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An empirical analysis of the price discovery and the pricing bias in the KOSPI 200 stock index derivatives markets

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Abstract

In this paper, Korean financial markets are investigated in two ways, time series and cross-sectional data analysis for the study of market microstructure of price discovery and pricing bias associated with stock index, futures and options. First, the lead–lag relationships among the KOSPI 200 stock index, the index futures, and the index options markets are explored based on minute-to-minute price data. The results explain that the KOSPI 200 stock index futures lead the index, as reported in the previous studies, and the at-the-money options lead the stock index. A symmetric lead–lag relationship is found between futures and options, except for out-of-the-money options. This paper also investigates the consistency of lead–lag relationships among the results from the different time intervals of price data. Second, the causes of the pricing bias in the index options market are analyzed. The pricing bias between the observed KOSPI stock index and implied stock index from at-the-money options are affected by market inefficiency, moneyness, and implied volatility. Time to maturity and trading volumes of call options also affect the pricing bias, while those of put options are not significant.

Keywords: Price discovery; Pricing bias

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1. Introduction

When new information is released in an efficient and perfect capital market bias, prices of securities and their derivatives fully and instantaneously reflect all available relevant information. But in real markets, there exist market frictions including various transaction costs and information asymmetry in real markets and the lead–lag relationship between markets is observed. It is also observed that the trading costs of security markets and those of derivatives markets are different from each other. This asymmetry in trading costs makes the market with lower trading costs reflect new information more quickly. Because many traders take positions in inter-markets simultaneously, the difference of reaction times and the size of the difference of cross-sectional prices between markets can make a crucial effect on the profits. For this reason, it is of interest to both academics and practitioners to suggest the price discovery process and pricing bias between markets by investigating the lead–lag effects for the price dynamics between markets.

Numerous studies have examined the intraday price relationship between the stock index and its derivatives. Kawaller, Koch, and Koch (1987) investigate the intraday price relationship between S&P 500 futures and the S&P 500 index using three-stage least-squares regression. They find that the futures price movements consistently lead index movements by 20 to 45 min on a minute-to-minute data basis, while the index price rarely affects the futures price beyond 1 min. Stoll and Whaley (1990) examine the time series properties of intraday returns of the stock index and stock index futures contracts with 5-min 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. They report that the S&P 500 and MMI futures returns lead stock index returns by about 5 min on average after eliminating infrequent trading and bid/ask price effects. Chan (1992) explores the intraday lead–lag relationship between returns of the MMI and S&P 500 futures using 5-min trading data. He confirms that the S&P futures strongly lead the cash index and suggests that nonsynchronous trading cannot completely explain the lead–lag relationship of futures prices and the cash index. Manaster and Rendleman (1982), Bhattacharya (1987), and Anthony (1988) provide evidence that the options price leads the stock market. Finucane (1991) also reports that the measure of the relative index options price leads the stock market by at least 15 min. But, Stephan and Whaley (1990) document that price changes in the stock market lead price changes in the options market for active CBOE call options about 15 to 20 min on average with a 5-min option price series. Using a nonlinear multivariate regression model, Chan, Chung, and Johnson (1993) confirm Stephan and Whaley's results that stocks lead options by 15 min. They argue that the lead can be caused by the relatively larger option tick, and it might be a spurious lead induced by infrequent trading of options. Abhyankar (1995) reports that the FTSE 100 index futures market leads by up to 1 h using hourly data for the FTSE 100 cash and futures markets. Fleming, Ostdiek, and Whaley (1996) provide a trading cost hypothesis for the relative rates of price discovery in the stock index, futures, and options markets. Their empirical results with 5-min returns for the markets show that S&P 500 index futures lead the S&P 500 stock index, and S&P 100 index options lead the S&P 100 stock index, even after controlling for the effects of infrequent trading on the indexes. Gwilym and Buckle (2001) also examine the lead–lag relationships between the FTSE 100 stock index and its derivatives markets with hourly data. They report that the index call options strongly lead the index futures, and the futures strongly lead puts, which suggest that expectations of rises or falls in the market may affect the lead–lag relationship between markets.

The purpose of this article is to provide the price discovery functions of KOSPI 200 stock index options related to the stock index and the futures market based on minute-to-minute price