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Common deviation and regime-dependent dynamics in the index derivatives markets

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ABSTRACT

We analyze high-quality intraday data for KOSPI 200 futures and options to examine a common deviation and regime-dependent price dynamics in the index derivatives markets according to reliability of the common deviation. We find common deviation in the futures and options markets. In terms of the dynamics of asset prices and trading volumes, the linkage between the derivatives (i.e., futures and options) markets is stronger than the relationship between the underlying stock market and the derivatives markets. Whereas the deviations between the derivatives markets and the stock market exhibit an inverted U-shaped intraday pattern, the pattern of the deviation between futures and options markets is relatively flat. The deviations between the derivatives markets and the stock market are tied to trading activities in the same direction. When we identify regimes based on the difference between deviations in derivatives markets, defined as the relative deviation, the common deviation is significantly corrected only when the relative deviation is moderate. Although the stock market does not lead the derivatives markets when the relative deviation is mild, there is a bi-directional information flow between the derivatives markets and the stock market with extreme relative deviation. The result is still consistent in subsample analysis, though we find the informational effect of stocks becomes faint over time. A sudden change in the relative deviation is induced by options trading rather than futures trading.

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1. Introduction

It is difficult to accurately determine a "fair value" of spots implied by derivatives in practice, due to model specification errors. This problem has motivated academic researchers to utilize model-free approaches, which are implicit in arbitrage opportunities. If the payoff of an underlying asset can be reproduced with tradable derivative assets, the price of the underlying asset should match the price of the corresponding combination of derivatives. Thus, deviation can be clearly defined as a difference between the spot price and the price of a synthetic asset comprised of derivatives. Cornell and French (1983) examine the pricing of stock index futures based on the simple arbitrage model. Moreover, Figlewski (1989) considers mispricing in the options market related to an arbitrage strategy using continuous rebalancing. By using the most actively traded derivatives contracts in the markets—futures and options, investors can easily replicate the payoff of an underlying asset. The cost-of-carry model provides implied spot prices, which equal the discounted prices of corresponding futures. Similarly, the put–call parity relationship holds under the no-arbitrage assumption in a frictionless market (Stoll, 1969). Investors can mimic the payoff of an underlying asset using a portfolio of a long call option and a short put option both with identical strike price and expiration date and debt contracts. Several studies evaluate the features of deviations. For example, by observing the behavior of arbitrage in the S&P 500 futures and spot markets, MacKinlay and Ramaswamy (1988) show deviation increases with the time to expiration of futures. In addition, Brenner et al. (1989) identify undervaluation in the Nikkei Stock Average (NSA) futures market that may be partially attributable to trading restrictions and transaction costs. Furthermore, Chung (1991) uses the cost-of-carry model to test the efficiency of the index futures market. Finucane (1991) suggests a measure of the relative prices of call and put options regarding put–call parity and shows that the relative prices lead the stock market by 15 min.

From this point of view, price dynamics of underlying assets and derivatives should be closely related to deviation adjustments because trading activities occur when arbitrage opportunity exists. Consequently, deviation adjustments and price dynamics exhibit somewhat different patterns depending on various market conditions that affect trading activities and decisions. Previous research in this domain considers a number of factors to determine the nature of market conditions. Fleming et al. (1996) show that if transaction costs for derivatives are lower than that for spots, the derivatives market can lead the spot market. Jiang et al. (2001) examine the dynamics between the spot index and the index futures under three types of short-selling restrictions on stocks in Hong Kong. Pan and Poteshman (2006) examine the information content of the ratio of put option volume to call option volume as a means to forecast underlying stock price changes. Recent studies including Cremers and Weinbaum (2010), Deville and Riva (2007), Lien et al. (2013), and Lin et al. (2013) also point out that deviations and their effects on price dynamics become more important when there is high information risk and/or low market liquidity.

Besides other factors associated with price dynamics, the size of deviation in and of itself has been studied as an indicator of arbitrage opportunity. A deviation is significantly adjusted only if the size of deviation is sufficiently large to overcome effective transaction costs from underlying and derivatives markets (Chung, 1991; Fung and Mok, 2001). Several researchers use the threshold vector error correction model (TVECM) framework in this manner. Dwyer et al. (1996) show that a three-regime TVECM on S&P 500 futures and spots provide a better fit than a linear model, and that estimated thresholds are reasonably close to independent estimates of transaction costs. Using a TVECM with five regimes on S&P 500 futures and spot prices, Martens et al. (1998) show that (a) prices react more sensitively when mispricing is substantial, and (b) the effect of futures prices on spot prices is more substantial when the futures are underpriced. Using a three-regime TVECM, Kim et al. (2010) show that indices outside the no-arbitrage band have a mean-reversion property which leads them into the no-arbitrage band, but the series of indices and futures located within the no-arbitrage band are non-stationary. Theissen (2012) estimates a TVECM using mid-quote transaction price data in the German stock and futures markets, and finds that the futures market leads the spot market. However, most previous work using a TVECM is limited to exploring the relationships between two of three markets (i.e., futures, options, and stock markets). These studies do not consider these relationships simultaneously, despite the fact that they are mutually co-dependent and their intraday trades are closely related. Furthermore, they only focus on transaction costs and limit-to-arbitrage, not on other important factors such as market information or liquidity in derivatives markets.

In this study, we use intraday data of both KOSPI 200 futures and options, which are world-class derivative assets, to investigate deviations in the futures and options markets simultaneously. Through this analysis, we