Empirical study of the functional changes in price discovery in the Brent crude oil market

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Abstract

Oil is an important source of energy and strategic materials. Understanding the function of price discovery in the futures market, the role of the futures market can be better played, and it is of great significance to ensure the security of energy supply. In this paper, the relationship between futures price and spot price is investigated by means of econometrics, to study price discovery modes on the futures market. The Brent crude oil (2007 to 2016) future price and spot price data were used in the study. It is found that, in GS, IS and PT models, the IS and PT model have their own advantages, which can be combined with two models to calculate the level of price discovery while the GS model is invalid. Comparing the price discovery level from 2007 to 2016, most of the price discovery of the oil futures market is higher. At the same time, the volatility of price is not the main reason behind price discovery. The main factors leading to the decrease of price discovery are the development of the macroeconomy and the degree of price volatility.

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1. Introduction

Oil is an important source of energy and strategic materials. In the long process of development and improvement, the oil market has formed a more mature spot market and futures market. Price discovery is an important function of

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the spot market, it means that the market has the ability to provide commodity price information. If the market is sufficiently mature, futures prices will be unbiased estimates of future spot prices.

From historical data, crude oil futures and spot prices usually have similar fluctuations, as shown in Figure 1 with the maturity of the underlying contract, futures prices will gradually move closer to the spot price. Using price discovery to estimate the spot price will greatly improve the accuracy; however, due to the volatile oil market, the level of price discovery is always changing. Especially in recent years, the sharp rise in oil prices greatly increased speculation and led to chaos in the crude oil market. Figure 1 shows the changes in the average and standard deviation of the futures and spot prices of Brent oil from 2007 to 2016. As seen in the figure, the standard deviation of the high stage respectively in 2008 and 2014 shows significant price fluctuations. In fact, the volatility of the price of oil in 2008 fell from $143 a barrel to $33 a barrel; oil prices fell from $115 to $55 per barrel in 2014. With such a significant change, is price discovery still able to be maintained at such a high level? This paper will study the dynamic effectiveness of the crude oil futures market, the function of the oil futures market price discovery investigation, analysis of factors affecting the function of price discovery, and the research is aimed at better playing the hedging function of the futures market, and achieved on the spot price trends by more accurate prediction.

![Average and standard deviation of Brent crude oil price](image)

**Fig. 1 Average and standard deviation of Brent crude oil price**

2. **Background**

The study about the market began with the exploration of its effectiveness. The concept of market effectiveness was first proposed by Gibson in 1889. It was until 1970 when Malkiel and Fama proposed the “effective market hypothesis” (EMH), that is: “A market in which prices always ‘fully reflect’ available information is called ‘efficient’.” [1]. Paul and Kimata explored the persistence and asymmetry of the impact of the US subprime mortgage crisis on the volatility of yield and price discovery. It supported the market efficiency hypothesis with the results of ARCH and GARCH [2]. Narayan et al. examine the long-run relationship between gold and oil markets which finds two markets are jointly inefficient [3].

The study of the effectiveness of the market starts from pricing and information efficiency. Price discovery is an important presentation of the effectiveness of the market. Holowczak et al. used value-based volatility and higher-order moments in the US stock and found that the price discovery of stock price mainly took place in the stock market [4]. Narayan et al. studied the impact of price discovery on asset pricing and used the forecasting regression model for predicting stock excess returns [5].

There are many ways to study price discovery, and the most common one is to use the GS model, IS method, and PT model. Garbade and Silber have developed a dynamic regression method for the GS model [6]. Oellermann et al. thought that, for cattle, the ratio was between 0.76 and 1.00 [7]. Schroeder and Goodwin proposed the GS model in merchandise for warehousing, and studied the change of price index in the live hog market [8]. Figuerola and Gonzalo used the GS model and the VECM model to obtain an equilibrium model among the spot price of commodities [9]. Zhang and Wang investigate the functions of price discovery in crude oil and gasoline futures markets and they find price discovery is effective in both crude and gasoline markets. [10].

IS (information share) models and PT (permanent-temporary) models are common methods used to study price discovery. Hasbrouck present a common measure method based on an implicit unobservable effective price for all
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