The Reliable Integrated Decision for Stock Price by Multilayer Integration Time-series of Coverage Reasonability

Chun-Min Hung and Chun-Wu Yeh*

Abstract—**Owing to globalization, financial operations are not local but comprehensive to all the countries in the world. In stock markets, many policies such as price limits are made to intervene between the financial operations so that a volatility of stock prices is more uncertain than one without disturbance. It is difficult for investors to buy or sell stocks when technical indicators are inconsistent or the information is in time. Lack of research seeks for reasonability of the volatility that is tracking asymptotic trend in different time periods. Therefore, this study brings up a concept of multilayer time periods and presents a Trend Tracking based on Coverage Reasonability method (TTCR) for stock markets based on a α / β waveform constructed by investors' greed and fear. An obvious feature of the proposed model is to decide a runaway gap in one wave band of price.**

Keyword: Trend Tracking; Trend and Potency Method; Coverage Reasonability

Introduction

Owing to globalization, the financial operation is not local but comprehensive to all the countries in the world. In addition, the speed of cash flow is so fast that it is not an easy task to handle financial conditions. It is noteworthy that the loss of financial issues is quite astonishing during the great depression. The conditions of global stock markets, especially, are much different from those in the past due to financial crisis. For stabilizing financial markets, many governments around the world regulate some policies to control such a dynamic environment. One of the familiar policies is a price limit mechanism. The stock price limits are artificial boundaries set by market governors to control daily movements of security prices. Price limits are currently utilized in many stock exchanges worldwide including: Austria, Belgium, France, Italy, Japan, Korea, Malaysia, Mexico, Netherlands, Spain, Switzerland, Taiwan, and Thailand [1]. Hence, price limit mechanisms indeed affect a substantial portion of capital markets around the world. Interestingly, very little research is focus on price limit effects in spite of their significant presence. References [2]-[4] pointed out reasonable sample sizes are difficult to obtain. In addition, there are still many unanswered questions regarding price limit mechanisms. Harris (1998) stated that this ignorance is a pity that we need to make proper decisions concerning how to protect markets. In this paper, we attempt to present a novel concept on how to make a proper decision (buy/sell) by investigating stock markets where price limits are systematically imposed and regularly used in the Taiwan Stock Exchange [5]. In Taiwan, the policy of stock market regulates a 7% limit of stock price fluctuation, especially. The stock price, therefore, will not reflect bearish information at a time and will display the asymptotic behavior [6]. Under the condition of asymptotic behavior of stock prices and 7% price limits, it is difficult for investors to buy or sell stocks without the reliable and robust integrated decisions at hand [5]. Furthermore, Chang and Fan (2008) proposed a novel approach to utilize a wavelet transform to decompose the time series [7]. By the

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hierarchical scale-wise decomposition concept, they reported the 99.1% accuracy of forecast about stock price variation in Taiwan Stock Exchange index [7](Chang and Fan, 2008).

Therefore, how to raise the predictive ability from empirical data in the near future is the main objective of this study. We proposed the TTCR (Trend Tracking based on Coverage Reasonability) method that brings up a concept of coverage reasonability and multilayer integration in time-series analysis which offers investors a reliable decision to buy or sell stocks.

The paper is organized as follows. In Section 2, we review the procedure of trend and potency tracking method proposed by Li and Yeh. In section 3, we introduce the trend tracking based on coverage reasonability. Section 4 shows the concept and procedure of TTCR. The last section is the conclusion of our study.

2 Trend and potency tracking method (TPTM)

Li and Yeh (2008) proposed a method named TPTM that mainly captures the dependency within a sequence of time series data and then used it as the basis of formulating the trend and potency (TP) function as shown in Figure 1 [8]. The TP value of each observation is calculated through given time stages and the existing data. Its concept is to seize the current change of information created by the latest data. Furthermore, the TPTM creates extra information tied closely with the original data and this will increase the knowledge for the learning machines and accelerate the knowledge acquisition. The computational procedure is as follows:

Step 1: Assume we obtain n periods of data; that is to say, the data set at phase i consists of $\{x_1^n, x_2^n, \cdots, x_i^n\}$, $i = 1, 2, \cdots, n$ and is marked as X^n. Let $x_{(\min:i)}$ be the element in X^n with the minimal value and $x_{(\max:i)}$ be the one with the maximal value in X^n.

Step 2: We then calculate the variations σ_i of the paired data (X_{i-1}, X_i), $i = 1, 2, \cdots, n$ to obtain the increasing or decreasing potencies according to the data sequence. If σ_i concerning the paired data (X_{i-1}, X_i) is positive, it denotes the trend of data at phase i is moving upward. On the contrary, the movement of the data at phase i is descending if $\sigma_i < 0$.

Step 3: We offer more weights to the up-to-date data to represent the intensity of different phases since the latest datum greatly dominates the occurrence of the oncoming datum. The importance w_i of the datum at phase i equals $i-1$, $i = 2, 3, \cdots, n$. For example, at phase 6 the importance (or the weight) of the datum $w_6 = 6 - 1 = 5$.

Step 4: Let $A_i = \sigma_i \times w_i$, $i = 1, 2, \cdots, n$ as an accession to strengthen the data trend and potency at different phases by multiplying both weights and variations. $A_i > 0$ means the increasing potency (IP), and $A_i < 0$ is the decreasing potency (DP).

Step 5: Find out the central location (CL) of the existing data using the following equation: $\mathrm{CL} = \dfrac{x_{(\min:i)} + x_{(\max:i)}}{2}$. This research utilizes the CL as the main point to make the asymmetric domain range expansion.

Step 6: We compute the average of the increasing potencies (AIP) and the average of the decreasing potencies (ADP) and then use them to asymmetrically expand the domain range. The upper limit of the expanded domain range is $\mathrm{EDR\_UL} = x_{(\max:i)} + \mathrm{AIP}$, and the lower limit of the expanded domain range is $\mathrm{EDR\_LL} = x_{(\min:i)} + \mathrm{ADP}$. Thus we acquire a new expanded domain range to explore extra information of data trend and potency.

Step 7: Through CL, EDR_UL, and EDR_LL, they are employed to form a triangular TP function. Here we set the TP value of the CL to be 1, and then we can obtain the TP values of the existing data through the ratio rule of a triangle. As figure 1 shows, it demonstrates a simple instance and the TP value of $x_{(\min:i)}$ is $t = \dfrac{p}{p+q}$, where

p is the distance between EDR_LL and $x_{(\min:i)}$, and q is the distance between $x_{(\min:i)}$ and CL. The range of the TP value is between 0 and 1, and the TP value represents the current datum's intensity close to the CL.

Step 8: If a latest datum appears in the sequence, return to step 1 and re-compute the TP value concerning each of the existing data.

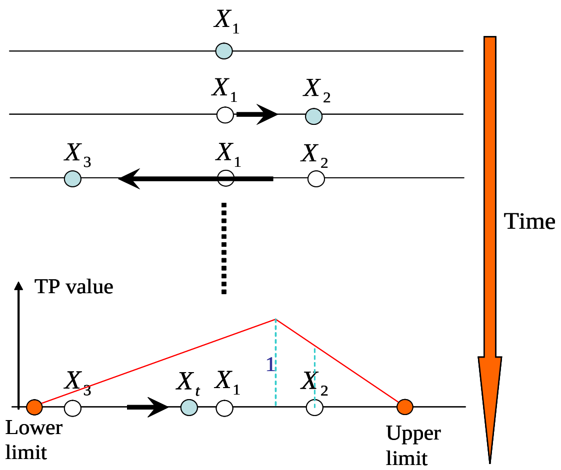

Figure 1: Data occurrence and the trend and potency (TP) function

3. Trend Tracking based on Coverage Reasonability

This study provides a novel technique TTCR that is modified from our previous work, TPTM (only using the boundary of Trend Tracking; TT), and combines multilayer time series with a coverage reasonability for the decision of stock transactions. The TTCR captures the trend boundary of time series with different periods to generate three quadratic curves This study applies TT to generate three quadratic curves according to closing prices and five-day moving averages. The altitude of quadratic curves is the distance between the closing price and the five-day moving average in that day. The changing point appears when the location of closing price is above or below the five-day moving average. That is, the stock price will fluctuate in a certain time period in case that the angle of triangle from TTCR changes to zero. We will estimate the upper and lower boundary of stock price through the location and the time units that closing price finally reached.

4. Coverage Reasonability and Multilayer Integration

Lack of research seeks for reasonability of the volatility that is tracking asymptotic trend in different time periods. We propose a concept of coverage reasonability to realize the improvement of prediction of stock prices. The definition of reasonability in the boundary detection of stock price is according to three factors such as financial policy, business performance, and valuable messages.

We mimic some stylized facts of stock market dynamics concerning several typical companies in each industry. The stylized facts of stock market dynamics are as follows: (1) maximal ceiling/flooring prices over time (2) great price fluctuation when the first K bar (black/red) appears, (3) stock prices are with uncertain correlation between successive daily changes. We observe the factors mentioned above to design the proposed algorithm (TTCR). The procedure of TTCR is shown as follows:

Input: time series data

Output: the transaction type (the decision that investors either buy or sell)

Procedure:

Step 1: to obtain the closing price every five days with the concept of sliding windows (Ying and Xin-Tian, 2008) and to calculate an average of upper and lower limits as the new boundary, that is $TT = \frac{1}{2}(EDR\_UL + EDR\_LL)$.

Step 2: to calculate the distance (ω) between the closing price and TT

Step 3: to obtain a sequence of ω along the time horizon and generate a waveform according to each top of ω; it will be a parabolic curve that is alpha-helix (α) if the waveform crosses the zero line; otherwise, it will be a non-single waveform by the name of beta-strand (β).

Step 4: to obtain other waveforms in the same way of step 3 based on different time periods such as day, week, month, and even a certain period of hours; that is the concept of multilayer integration to cross different periods and discover sophisticated decision to promote profits of investors.

Step 5: to determine the trend from the pattern of waveforms in different time periods, and to evaluate the coverage between the range accumulated from TTCR (AC1) and the 7% range (AC2) of reasonability regulated by the financial policy of government.

Step 6: the exception distance (δ) defines a distance between the actual price and expected price in a parabolic track. If δ is positive, it will approach beta-strand. Otherwise, it will be alpha-helix. The τ parameter is an angle formed by the slope of the parabolic track. In addition, τ is related to θ that is an opportunity interval for cross periods. To calculate the range of θ from the maximum position of ω is to estimate the number of time units (T). Through the calculation of coverage between AC1 and AC2 is to estimate the increasing/decreasing potency of stock prices.

Step 7: the criteria is the percentage of increase/decrease that is a stepwise parabolic function with three parametric points (TS_{LL}, TS_{UL}, and TS_{TT}). TS_{UL} and TS_{LL} are the upper and lower limit of trend and potency function, separately. TS_{TT} is the largest distance ω of the waveform.

In that the direction of bias in different periods may not be the same, the strategy of cross-period is to look ahead/backward concerning the possible trend of stock price. Through the calculation of exception distance (δ), we can estimate the opportunity interval (θ) for stock price. This offers a correct direction for investors to make the decision of buy/sell stocks as shown in Fig. 2 (a), the starting point of runaway gap [9] is decided by detecting exception distance (δ). The runaway gap is a stock gap that occurs within the investors' emotional context of a price move. When the runaway gap occurs, they either become greedy to chase prices along the beta-strand (β) or fear to exit prices along the alpha-helix (α).

In Fig. 2 (b), an alpha-helix (α) waveform that is a trend pattern of stock price biases compared to bench-mark displays a coiled structure within price biases ($+-+-$). This structure that integrates patterns in different periods such as time period integration in hours or days, demonstrated in Fig. 2 (b) and (c), influences the range of stock price. In Fig. 2 (c), a beta-strand waveform is an anti-parabolic curve of price biases. Note that Fig. 2 (b) and (c) are only used to demonstrate the concept of accumulated waveforms to display the pattern of price fluctuation. Actually, the true fluctuation of price is shown in Fig2. (d) that is mapping the terminology (alpha-helix (α) and beta-strand (β)) proposed in this study. In that the pattern of an alternation of ups and downs in price biases might increase successive (parabolic/anti-parabolic) waveforms ($\beta^+\beta^+\beta^+\beta^+$ or $\beta^-\beta^-\beta^-\beta^-$). If an integrated decision of different periods is inclined to a beta-strand waveform, the stock price will rise or descend continually. If their decisions correctly match the two waveforms mentioned above, investors would obtain appreciable profits. In addition, the size of a sliding window [10] is a cardinality of dataset to get in and out of the latest and the oldest stock price data.

5. Conclusion

This paper applies a novel concept to design TTCR and then searches the cumulative distance of the volatility is consistent with an asymptotic α / β waveform. We think that having a splendid consciousness of what is going on in stock markets is quite important. Our method helps investors to develop better strategies in stock markets. One may, for instance, use the proposed model as a consulting tool and make proper decisions in stock markets to reduce the risk of investment. The future study will seek for estimating a more precise time span for early warning of stock prices.

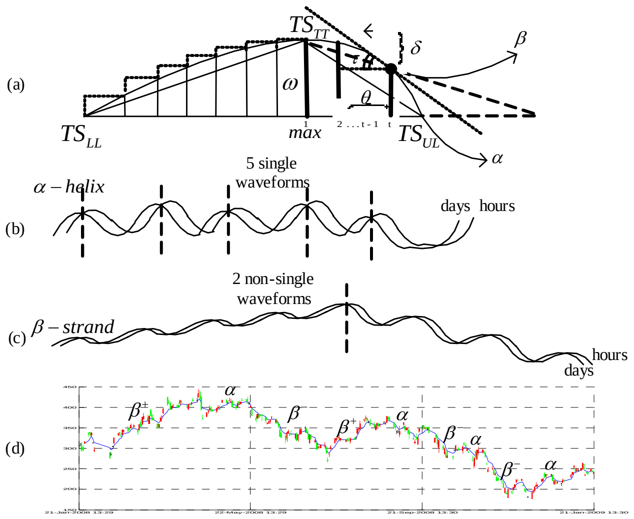

Figure 2: Demonstration of single waveform and non-single waveform

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