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Applying market profile theory to forecast Taiwan Index Futures market

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ABSTRACT

This research applies a market profile to establish an indicator to classify the correlation between the variation in price and value with the stock trends. The indicator and technical index are neural network architecture parameters that assist to extrapolate the market logic and knowledge rules that influence the TAIEX futures market structure via an integral assessment of physical quantities.

To implement the theory of market profile on neural network architecture, this study proposes qualitative and quantitative methods to compute a market profile indicator. In addition, the indicator considers the variation and relevance between long-term and short-term trends by incorporating the long-term and short-term change in market in its calculation. An assessment of forecasting performance on different calculation approaches of market profile indicator and technical analysis is conducted to differentiate their accuracies and profitability.

The experimental results show the qualitative market profile indicator outperforms the quantitative approach in a short-term forecast period. In contrast, the quantitative market profile indicator has a better trend-predicting ability, thus it is more effective in the long-term forecast period. The integration of market profile and technical analysis surpasses technical analysis as a neural network architecture parameter by effectively improving forecasting performance and profitability.

1. Introduction

The Taiwan Futures Exchange (TAIFEX) was established in September 1997. The Taiwan Weighted Stock Index Futures (TAIEX futures) was launched in July 1998, and declared the official start of Taiwan's futures market. A number of commodity futures electronic futures, financial futures, small TAIEX Futures were launched over a ten year period. Investors can select the appropriate investment vehicles depending on the degree of risk. Futures accounts are growing year by year. The futures market has tended to improve, becoming an important hedging and arbitrage method for Taiwan stock market investors with tools.

However, the futures market has become increasingly volatile, with the legal entity participation in the futures market gradually increased (Lien, Lim, Yang, & Zhou, 2013). In addition, the financial tsunami of capital withdrawals during share transactions increasing year by year, has become the main force leading the Taiwan stock market ups and downs. Studies have shown that, in the Taiwan stock market, the average retail investor withstands losses of about 3.5% per year, with corporate investors, due to rare information and chip advantages, can obtain a 1% after-tax return (Barber, Lee, Liu, & Odean, 2004). Yu and Huarng (2008) proved fuzzy time series models can forecast TAIEX futures markets (Yu & Huarng, 2008).

Steidlmayer (1984) proposed the market profile theory; refute the efficient market and random walk theory (Steidlmayer, 1984). At different time intervals, participants in different prices bid passive or active, leading to price movement rather than random development. Different participants have different thoughts and behavior preferences for the same price, so the market cannot meet the needs of each participant, without any prices representing fair value. In other words, the market is not efficient. Steidlmayer also pointed out that the risk and reward in the market is not a linear relationship (Roll, Schwartz, & Subrahmanyam, 2007). The asymmetric opportunities, irrational human investment behavior cause market fluctuations through an understanding of long-term (artificial person) and short-term (retail investors) market behavior and logic is able to predict changes in the market structure to reduce investment risk.

In the face of these non-linear problems, artificial intelligence (AI) methods learn the knowledge (Lin, Hu, & Tsai, 2012; Won, Kim, & Bae, 2012) and rules that can be effective in predicting an environment of uncertainty without the need to rely on subjective judgment is better than the traditional model (Desai, Desai, Joshi, Juneja, & Dave, 2011; Roon, de Nijman, & Veld, 2000). The neural

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network (NN) deals with knowledge problems as a forecasting tool (Esichaikul & Srithongnopawong, 2010; Kaastra & Boyd, 1995). The NN through self-learning creates learning through repeated historical data (Gregoriou, Healy, & Ioannidis, 2007; Ntungo & Boyd, 1998), establishing a non-linear prediction model (Yoon & Swales, 1991).

The market profile concept has been widely used in the financial decision-making field (Canoles, Thompson, Irwin, & France, 1998); however, there has been little direct research (Dalton, Dalton, & Jones, 2007). Therefore, this study used the market profile principle and technical analysis (Taylor & Allen, 1992), as back-propagation neural network (BPNN) input variables. A better model than the old learning model is constructed using only the technical analysis and a new research model to explore the market logic and knowledge rules (Edwards & Magee, 1997).

The market contour theory with technical analysis is extracted from the relationship between price and value using the NN knowledge of rule changes learning using the market logic and market structure (Grudnitski & Osburn, 1993). How the market profile is used as the BPNN input variables is the focus of this study. The experimental design involved observed the market profile information. The impact on the future Taiwan stock market trend, to further assess and validate the predictive ability of the different intervals, to provide an innovative investment tools for investors and future researchers as a reference.

2. Methodology

2.1. Research design

The TAIEX futures' tick data used the Windows Mobile cut five minutes of the K-bar. The K-bar used the opening price, high price, closing price and low price, as calculated BPNN input variables of the original value. The original value is then calculated and the item pre-treatment in order to determine technical analysis and market profile indicators.

In the control group model the MACD and KD of the technical indicators are used as the NN input variables. In order to compare the market profile model prediction mechanism, its performance is superior to the only technical indicators as the input value of the mechanism. The input variables of the experimental group are used to consider the technical indicators and market profile indicators.

Based on the market profile theory (Dalton et al., 2007), this study proposes a qualitative and quantitative market profile index calculation method. The range of values and price trends in the relationship between variables are examined for advantages and disadvantages. To investigate the stock price at the same time "long-term protection of the short-term, short-term support for long-term" benefits, as the market profile indicators calculated on a long-term basis (the market change on 75 min ago). The prediction effect is better than simply using the long-term market profile model. Therefore, the experimental group was calculated according to different market profile and divided into four groups:

- Experimental Group A (EG A): The market profile indicators to calculate the long-term (75 min) qualitatively market profile.
- Experimental Group B (EG B): The market profile indicators to calculate the long-term (75 min) quantitative market profile.
- Experimental Group C (EG C): The market profile indicators to calculate the long-term (75 min) and short-term (15 min) qualitatively market profile.
- Experimental Group D (EG D): The market profile indicators to calculate the long-term (75 min) and short-term (15 min) quantitative market profile.

2.2. Subjects

The subject of this study is the TAIEX Futures. The data source is the TAIEX days Tick transaction data provided by the Taiwan Futures Exchange, including trading hours, the transaction price, number of transactions and information.

Experimental samples during the study period from August 10, 2009 to 2010. Screening and pre-processing a total of 48,080 pen five minutes of trading information, data, contains the opening price, closing price, highest price, lowest price.

During the experiment and verification inverted propagation neural network (Watanabe & Iwata, 2009), the information should be divided into training and testing during the training period for the conduct of online learning, according to Kearns (1996) described the input data to 80% training period, 20% for the test period split for the ideal proportion (Kearns, 1996).

2.3. Data collection procedure

Data pre-processing, the first Windows Mobile the TAIEX days tick transaction information, cutting the required five minutes of data were calculated, and five minutes of data output and input variables. The input variables were used to calculate the technical indicators and market profile indicator values. Numerical regularization was used to avoid uneven numerical distribution.

The output variable reward punishment mechanism is used to calculate the relative change range and grouping. The input and output variables are then input into the back-propagation neural network to learn and predict the results (Kimoto, Asakawa, Yoda, & Takeoka, 1990).

2.4. Windows mobile cutting

TAIEX futures tick data use to move the window to be cut, calculating the required 5 min of data, and cutting shown in Fig. 1.

Therefore, every five minutes of the opening price, closing price, highest price, lowest, opening tick transaction price is the point in time $t-5$, the closing price for the time point t tick transaction price and the highest price and the lowest that the computation time point $t-5$ to t transaction price between the maximum and minimum values.

2.5. Calculate the input variables

2.5.1. Moving average convergence divergence (MACD)

This MACD indicator indicates the big band trend. DIF said that the amount of a small band of fluctuation. If the market shows an upward trend, the deviation in the line speed is gradually expanded, while the MACD is still moving along the trend, resulting DIF and MACD cross situation, namely buy signal; contrary can sell signal. Using the following formula:

$$\mathrm{EMA}(m)_i = \mathrm{EMA}(m)_{i-1} + \alpha_m \times (\mathrm{C}_i - \mathrm{EMA}(m)_{i-1}) \quad (1)$$

$$\mathrm{EMA}(n)_i = \mathrm{EMA}(n)_{i-1} + \alpha_n \times (\mathrm{C}_i - \mathrm{EMA}(n)_{i-1}) \quad (2)$$

$\mathrm{EMA}(m)_i$: The i day's long term EMA value

$\mathrm{EMA}(n)_i$: The i day's medium term EMA value

C_i : The i day's closing price

$$\alpha_m = \frac{2}{1+m}; \quad \alpha_n = \frac{2}{1+n} \quad (3)$$

$$\mathrm{DIF}_i = \mathrm{EMA}(n)_i - \mathrm{EMA}(m)_i$$