

Analyzing Market Trends using a Visual Approach

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Abstract: - This research discusses various technical analysis methods and their flaws in the stock market price trend, and proposes a plan that integrates several technical indicators to analyze the price trend. Changes in price trends are mainly due to market uncertainty about the future. The macro investment sentiment is crucial to the impact of price trends. Any political and financial decision-making changes or events can affect the market's investment sentiment. Changes in securities market prices usually have a direct response to changes in the macro investment environment. A single technical indicator captures this change. But when multiple technical indicators are used, there is the potential for conflicting signals. Investors can judge future trends based on their familiarity with the market or experience. For resolving the conflict of technical indicator signals and managing future uncertainty, this study uses information entropy theory as an algorithm for integrating technical indicators and then forms an easy-to-read price trend chart. The K-line chart with various color changes provides a visual price trend judgment to facilitate investors to make decisions. This study uses several exponential moving averages as the main component indicators of price information entropy to test the Dow Jones futures and many individual stock research objects. The emphasis of this study is not on finding indicators that are 100% profitable, but on the management of market uncertainty. The liquidity of investment products is very important, and sufficient liquidity is needed to accurately judge the trend. When the price trend is uncertain, the K-line chart designed in this study is displayed in different colors, and investors can directly observe whether they can enter the market for trading. The timing of entry and exit proposed in this study is entirely based on the certainty of the trend. In the verification, strictly observe the timing of entering and exiting the investment strategy, and only enter the market when you are sure of the trend, so that the investment profit is significant. This study verifies the practicability of this method with past historical data.

Keywords: - Price trend, Technical indicators, Information entropy theory, K-line chart.

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1 Introduction

The methods of stock market price trend can be divided into fundamental analysis and technical analysis. Fundamental analysis focuses on the company's operating conditions and financial data, while technical analysis focuses on current price trends and uses various technical indicators as analysis methods. Due to the often incomplete expected cycle of price action changes, a single technical indicator fails. The analysis method must use several indicators at the same time to make more accurate predictions. When a variety of indicators are used together, it is easy to cause contradictions in the analysis results. This study argues that a simple and easy-to-read single decision indicator should be established to avoid this phenomenon. The method of technical analysis is mainly to generate some indicators and trend patterns of stock prices, such as RSI, KD, MACD, etc. Then make an analysis based on such indicators

for investment. Due to the variety of indicators in technical analysis, some methods use a single indicator as a strategy, and some use multiple indicators to analyze at the same time as an investment strategy. When multiple indicators are used together, visual confusion can easily occur. The purpose of this research is to simplify the way of technical analysis and to generate an easy-to-read visual chart by synthesizing multiple indicators. The basic thinking is similar to the blackjack poker calculation method [4], which calculates the best entry opportunity to invest, makes a profit in the proportion of the final winning rate, and does not pursue success every time. The method used is to use information entropy theory [2] to summarize several technical indicators and patterns into one, and then generate trend graphs for investors to make trading decisions.

2 Literature Survey

Technical analysis can be roughly divided into four categories, trend indicators, momentum indicators, volatility indicators, and volume indicators. Among them, Moving Average, MACD, and RSI are the most commonly used. Combining volume and other indicators at the same time, the Volume Weighted Average Price Indicator is also often used.

2.1 Moving Average

Well-known mathematician ED Throp, Patterson [17] used the Moving Average method to successfully make profits in the US stock market in the early 1950s. Moving average is to calculate the average price for some time. ED Throp uses this average price as an investment indicator. When the price rises above the average price, it buys, and when it is lower than the average price, it sells. The way to improve is to use two average price lines to analyze, short-term and long-term. But when the short-term average price line rises above the long-term average price line. Conversely, sell when the average price line falls below. In this way, there will still be frequent transactions during the price consolidation phase. When this happens, the analysis of average prices fails [9].

2.2 MACD

Moving Average Convergence Divergence was proposed by Gerald [1], and its method is to calculate the difference between the short-term and long-term average prices to measure the price trend. A difference below zero indicates a downward trend, and a difference greater than zero indicates an upward trend [5]. Since the calculation is based on the average price, this indicator will lag.

2.3 RSI

The scholar J. Welles Wilder (1978) proposed the RSI indicator in 1978, the Relative Strength Index, which is a momentum-based indicator. It mainly calculates the magnitude and rate of price changes. This indicator is often used to assess oversold and overbought price movements [6]. The value of RSI ranges from 0 to 100. When the RSI exceeds 80, it indicates that the price rises too fast and maybe overbought. The most likely follow-on reaction to overbought is a fall in price. When the RSI is too low, such as below 25, it will be oversold, and the subsequent price trend may rebound at any time.

2.4 Volume Weighted Average Price Indicator (VWAP)

Volume as a measure of price trends was first proposed by Osborne [14]. Osborne built a mathematical model to analyze the correlation between price action and volume. In his research, he found a statistically significant correlation between volume and price period changes. The average experienced investor must have noticed that when the price plummets, there will be a last large volume of instantaneous decline. After that, the price will see a situation where the price is hovering around the low price. This phenomenon usually occurs in a market where the overall average trading volume is relatively fixed. Scholars Li and Zhu (2014) studied the efficiency of a volume-weighted average price indicator. Its research found that including volume in trend analysis can improve the efficiency of forecasting.

3 Research Method

3.1 Market Uncertainty

In general, when people feel uncertain about the future of something, they feel uneasy or hesitant to move forward. In the stock market, investors react similarly to uncertain events. For example, when the U.S. Federal Reserve talks about increasing the base rate for borrowing, the stock market's first reaction is usually a decline or stagflation. One of the uncertainties is that the market cannot predict how much the US Federal Reserve will raise interest rates in the future. But when the decision is officially announced, the stock market sometimes rises instead because the uncertainty has been lifted. For example, on March 16, 2022, the U.S. Federal Reserve raised interest rates by 25 basis points, and the three major U.S. indexes all rose sharply the next day. In the operation of stock trading, people's reaction to future uncertainty can make definite speculation on investment decisions, that is, the market will fall or stagnate, or even fluctuate violently, which is not conducive to investment. When uncertainty turns to certainty, people's reactions change with it. This could be seen as a turning point in the stock market's reaction. If you can grasp the turning points of the stock market, the success rate of buying and selling decisions will also be relatively improved.

3.2 Measuring Uncertainty

The difficulty in analyzing price trends is that the influence of external factors leads to uncertainty in

future prices. By grasping the turning point of uncertainty, you can grasp the future trend. However, there is no technical indicator that can fully predict future price movements. When using various technical indicators, the phenomenon of conflicting indicator signals often occurs. When indicators conflict, how to make a decision becomes an investment strategy issue. If such uncertainty can be represented by quantifiable data, the situation of index conflict can be quantified as data. Investment strategies can then make decisions based on this data.

The method used in this study to quantify uncertainty refers to Shannon's information entropy theory [2]. Information entropy is used to quantify the uncertainty of text transmission during communication. The method is, to sum up, all possible situations probabilistically to get a value. Higher numbers indicate higher uncertainty. The basic concept of information entropy believes that the role of information is to eliminate people's uncertainty about things. When a message has a higher probability of appearing, it means that it is more widely spread. From the perspective of the breadth of information dissemination, information entropy can represent the value of information. The calculation method of information entropy is as follows:

$$H(X) = -\sum_{i=1}^n P(x_i) \log P(x_i) \quad (1)$$

x represents a random factor, and $P(x)$ represents the output probability function

Assuming that there are n observed events, the probability of occurrence is P_1, P_2, \dots, P_n , the probability combination can be written as (P_1, P_2, \dots, P_n) , then according to the above formula, the uncertain value is $H(P_1, P_2, \dots, P_n)$

In this study, the uncertainty of the price trend takes the prediction of future trends of technical indicators as a random factor, and the sum of several technical indicators is used as the value of information entropy, which is defined as price information entropy. Each of these technical indicators predicts that the probability of rising is regarded as an event in the price information entropy formula. The formula for price information entropy is as follows:

$$H(X) = \sum_{i=1}^n P(x_i) \quad (2)$$

$$\text{Where } P(X) = a(x - 50)^2 + k \quad (3)$$

$P(X)$ is the price information entropy value of an event, x is the probability of event occurrence, a is

the rate of change of price information entropy, and k is the minimum price information entropy. When x is closer to 50, that is, when the probability of event occurrence is close to 50%, the value of price information entropy is lower. When the price information entropy value is lower, it means that the uncertainty is high, which means that it is not suitable for any investment behavior. For example, three indicators are used to make predictions. At time A, the calculated rise probability of each indicator is 50%, 60%, and 50%. At time B, the calculated ascent probabilities are 40%, 70%, and 65%. The entropy value calculated at time A will be lower than that at time B, indicating that the price trend at time A has high uncertainty and is not suitable for any operation.

3.3 Research Methods

This study is divided into three steps:

- (1) Select appropriate technical indicators and establish a price information entropy calculation model.
- (2) Design visual graphics to show price trends.
- (3) Test the price information entropy calculation model with the actual market price trend.

The main research object is the US Dow Jones futures index.

Screening of technical analysis indicators:

In simple terms, price information entropy is a way of making decision-making judgments by combining multiple indicators into one value. Any technical indicator can be used as one of the factors of judgment, and this method also provides decision-making flexibility. Investors can set it in the calculation formula of price information entropy according to their familiarity with various technical indicators.

Embedded Cycle:

Based on the historical data of market price changes for many years, the results of induction and analysis of this research show that the trend-type technical indicators are the most suitable for trend analysis and forecasting. Such indicators are directly related to the average value of the price. By analyzing the way of Exponential Moving Average (EMA), a natural law phenomenon of price trend can be obtained. The price of a product is analyzed by 4 exponential moving averages with values of 24, 60, 120, and 240. When the exponential moving average of 24 falls below the exponential moving average of 60, the price action begins to decline. When the price bounces up to meet the exponential moving average near 60, this price becomes the

upward resistance and the price will fall again. Exponential moving averages of 120, and exponential moving averages of 240 also show such price movements. This kind of price change trend is suitable for the K-line chart drawn in any period, 1 minute, 3 minutes, 5 minutes, 30 minutes, 1 hour, 4 hours, daily chart, etc., and similar trend phenomena can be obtained. That is, the price trend phenomenon can be observed in the K-line chart at any time. This study calls it the Embedded Cycle.

This phenomenon also provides the basis for the observation of uncertainty and certainty in this study. From the K-line chart of a longer period, the certainty of the price increase is judged according to the price resistance and support area of this group of moving averages and then subdivided into the price trend of the K-line chart of a shorter period. For example, in the 4-hour chart, the trend is down, if the hourly chart is used for operations, the 4-hour trend can be used as a judging factor for the price information entropy.

3.4 Judgment of Uncertainty

There are various analytical methods for judging price movements, this study focuses on the exponential moving average method [3]. Repeated analysis of historical data found that when the price entered between several exponential moving averages, the trend immediately became unclear. When the price enters between the two exponential moving averages, the trend is very likely to be range-bound and uncertainty increases.

3.5 Visual Presentation Method

In this study, K-line charts with different colors are used to display the numerical range of price information entropy [7]. Figure 1 4-hour K-line chart of the US Dow Jones futures index in February 2020, the numerical information of the price information entropy is displayed below the figure. The red line represents the decline, the green line represents the increase, and the other colors represent high uncertainty and are not suitable for trading. The value and color of the price information entropy are set as rising and falling. The rising price information entropy color ranges from dark green to light green, with dark colors indicating low and light colors indicating high. The price information entropy color of the downward trend is from light red to dark red, with light color indicating low and dark color indicating high. Arrows indicate price trend turning points. The downward arrow indicates that the trend is very likely to decline. On the

contrary, the upward arrow indicates that the trend is very likely to rise. [11]

In this study, candlesticks that are in a downtrend are shown in red. Among them, red and pink are negative lines, and orange is positive lines. Although the positive line is rising, according to the judgment of price information entropy, the probability of rising is less than 40%, so it is displayed by the orange Kline [12]. The K-lines that is in an uptrend are shown in green. Among them, dark green, light green, and apple green are positive lines, and blue is negative lines. The negative line is down. According to the judgment of price information entropy, the probability of downside is less than 40%, so it is displayed by the blue Kline.

The color bar below the candlestick chart shows the change in long-term price information entropy. The long-term judgment is the price change of the last 240 K-lines. Red represents a long-term downtrend, and blue represents a rebound in a downtrend. Green represents a long-term uptrend, and pink represents profit-taking on an uptrend [8].



Fig. 1: 4-hour K-line chart of the US Dow Jones futures index in February 2020

4 Validation of Research Methods

No single indicator or investment strategy can be 100% accurate in predicting stock market price movements. Rather than seeking 100 percent forecasts, the approach of this research focuses on managing uncertainty and planning investment strategies to deal with it. Uncertainties include actual trends in the stock market and macroeconomic sentiment. When the market feels uncertain about the future, investment judgment becomes a definite factor that affects price trends, namely stagflation or decline [10]. This chapter discusses the utility of price information entropy. The investment strategy is as follows:

- (1) Only enter the market when a turning signal appears.
- (2) Follow the long-term price information entropy data as the main, supplemented by the short-term price information entropy.
- (3) According to the macroeconomic climate, the long-term information entropy is used as the actual

reaction of the market to the investment climate, rather than the subjective psychological impact of economic events.

Investment methods:

Investment methods are divided into long and short. Going long means buying, if the index rises, it will make a profit, and if it falls, it will make a loss. Conversely, shorting means buying, if the index falls, it will make a profit, and if it rises, it will make a loss. [13]

Time of entry:

Observe the color change of the K-line chart, the K-bar, and the long-term price information entropy below

Go long: When the upward arrow at the turning point appears, the K bar shows apple green and the long-term price information entropy below is green.

Go short: When the downward arrow of the turning point appears, the K bar is red and the long-term price information entropy below is red.

Time to play:

Go long: The K bar appears 2 consecutive blues or the second blue appears, or a red K bar appears.

Going short: The K bar appears 2 consecutive oranges or oranges for the second time or a green K bar appears.

Main research object:

4-hour chart of the US Dow Jones futures index.

4.1 US Subprime Mortgage Crisis

Time: July 2007

Event point

July 27: Global stock markets plummeted for the first time due to the U.S. subprime mortgage crisis.



Fig. 2: US subprime mortgage crisis July 2007 US subprime mortgage crisis Dow Jones futures chart

4.2 The U.S. Subprime Mortgage Crisis Expands

Date: February 2008

Event point

Feb. 12: Big six U.S. mortgage lenders announce lifeline plan

March 6: U.S. ADP payrolls plummet by more than 20,000 in February

March 19: The Fed announces a 75 basis point rate cut.



Fig. 3: The U.S. subprime mortgage crisis expanded in February and March 2008. The Dow Jones futures index chart

4.3 Lehman Brothers goes bankrupt

Time: September-October 2008

Event point

September 15: Lehman Brothers files for bankruptcy protection

September 29: The U.S. House of Representatives rejects the \$700 billion rescue plan

October 2: Rescue plan passed

October 8: The U.S. Federal Reserve announces a 50 basis point rate cut.



Fig. 4: Dow Jones futures chart in September 2008 after Lehman Brothers went bankrupt

4.4 US President Trump Inauguration Month

Time: January 2017

Event description:

In November 2016, President Trump was elected. The U.S. stock market surged until the Dow rose to an all-time high of nearly 20,000 in January of the following year. Psychological pressure is formed here, and the stock market stagnates but does not fall. At the same time, the U.S. federal government

was shut down for several days due to budget problems. Until January 25, 2017, US President Trump signed a temporary appropriation bill to allow the US federal government, which had been shut down for 35 days, to resume operations until February 15.



Fig. 5: The Dow Jones Futures Chart in January 2017, the month of US President Trump's inauguration

4.5 Covid-19 New Corona-virus Outbreak

Timepoint: January-February 2020

Event point

January 23: Covid-19 outbreak, lockdown in mainland China

February 23: Cases surge in Europe



Fig. 6: Trend chart of the Dow Jones futures index from January to February 2020 due to the new Corona-virus epidemic

4.6 US Fed Rate Hike Expectations and the Russian-Ukrainian War

Time: January-February 2022

Event description:

On December 15, 2021, the U.S. Federal Reserve announced that it will keep interest rates unchanged, and it is expected to end bond purchases as early as March 2022. From January 2022, the US Federal Reserve officials believe that inflation is not temporary, leading to a change in market sentiment,

and it is expected that interest rates will be raised more than three times in 2022. Uncertainty emerged in the market, speculation about the rate hike in 2022 began, and stock market prices began to fall. On January 26, the U.S. Federal Reserve announced no change in interest rates. On February 14, U.S. intelligence officials informed that Russia would invade Ukraine on February 16. On February 24, Russia announced a special military operation against Ukraine.



Fig. 7: The Dow Jones Futures Index Trend Chart in January-February 2022 for the US Federal Reserve to Raise Interest Rate Expectations and the Russian-Ukrainian War.

4.7 Stock Operation Strategy

Operating period: daily chart of individual stocks. From April 1, 2021, to March 11, 2022.

Trend judgment: Observe the color change of the long-term price information entropy below. Green represents an uptrend and red represents a downtrend. In an uptrend, pink represents a profit-taking phase. In a downtrend, blue represents the price rally phase. [15]

How it works: Go long.

When to enter the market: when the long-term price information entropy below is in an upward trend. The green K-stick comes into play. The rebound trend of the downtrend does not enter the market.

Timing of appearance: When the red K-stick appears.

Re-entry timing: After the red K-bar appears, you need to observe the trend, and not enter the market immediately when the color of the next long-term price information entropy turns green. Wait for the market to absorb selling pressure and remove market uncertainty before entering the market.

Individual stock research objects: Apple (AAPL), Microsoft (MSFT), Nvidia (NVDA), Facebook (FB), Google (Google), Tesla (TSLA),

The display method of buying and selling: In the K-line chart, the orange arrow indicates the buying point, and the horizontal line indicates the selling point. Losing trades show losses or flats at the end of the arrow. [16]



Fig. 8: Apple (AAPL)



Fig. 9: Microsoft (MSFT)



Fig. 10: Nvidia (NVDA)



Fig. 11: Facebook (FB)



Fig. 12: Google (Google)



Fig. 13: Tesla (TSLA)

4.8 Analysis of Verification Results

This section uses several exponential moving averages and filtered average prices as the main components of price information entropy to test several individual stock trends. Overall, the investment strategy is appropriate. All products have made significant profits. Because this research adopts the most conservative investment strategy, that is, when the trend weakens, stop loss immediately and complete other trend-turning signals before entering the market, which can avoid high-risk situations.

This section uses several exponential moving averages as the main component indicators of price information entropy to test the Dow Jones futures. The emphasis of this study is not on finding indicators that are 100% profitable, but on the management of market uncertainty. The liquidity of investment products is very important, and sufficient liquidity is needed to accurately judge the trend. When the price trend is uncertain, the K-line chart designed in this study is displayed in different colors, and investors can directly observe whether they can enter the market for trading. The timing of entry and exit proposed in this study is entirely based on the certainty of the trend. In the verification, strictly observe the timing of entering

and exiting the investment strategy, and only enter the market when you are sure of the trend, so that the investment profit is significant. There are various methods of technical analysis, which can be judged according to the trend pattern and can also be integrated with several technical indicators to design investment strategies. As long as you can use these indicators to find out when the trend is uncertain and avoid investing in the market, you can reduce losses and increase profit opportunities.

5 Conclusion

This study discusses the technical analysis method of the price trend of the securities market. Changes in price trends are mainly due to uncertainty about the future of the market. The macro investment climate is crucial to the impact of price trends. Any kind of political or financial decision-making change or event can affect the market's investment sentiment. Changes in securities market prices usually have a direct response to changes in the macro investment environment. The three theoretical bases of technical analysis are that market prices have fully reflected the status quo, prices have moved according to a trend, and history will repeat itself. These three points are also the research basis of this study, which is based on observing the market price's response to macroeconomic events and managing the uncertainty of price trends to achieve judgments on price trends. This study uses the information entropy theory as the basic basis for the fusion of technical indicators to quantify the uncertainty of prices. The value of price information entropy is based on the long-term and short-term exponential moving average price of the market price as the main judgment indicator and sets its value in combination with other indicators mainly based on average price. Colors are mainly divided into red series and green series. Based on this K-line color change, investors are given an easy-to-understand investment decision-making method.

Validating the method proposed in this study from past historical data yields positive results. This research analyzes the changes in the past six important macro-investment environments and uses the trend of the Dow Jones futures index to verify. During this period, the investment strategies of this study can be very profitable. The index composition of the price information entropy proposed in this study can be changed at any time according to investors' familiarity with technical indicators, to adapt to the changes in the public's investment

psychology in the future. The emphasis of this study is not on finding a 100 percent profitable model, but on building a model that can manage market uncertainty. Various possibilities for future market changes are based on this model. The logical analysis model of price information entropy, from the verification of this study, can provide investors closer to realizing wealth freedom.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

-Hsueh-Ying Wu carried out the simulation and the optimization.

-Jih-Lian Ha has organized and executed the experiments of Section 4.

-Shu-Wen Lei was responsible for the Statistics.

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