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# Volatility Spillovers in the CSI300 Futures and Spot Markets in China: Empirical Study Based on Discrete Wavelet Transform and VAR-BEKK-bivariate GARCH Model

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## Abstract

China's introduction of CSI300 futures in 2010 has aroused widespread attention to whether the stock index futures market has effectively stabilized price fluctuations of its spot market in the past four years. Since the prices of CSI300 futures and CSI300 contain numerous noises and fluctuate drastically over time, this paper applies discrete wavelet transform to denoise these series by decomposing and reconstructing their return. Further, a VAR-BEKK-bivariate GARCH model is established to study the volatility spillover effects. Empirical results show that a bi-directional volatility spillover effect exists between CSI300 futures and the spot market, but the former affects the latter in a more obvious way. The introduction of CSI300 futures also contributes to the stabilization of the stock market.

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*Keywords:* CSI300 futures; discrete wavelet transform; volatility spillovers; VAR-BEKK-bivariate GARCH model

## 1. Introduction

On April 16th, 2010, China formally launched CSI300 futures, which symbolizes the introduction of a mechanism for short sales of stock, providing an efficient vehicle to disclose market information meanwhile. Theoretically, stock index futures have important functions including price discovery, volatility stabilization, hedging, etc., and serve as a burgeoning but efficient risk management tool. In practice, however, a mass of irrational speculative transactions does exist in the futures market, increasing the risk of short-term fluctuations in the spot market. Bad news magnified by the leverage effect also aggravates the potential jeopardy to the spot market. Thus, it has already become a hot spot in Chinese academy whether CSI300 stock index futures market,

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the "shadow market" of CSI300 stock index market, stabilizes the stock price around its real value, and what the dynamic relation between them is.

This paper chooses the CSI300 futures market and its spot market as subjects, trying to answer the following questions via empirical analysis: what is the volatility spillover relation between CSI300 futures and its spot market? How does information flows between them? Does the introduction of CSI300 futures contribute to its spot market's stability? Should these financial innovations be encouraged in the present Chinese financial market? Exploring these questions allows us to unravel the relationship between CSI300 futures and its stock market for financial regulatory departments and investors concerned, which also helps China's further development of the financial market.

## 2. Literature review

Most literature applied the GARCH family models to characterize price volatility in the stock index futures and its spot market. These models are known for their consideration in modelling volatility clustering and asymmetry that are typical of stock index and its futures prices. In studying the volatility spillover effect between the stock index futures and its spot market, most researchers agreed that the relation was generally bi-directional, but the direction of volatility spillover may vary with different countries, with well-developed financial markets' stock index futures playing a leading role in spill. Koutmos and Tucker (1996) [1] analysed daily S&P500 index futures and spot prices. They found that the futures' volatility led the spot for one day, and the spillover effect was asymmetric. Tse (1999) [2] analyses DJIA index futures and spot, suggesting bi-directional spillover effect in the two markets, with the future markets' spillover being more evident. Bhar (2001) [3] studied daily Australian stock index futures and spot data and suggested that markets utilized volatility spillover effect to transfer information. In China's academia, Liu et al. (2011) [4] analysed CSI300 and futures with a bivariate EGARCH model, finding that the volatility spillover effect is larger in the spot market than the futures market, and suggested that both good and bad news had leverage effect on market returns. Zhou Pu et al. (2013) [5] applied both linear and nonlinear Granger Causality Test, co-integration test and built a VECM model to analyse information spillover in the CSI300 futures and spot market, discovering only linear variance information spillover from the spot to futures, but remarkable nonlinear variance information spillover between them.

The majority of existing research utilized bivariate ECM-EGARCH model, but this model contains many parameters and may not guarantee the positive definiteness of its residual's variance-covariance matrix, which questioned the validity of the model. To solve this problem, Engle and Kroner (1995) [6] proposed a parametric model with positive definiteness restrictions, namely the BEKK-GARCH model, and thus offered an effective device for volatility modelling. This new type of GARCH is known for its ease in satisfying the positive definiteness of the variance-covariance matrix as well as its efficiency in reducing parameters for estimation. Compared to traditional GARCHs, the BEKK-GARCH has great advantage in analysing the volatility spillover effect of the stock index futures market. Thus in this paper, we utilize a VAR-BEKK-GARCH model to explore the volatility spillover effect between CSI300 stock index futures market and its spot market in China.

## 3. Data selection and discrete wavelet transform

### 3.1. Data selection

We choose the 1080 closing prices of CSI300 stock index and CSI300 stock index futures from April 16th, 2010 to September 25th, 2014 (Data sources: Wind Database). To avoid drastic fluctuations of financial prices series, we transform the prices into daily returns using logarithmic difference, namely  $R_t = 100 \times \log(P_t / P_{t-1})$ , and obtain 1079 return rates since CSI300 futures' introduction in China.

Figure 1 plots the return rates of CSI300 and CSI300 futures together. As the picture shows, CSI300 and its futures share much in common in both trend and volatility, and the volatility clusters in certain periods.

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