory properties with power-law correlations [7–12].

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On the other hand, more recent studies have focused on the volatility interaction between spot and futures markets and provided evidence of strong cross-market dependence in the volatility process. Understanding volatility spillovers is important for predicting future volatility in both markets. There are three streams of research on volatility spillover effects. The first stream proposes bi-directional volatility spillovers between the two markets [3,20–24]. The second stream suggests unidirectional volatility spillovers from futures to spot markets, suggesting that the arrival of new information disseminates faster in derivatives markets [19,21,25,26].[2] The final stream proposes no volatility spillover effects [28,29].

In this paper, we focus on the issue of volatility spillovers between the KOSPI 200 spot market and its futures market by using bivariate GARCH models, in order to provide an important insight on the mechanism of information transmission between the two markets. It is well known that the two indices related to stock markets exhibit fat tails in the distributions of their returns. In the literature of econophysics, the non-Gaussianity is often described as α-Levy stable distributions, given that the fat-tail distributions have power-law decay. Mantegna and Stanley [30] and Podobnik et al. [31] suggested the use of ARCH–GARCH type models to describe the power-law stability in the distributions of the returns in these kinds of the variables. Our major concern in this study is to examine the lead–lag relationships between spot and futures indices, which exhibit power-law tails in the distributions of their returns. To investigate the correlations of the return volatilities with this characteristic, we use bivariate GARCH models, which are useful in simultaneously exploiting the possible linkages of volatility spillovers between the two non-Gaussian indices, rather than separate univariate models [32].

In this study, we examine the intraday volatility spillover effect by using three intraday data sets (10 min, 30 min, and 1 h intervals). Although many empirical studies have documented the volatility spillover effect in these markets, few have examined it for the cases of intraday high frequencies data of the Korean stock market, which has one of the largest futures derivatives markets in the world. The reason for using different time scales is because we are interested in measuring a fractal structure with self-similarity [33]. Although many econophysics studies analyzed the high frequency data of financial markets [34–36], they mainly focused on a single market rather than cross-market relationships. Daly [37] introduces cross-market issues and techniques in the econophysics field. In particular, the interaction relationship of econophysics variables can be examined by a multivariate context. Lee, Chiu and Lee [4] investigated the lead–lag price jump relationship between spot and futures markets using a bivariate Granger-causality test. Chiang, Yu and Wu [38] employed a multivariate model, dynamic conditional correlation (DCC), in estimating the difference intraday time scale relationship between the US spot and futures markets.

We also investigate the market opening effect of overnight information flow on intraday returns and consider the volatility spillover effect by using the bivariate GARCH model. This investigation of the intraday volatility spillover effect provides arbitrageurs, hedgers, and speculators with a better understanding of short-term dynamics of return volatility.

The rest of this paper is organized as follows. Section 2 provides the descriptive statistics of 10 min high-frequency data. Section 3 discusses the econometric methodology used in this study. Section 4 provides the results, and several conclusions are discussed in Section 5.

2. Data and descriptive statistics

2.1. KOSPI 200 spot and futures markets

The Korean Composite Stock Price Index (KOSPI) of the Korean Exchange (KRX) is the underlying stock index for futures and options contracts traded on the KRX futures market. The KOSPI 200 index is a capitalization-weighted index composed of 200 blue-chip stocks listed on the KRX. These 200 stocks account for approximately 70%–80% of domestic market capitalization, and thus, the KOSPI 200 index closely reflects the market's overall performance.

The KOSPI 200 futures market, which opened in May 1996, has rapidly become one of the largest derivatives markets in the world. The market has a robust trading system as well as an effective market management system, and consequently, it is considered to be a model derivatives market. As of 2007, it ranked 8th among stock index futures markets. Table 1 presents the descriptive statistics for KOSPI 200 futures contracts.

2.2. Descriptive statistics for sample data

We considered three high-frequency (10 min, 30 min, and 1 h time-scales) intraday data sets of KOSPI 200 spot and futures contracts from January 2, 2004, to December 29, 2005. The high-frequency price series were then converted into logarithmic return series for all sample indices, that is, $R_{i,t} = \ln\left(P_{i,t}/P_{i,t-1}\right) \times 100$, where $R_{i,t}$ denotes the continuously compounded percentage returns for index i at time t and $P_{i,t}$ denotes the price level of index i at time t.

Table 2 shows the descriptive statistics and the results of the unit root tests for three intraday return series of both futures and spot markets. As shown in Panel A of Table 2, the return series show very similar descriptive statistics. According to skewness (Skew.) measured the third standardized moment, excess kurtosis (Kurt.) measured the deviation of the fourth

[2] In contrast to the second stream, Kasman and Kasman [27] found unidirectional causality from spot to futures markets, indicating that news disseminates first in the spot market and then in the futures market.