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The time difference effect of a measurement unit in the lead–lag relationship analysis of Korean financial market ☆

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Abstract

This paper investigates Korean financial markets for the study of market microstructure of price discovery in the KOSPI 200 stock index and its related derivatives markets using different time-interval price data. The Granger causality test and vector error correction model are used to analyze the empirical relationship between markets. The lead–lag relationship between the KOSPI 200 stock index and its derivatives markets can be supported by the trading cost hypothesis and leverage effect hypothesis. This paper also shows the congruent lead–lag results in various time-intervals, but as the time-interval becomes large, more information loss and spurious results are induced. The correlations among 1-minute data, 5-minute data, and 10-minute data are significant under a 1% significance level, however, in the case of 60-minute data, the correlations with any other time-interval data are not significant. The 60-minute data even have negative correlations with others. These results are consistent regardless of the raw data or the innovation data. Therefore, we can conclude that the previous research using the 60-minute data due to an insufficiency of trading volume can be biased considerably.

JEL classification: G15
Keywords: Price discovery; Granger causality test; Vector error correction model

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1. Introduction

In case of perfectly frictionless and rational markets, the stock index and any financial derivatives based on it must simultaneously reflect new information. If it does not, costless arbitrage profit would be possible. But in real markets, there is market friction including various transaction costs and information asymmetry and the lead–lag relationship between markets is observed. Recently, the lead–lag relationship between two securities markets has attracted significant attention in the literature on market efficiency and microstructure. Hodgson, Masih, and Masih (2006) conclude that futures prices provide a short-term information lead to stock prices that dominates trading volume effect. Also, Stoll and Whaley (1986) report that there are frequent violations of the cost-of-carry relationship in excess of transaction costs using hourly S&P 500 index and index futures data. Fleming, Ostdiek, and Whaley (1996) rightfully argue that, in general, instruments with lower trading costs play a more important information discovery role compared to their higher cost substitutes. Therefore, it is expected that returns in index futures lead returns in the underlying cash index, and numerous studies have provided supporting evidence on the conjecture. Examples of this include Garbade and Silber (1983), Herbst, McCormack, and West (1987), Kawaller, Koch, and Koch (1987), Stoll and Whaley (1990), Schroeder and Goodwin (1991), and Chan (1992). Numerous studies have examined the intraday price relationship between the stock index and its futures. These studies use different time-intervals, 1, 5, 10-minute or as far as 60-minute price data, only following the purging method for high frequency data. For example, Stoll and Whaley (1990) examine the time series properties of intraday returns of the stock index and stock index futures contracts with 5-minute rate of return series of the S&P 500 and Major Market indexes (MMI) using an ARMA(2,3) process to purge the effects of infrequent trading. Fleming et al. (1996) use the ARMA process to purge the problem from the high frequency price data. Shyy, Vijayraghavan, and Scott-Quinn (1996) and Frino, Walter, and West (2000) recalculate index returns using stock bid and ask quotes rather than trade prices. Frino et al. (2000) argue that one of the limitations of the approach is that in purging the effects of infrequent trading and bid-ask bounce from the observed index return, a portion of "true" returns can also be removed. Second, ARMA (p,q) estimation results in a loss of observations at the beginning of each day equivalent to the maximum number of lags included in the model.

Since the studies for interrelationship between the stock index and its options markets have been conducted, researches have failed to reach a consensus on the lead–lag relation between them. Manaster and Rendleman (1982), Bhattacharya (1987), and Anthony (1988) argue that the options price leads the stock market. But, Stephan and Whaley (1990) report that price changes in the stock market tend to lead those in the option market for active CBOE call options by as much as 15 min. Finucane (1991), however, describes that the measure of the relative index option prices leads the stock market by at least 15 min. In contrast, Chan, Chung, and Johnson (1993) use a nonlinear multivariate regression model to report that stocks lead options by 15 min confirming Stephan and Whaley's results. They analyze the cause of the lead–lag relationship based on the relatively larger option tick, and it might be a spurious lead induced by infrequent trading of options. Thus it will be observed that the stock price leads the option price until the stock price has changed sufficiently to generate a tick change in the option.

Considering the results of the previous studies collectively, we can conclude that the lead–lag relationship between markets are different from one another depending on the time-interval and corresponding markets of the countries and methodologies. To find out more apparent lead–lag relationship between markets, it is necessary to analyze the intraday patterns with a high-frequency of derivatives markets with abundant liquidity. This paper examines and compares the lead–lag