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Quantitative strategy for the Chinese commodity futures market based on a dynamic weighted money flow model

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HIGHLIGHTS

- A new dynamic weighted money flow model considering open interest is proposed.
- Analysis of money flow between sectors and correlation with future commodity futures prices.
- Evaluating the predictive ability of the money flow index by logistic model.
- The back-testing results exhibit very robust performance and excellent risk control ability.

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ABSTRACT

Due to the short mechanism of the commodity futures market, a dynamic weighted money flow model is proposed in this paper. The model proposed herein is based on the original money flow model but considers the impact of changes in both open interest and price on money flow. The proposed model aptly depicts the overall law of money flow in the Chinese commodity futures market. The results regarding correlation between current money flows and future futures prices show that there are 17 futures contracts with strong negative correlations and three futures contracts with strong positive correlations between 2011 and 2013. Then, the logistic regression, Bayesian discriminant, decision tree, random forest and support vector machine models are applied to validate the forecasting ability of the proposed money flow model with respect to price fluctuations. The average prediction accuracies of the above models exceed 55%, indicating that the money flow model proposed in this paper has a strong forecasting ability. Finally, a binary classification logistic regression strategy based on the dynamic weighted money flow model is established for back-testing and is compared to the double-moving average strategy and the buy-hold strategy. The back-testing results show that the cumulative annualized yield of the portfolio that uses the strategy proposed in this paper is 281.95%. Therefore, the proposed strategy is far superior to other strategies and exhibits better profitability.

1. Introduction

High-frequency trading is automatically executed by computer programs in minutes or even seconds. It has been a popular research field and has attracted the interest of many scholars [1–7]. However, due to the relatively recent establishment of the Chinese commodity futures market, studies of this market are relatively scarce. Therefore, it is crucial to establish a reasonable and accurate quantitative trading strategy suitable for the Chinese futures market. Such a strategy

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will not only help investors to diversify their investment risk but also assist the relevant regulatory agencies in monitoring the risks over time in order to avoid non-systematic risks.

Money flow is a mature technical index in the financial world. It reflects the market's current excess demand for or supply of a stock, which can help investors understand the behavior of other investors through price fluctuations [8]. Money flow can not only be used to measure the degree of excess supply and demand with respect to current risk assets (such as stocks and futures) for venture investors but can also provide investors with predictions of future excess supply and demand for risky assets. Therefore, it is extremely important to accurately measure the money flow index.

However, in the existing research, scholars mainly study the relationship between volume and price [9–17], and research on the relationship between money flow and stock price is relatively scant. The money flow index (MFI) was first proposed by Welles [18] and is used to measure the volatility of funds and the overall market. The theory holds that the market is in an overbought area when the MFI exceeds 80. In this case, the market may be reversed, and then stock should be sold. Likewise, the market is in an oversold zone when the MFI is less than 20; it may be reversed, and then stock should be purchased. In addition, there is no major trend in the market when the MFI is near 50. Existing studies focus mainly on the relationship between money flow and stock yield [19–25] and primarily consider the stock market. In the existing research on money flow in the stock market, the calculation of money flow is based on the fluctuation of transaction prices and the strength of buyers and sellers. In the stock market, money will flow out when the price falls and money will flow in when the price rises. However, there is a short mechanism in the futures market through which money may flow in or out when the futures contract price falls. Therefore, the formula for money flow in the stock market is not suitable for describing the behavior of the futures market. It is thus important to establish a set of money flow models suitable for the futures market.

In the futures market, the increase and decrease of open interest may affect the inflow and outflow of money, which is an important impact factor in the direction of money flow. Therefore, in this paper, open interest is innovatively introduced when calculating money flow and the dynamic weighted money flow model is established. In addition, the money flow model established in this paper is applied to the analysis of the Chinese commodity futures market. Then, a quantitative trading strategy based on the dynamic weighted money flow model is developed.

The remainder of the paper is organized as follows. Section 2 gives a brief introduction of the methods used. The empirical analysis and results are described in Section 3. Section 4 states the conclusions.

2. Methodology

2.1. The dynamic weighted money flow model

In research on stock markets, Olaison [21] defines the formula for money flow as

$$MoneyFlow = \sum_{i}^{n} \left(\frac{P_i \cdot P_{i-1}}{|P_i - P_{i-1}|} \right) \times V_i \times \left(\frac{P_i - P_{i-1}}{P_{i-1}} \right) \tag{1}$$

However, due to the short position in the futures market, changes in money flow and price are not simple one-way relationships. That is, the direction of money flow is uncertain when prices rise and fall. Therefore, the money flow defined by formula (1) cannot characterize the real law of money flow for futures contracts. In the futures market, funds are likely to flow into the market when open interest increases and to flow out of the market when open interest decreases. Therefore, an analysis of changes in open interest can be used to predict changes in funds in the futures market, which helps investors to determine the direction of the next price fluctuation. Moreover, we consider the impact of price and open interest on money flow. Open interest is regarded as an important factor and thus is introduced to establish the formula for money flow in the futures market. Money flow of the commodity futures market is defined as follows:

$$\begin{aligned} MoneyFlow &= \textstyle\sum_i^n V_i \times P_i \times sgn\left(\alpha_i \times \frac{P_i - P_{i-1}}{|P_i - P_{i-1}|} + \beta_i \times \frac{I_i - I_{i-1}}{|I_i - I_{i-1}|}\right) \\ \alpha_i &= \frac{|P_i - P_{i-1}|' + \varepsilon}{|P_i - P_{i-1}|' + |I_i - I_{i-1}|' + 2\varepsilon} \\ \beta_i &= \frac{|I_i - I_{i-1}|' + \varepsilon}{|P_i - P_{i-1}|' + |I_i - I_{i-1}|' + 2\varepsilon} \end{aligned} \tag{2}$$

where P_i represents transaction price at time i, I_i is open interest at time i, V_i is volume at time i, and $|P_i - P_{i-1}|'$ $|I_i - I_{i-1}|'$ are variables of 0–1 normalization of $|P_i - P_{i-1}|$ and $|I_i - I_{i-1}|$, respectively. Furthermore, α_i is the weight of the change in transaction price at the moment of i, β_i is the weight of the change in open interest at time i, and ε is an infinitely small amount that is greater than zero. Finally, for the money flow formula in the commodity futures market, the symbolic function $sgn(x)$ is defined as follows:

$$sgn(x) = \begin{cases} -1 : x < 0 \\ 0 : x = 0 \\ 1 : x > 0 \end{cases} \tag{3}$$

To eliminate the impact of dimensions and more effectively reflect the impact of price and open interest on money flow, $|P_i - P_{i-1}|$ and $|I_i - I_{i-1}|$ are standardized when calculating the weight according to formula (2). The normalization processes