

# Research on stock analysis methods based on fluid mechanics

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## Abstract

In this study, the leading indicator is considered as a new technical analysis method for evaluating stocks. This paper is written using the special characteristics and features of the principles of fluid motion, which can be applied to microscopic and macroscopic aspects of stock prices. Microscopic aspect: the stock that changes fastest is considered the leading indicator, which can be easily found by auto-filtering in Excel after working out the speed rate via program Matlab. The trend of other stocks will be predicted by analysing the leading indicator. Macroscopic aspect: determine the leading indicator, which are the top 10 stocks listed in the speed analysis results in the microscopic aspect. The trend of A-shares in a certain time period will be predicted according to the trend of the leading indicator. In order to verify the viability of the leading indicator analysis method in microscopic and macroscopic aspects, we do the following research. We collect 4 days of stock price data to find out the leading indicator via the microscopic or macroscopic leading indicator method. When the corresponding leading indicator is found, then we predict the trend of other stocks and A-shares in a certain time period, so that the feasibility of the leading indicator methods can be proved.

*Keywords:* financial physics, leading indicator, stock analysis, Matlab

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## 1 Introduction

Securities investment analysis is a comprehensive study of the information that affects the value or the price of securities. It is the professional way to estimate the value of stocks as well as any changes in stock value, and as an essential part of securities investment it cannot be overlooked. Through proper securities investment analysis, investors can make a scientific assessment and value stocks correctly thereby reducing their risks and maximizing the net profit of an investment [1, 2].

Three methods of conducting securities analysis are as follows:

1) The basis analysis method. This method derives results mainly according to the theories of economics, finance, and investment;

2) The technical analysis method. This method derives results based on the changing laws of the securities market;

3) The portfolio analysis of securities. The point of this analysis method is to reduce non-systematic risks by creating diversity investments, whose outstanding feature is to be quantified [3-5].

The securities investment believes that the change of stock prices depends on the supply-demand relationship in the market. All the factors that affect stock prices can be found by noting price changes and transactions instead of analysing the basic data. Technical analysis is intuitive, but time-limited. This method is mostly used for analysing short-term fluctuations in the stock market to find the right time for investing [6]. The theory of

technical analysis is actually the theory of market behaviour, which can be generally classified into 6 parts: K-line theory, Tangent theory, Morphology theory, Technical index theory, Wave theory, and Circulation period theory.

Using the features of fluid motion, the author of the presents study has created a new stock analysis method - the leading indicator analysis method derived from microscopic and macroscopic aspects. This paper is divided into four parts:

1) the introduction;

2) the micro leading indicator and macro leading indicator are briefly introduced with empirical analysis;

3) analysis of the advantages of the leading indicator analysis;

4) the conclusion.

## 2 A newly discovered indicator for technical analysis - leading indicator

### 2.1 MICROSCOPIC ASPECT

The main concern of leading indicator analysis method is as follows: The leading indicator stock will be found after analysing the data of stock prices using the leading indicator analysis method. The trend of other stocks during a period will be predicted by analysing the trend of the leading indicator stock.

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2.1.1 Background and definition

The main concepts of this method focus on the mechanics of the fluid particle as described by Lagrange in his study of fluid motion. The motion of each fluid particle is read from the very beginning to the end; that is, the position of each fluid particle is changing over time. From the principles of fluid mechanics, we learn that the fluid particle is normally treated as the smallest research object, and the fluid is the medium made up of numerous fluid particles that occupy the whole fluid space consecutively without gaps [7].

Firstly, consider the fluid as a composition made up of numerous fluid particles that occupy the whole fluid space consecutively without gaps. Secondly, allow that at the very same moment, the fluid particles become streamlines, and that the numerous streamlines turn into clusters. Since the streamlines never join or go out, the cluster is composed of the streamlines of the same shape in sequential order. Thirdly, allow that the velocity vector of the fluid particles on the curve line is tangent to it. Each fluid particle is at a speed, and given the three conditions mentioned above, we will see that the velocity of high-speed value fluid at time point  $t$  is the same as that of low-speed value fluid at time point  $t+k$ ; that is to say, the fluid of high-speed value will present its velocity direction one step earlier than the low speed value fluid (shown as Figure 1). Hence, we only need to figure out the velocity direction of high-speed value fluid at any time point, and the velocity direction of low speed value fluid will be predicted. The amount of time will be decided later by the speed value.

The fluid of highest speed value is considered the leading indicator, and its velocity direction will appear earlier than any other fluids. We will figure out the velocity direction of other fluids after a period of time as long as we analyse the velocity direction of the leading indicator. Meanwhile, the speed of the other fluids determines how much time it takes to form their velocity direction—the higher speed value it has, the less time it spends, and vice versa.

In order to have a direct impact of the quantity of fluids on the speed value, we build a two-dimensional rectangular coordinate, from which the greatest speed value fluid will be easily seen. The result is roughly shown in the Figure 2 as follows:

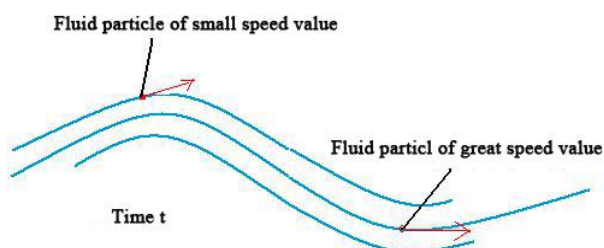


FIGURE 1 Fluid particle movement

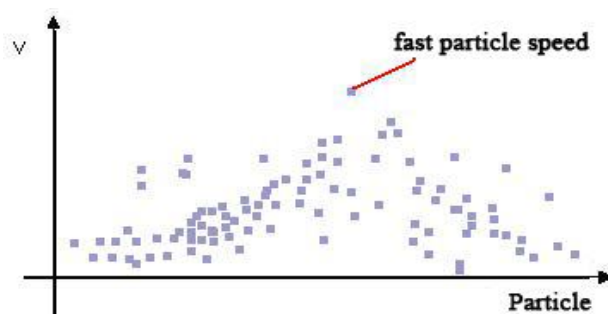


FIGURE 2 Fluid particle speed

A change in the supply-demand relationship is the direct reason that changes the stock price occur. Any change or policy of politics, economy, finance, banking, business transactions, diplomacy, military, or the social situation will influence the investors' prediction during an afternoon session. Whether the result is positive or not directly influences the investors' behaviour, which will influence the supply-demand relationship in the stock market and change the stock price. Since we can see the changes in stock price, we will know the market better only by analysing the changes of stock price [8-10].

To project the leading indicator of the fluid motion into the stock price, the stock price will be taken as the fluid, the change of stock price as the speed, and the trend of stock price as the velocity direction. We can then see that the stock whose price is fluctuating more quickly than normal will show its direction earlier than the others. And it will therefore be regarded as the leading indicator, the one which presents its direction earlier than other stocks. From its trend, we will predict the others after a period time. The time when other stocks show their trends depends on their speed; the higher speed they have, the earlier they appear, and vice versa.

Hence, Microscopic Leading Indicator is the method to figure out the stock price that fluctuates quickest by analysing the historic stock price data, the so-called the stock leading indicator. The other's price trend will be predicted by analysing the price trend of the leading indicator. Since the speed of the other stocks is different from one another, the time needed for prediction will also be different.

2.1.2 Analysis on speed and time

The leading indicator method not only can be used in the study of daily stock prices, but also other stock price studies of different time periods, such as a week, a month, or even a year. The study results below are listed based on daily stock price; the others can also be figured out in the same way.

Every day, the stock market is open from 9:25 am to 3:00 pm. During this period, the opening price and the closing price are formed by Call Auction. Since the price forming has an effect on the result, we will remove the stock price formed by Call Auction when the MATLAB project performs the data analysis. That is to say, only the stock price formed by Continuous Auction will be kept

for speed analysis.

**1) Speed analysis**

From the Figure 3, we can see that the daily stock price changes in a vibrating way. To take the stock price results picked every  $L$  seconds as the time sequence of daily stock price,  $P_1, P_2, P_3, \dots, P_m$  stand for the stock price picked every  $L$  second, we will see 4 speeds. They are:

1) Average increasing speed  $v_1$ : when  $P_i \leq P_j, (i < j \text{ and } i, j = 1, \dots, m), v_1 = \sum(P_j - P_i) / Ln_1, n_1$  refers to  $P_j$  is equal or greater than the number of  $P_i$ ;

2) Average decreasing speed  $v_2$ : when  $P_i > P_j, (i < j \text{ and } i, j = 1, \dots, m), v_2 = \sum(P_j - P_i) / Ln_2, n_2$  refers to  $P_j$  is less than or equal to the number of  $P_i$ .

3) Non-absolute value integrated average speed  $v_3$ : when  $P_i \leq P_j, (i < j \text{ and } i, j = 1, \dots, m), \text{ and } P_k > P_h, (k < h \text{ \& } k, h = 1, \dots, m), v_3 = [\sum(P_j - P_i) + \sum(P_h - P_k)] / L(n_1 + n_2), n_1$  refers to  $P_j$  is equal or greater to the number of  $P_i$ , and  $n_2$  refers to  $P_h$  is less than or equal to the number of  $P_k$ .

Three explanations for speed  $v_3$  as follows: when  $v_3 > 0$ , it means that the increase speed of the stock price is greater than decrease speed, and it will move to the high price in a short period;  $v_3 < 0$  means that the decrease speed is greater than the increase speed, and it will move to the low price in a short period; and  $v_3 = 0$  means that the increase speed is almost equal to the decrease speed, and the stock price will be almost on a horizontal level in a short period. Hence, the speed  $v_3$  reflects the trend of the stock price.

4) Absolute value integrated average speed  $v_4$ : when  $P_i \leq P_j, (i < j \text{ \& } i, j = 1, \dots, m), \text{ and } P_k > P_h, (k < h \text{ \& } k, h = 1, \dots, m), v_4 = [|\sum(P_j - P_i)| + |\sum(P_h - P_k)|] / L(n_1 + n_2), n_1$  refers to  $P_j$  is equal or greater to the number of  $P_i$ , and  $n_2$  refers to  $P_h$  is less than or equal to the number of  $P_k$ .

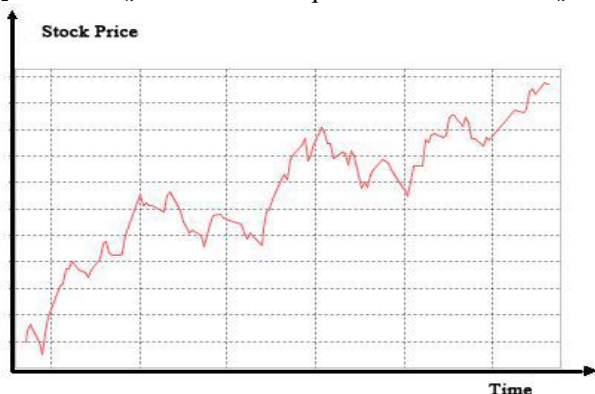


FIGURE 3 Daily stock price

Speed  $v_4$  is the absolute value between the increased speed and decreased speed. The stock of highest speed  $v_4$  is considered as the leading indicator. To the non-leading indicator stocks, speed  $v_4$  is the exact factor that decides when the trend of the leading indicator will appear. The greater the speed is, the less time it takes. Easily can we read the stock quantity of each speed rate from the Figure

4 shown below by putting the stock codes into the two-dimensional rectangular coordinate along with the speed  $v_4$ .

From the four speeds, we can learn the logic of the microscopic leading indicator method; that is, speed  $v_4$  is the key to figuring out the leading indicator of stocks, while speed  $v_3$  is the point to predict the trend of leading indicator.

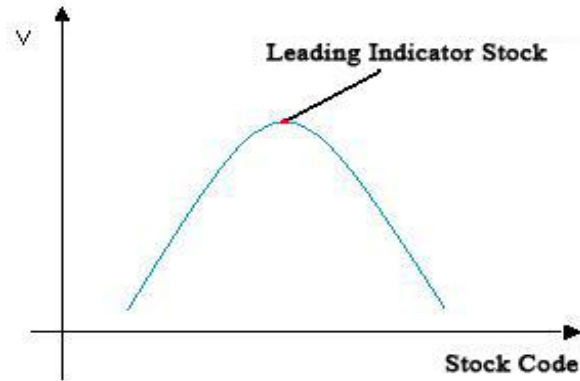


FIGURE 4 Leading indicator stock

**2) Time analysis**

When we figure the leading indicator and its trend via the above speed analysis, the trend of other stocks after a period time will also be known. The length of the “period time” will depend on speed  $v_4$  of the other stocks. To assume that the other stocks are moving at the speed of  $v_4$  within the “period time”, under this perfect and ideal condition, we will work out the ratio between the “period time” and the time needed to form the trend.

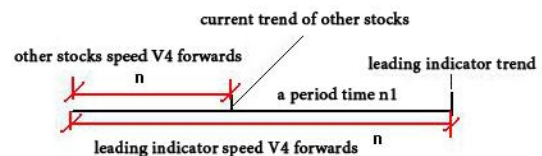


FIGURE 5 Time of leading indicator

Let “ $n$ ” be the time the other stocks spend to form the current trend; that is, the time that the leading indicator needs to form the predicted trend. “ $n_1$ ” stands for the “period time” that the other stocks need to form the trend that the leading indicator predicts shown as the Figure 5. Then:

$$\begin{aligned} \text{other stocks speed } v_4 \times (n + n_1) &= \\ \text{leading indicator speed } v_4 \times n & \end{aligned} \tag{1}$$

With a little calculation, we will get the time ratio:

$$\begin{aligned} \frac{n_1}{n} &= \\ \frac{\text{Leading Indicator Stock Speed } v_4 - \text{Other Stock Speed } v_4}{\text{Other Stocks Speed } v_4} & \end{aligned} \tag{2}$$

Following the above time-ratio equation, under an ideal condition, we will without doubt work out the “period time” that other stocks need to form the trend

predicted by the leading indicator.

However, in fact, the speed  $v_4$  of other stocks in the “period time” is not always the same, and it will change as the time moves on. Even though there are differences between theory and a real situation, the law figured out in theory is also workable. Therefore, I would like to make it clear here that the leading indicator in this paper is analysed under an ideal condition.

### 2.1.3 Leading indicator method based on program Matlab

We learn from the above study that the leading indicator and time are decided by speed  $v_4$ , while the trend of leading indicator is decided by speed  $v_3$ . Hence, we can predict the trend of other stocks after a period of time by working out the speed  $v_3$  and speed  $v_4$  of the leading indicator and the speed  $v_4$  of the other stocks. The leading indicator can be found by the auto-filtering function available in Excel after working out the speed  $v_3$  and speed  $v_4$  using the program Matlab.

The working theory of the program Matlab is to read repeatedly from Excel forms the stock price data in the current folder and try to determine the speed of the stocks in the folder, from which the data formed by Call Auction will be deducted. When the results are completed, the file will be saved to the Excel form named “conclusion” in the folder, using the auto-filtering function in Excel to do the final study [11].

```
locate=2; //see result at the initial position of Excel
//y1 as the initial file name & y2 as the final file name
for Name=y1:1:y2
    Namestr=[num2str(Name),'.xls'];
    //to check the filename available or not
    p=exist(Namestr,'file');
    //Speed calculation is processing
    if p==2
        //put the data into program Matlab rectangularly
        Original=xlsread(Namestr);
        //read stock prices in the rectangular
        Cut=Original(:,2);
        //select the number of stock price per second
        [count,n]=size(Cut);
        j=1; k=1;
        //deduct the stock price formed by Call Auction
        for i=3:(count-3)
            if Cut(i)>=Cut(i+1)
                //increase speed matrix
                increase(j)=(Cut(i)-Cut(i+1))/L;
                j=j+1;
            else
                //decrease speed matrix
                decrease(k)=(Cut(i)-Cut(i+1))/L;
                k=k+1;
            end
        end
        //elements number of increase speed matrix
        [count1,n1]=size(increase);
        //elements number of decrease speed matrix
        [count2,n2]=size(decrease);
        //average increase speed
```

```
avgincrv=(sum(increase))/n1;
//average decrease speed
avgdecrv=(sum(decrease))/n2;
//non-absolute value integrated average speed
avgv1=(sum(increase)+sum(decrease))/(n1+n2);
//absolute value integrated average speed
avgv2=(sum(increase)+abs(sum(decrease)))/(n1+n2);
V=[Name,avgincrv,avgdecrv,avgv1,avgv2];
//to confirm the place where the result is saved
locatestr=['A',num2str(locate)];
locate=locate+1;
//save the speed result in the Excel for further study
xlswrite('conclusion', V, 'conclusion', locatestr);
else
    continue;
end
end
```

The program indicates that the speed result begins saving from the very second line; that is to say, the content in first line should be described clearly enough to indicate the meaning of each line to make sure that the form is expressing perfectly and precisely.

In order to filter the stock of greatest speed  $v_4$ , the leading indicator stock, we set the filter function for the four columns. And we can then predict the price trend of the other stocks after a period time according to the speed  $v_3$  of the leading indicator. The “period time” can be figured out by the time ratio equation from the above time analysis via the speed  $v_4$  of the other stocks.

### 2.1.4 Application and verification on microscopic leading indicator method

#### 1) Data collection and process:

The data collection includes the opening price and closing price formed by Call Auction, which will be removed when the program Matlab calculates the change speed of stock prices, and the stock price formed by Continuous Auction will remain. Therefore, we only need to collect the stock price data between 27/06/2011 and 30/06/2011, codes from 000001 to 601999, and save them respectively to Excel in four files (Figure 6). We set the Excel name as “20110627 + stock code” to make it more convenient when moving the data to the program Matlab. While collecting the data, we select the time sequence of stock price for every 3 seconds.



FIGURE 6 Stock price data file

#### 2) Results analysis and verification

We will integrate the speed calculation results in four label-Excel, and analyse it in order. As we know, the stock price whose speed  $v_4$  is greatest is the leading indicator, and stock price of greatest speed will be found by setting the auto-filtering function, descending order, for the list of speed  $v_4$ .

1) Result analysis and verification for the data on



2011-6-27:

using Excel, we built a two-dimensional rectangular coordinate consisting of speed  $v_4$  and the corresponding stock codes. The stock quantity and the speed rate of the leading indicator belonging to each speed value can be viewed directly from the Figure 7.

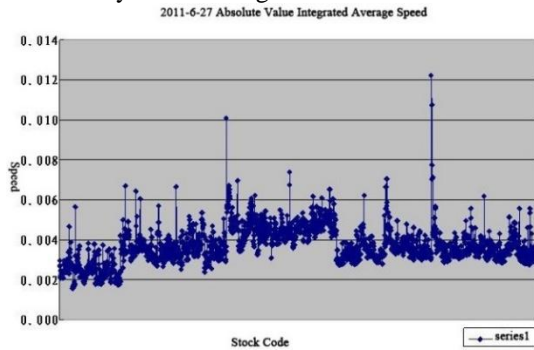


FIGURE 7 Absolute value integrated average speed

To pick out the Top 10 results of Speed  $v_4$  in descending order, shown as the Table 1:

TABLE 1  $v_3$  and  $v_4$  of stock on June 27

stock code	avg increase speed	avg decrease speed	speed $v_3$	speed $v_4$
20110627600519	0.00810	-0.02361	-0.00028	-0.01220
20110627600520	0.00688	-0.02146	-0.00061	0.01073
20110627002304	0.00676	-0.01938	-0.00015	0.01009
20110627600521	0.00441	-0.01706	-0.00126	0.00776
20110627300006	0.00495	-0.01422	-0.00012	0.00740
20110627600523	0.00375	-0.01661	-0.00163	0.00715
20110627600522	0.00346	-0.01702	-0.00196	0.00704
20110627600261	0.00482	-0.01314	-0.00008	0.00702
20110627002353	0.00444	-0.01396	-0.00043	0.00695
20110627300007	0.00451	-0.01291	-0.00009	0.00673

Table 1 show that the stock code No 600519 is the leading indicator, whose speed  $v_3$  is -0.00028. That is to say, the prices of other stocks are tending to decline after a period of time. We can select two stocks from the data on 28<sup>th</sup> to verify the leading indicator method:

- verification of the stock code No 600520: As per the time ratio equation determined by the time analysis, we will calculate the time ratio  $(0.01220-0.01073)/0.01073=0.13662\approx 7/50$ , which indicates that it takes 7/50 of the initial time for the stock to show the decline trend. Shown in the Figure 8, we can see the trend of stock code No 600520 on 28<sup>th</sup>. The part in the red circle is near 7/50, the point at which the stock is moving to the low price, and it proves that the leading indicator is feasible.

- verification of the stock code No 002304: Following the time ratio equation, we will figure out that the time ratio is  $(0.01220-0.01009)/0.01009=0.20854\approx 5/24$ , which indicates that it takes 5/24 of the initial time for the stock to show the decline trend. From the Figure 9 showing the trend of stock code No 002304 on 28<sup>th</sup>, we will see that the part in the red circle is near 5/24, where the stock is moving to the low price. Even though it is a small movement, it still proves that the leading indicator is feasible.

In conclusion, the stock code No 600519 is the leading indicator, and the microscopic leading indicator method is proved feasible.



FIGURE 8 Absolute value integrated average speed

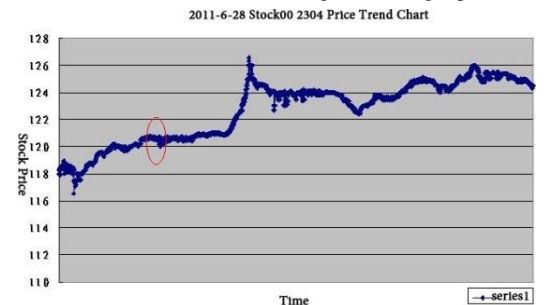


FIGURE 9 Price trend of stock 002304 on June 28

2) Result analysis and verification for the data on 2011-6-28: using Excel, we built a two-dimensional rectangular coordinate consisting of speed  $v_4$  and the correspondent stock codes. The stock quantity and the speed rate of the leading indicator belonging to each speed value can be viewed directly from the Figure 10.

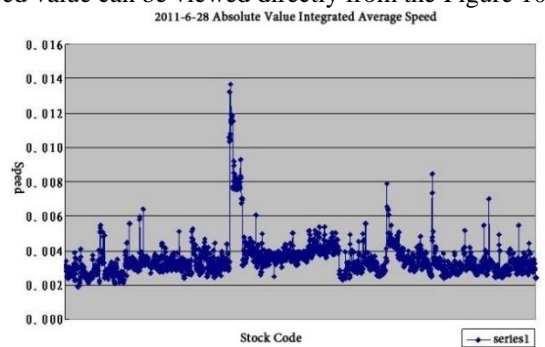


FIGURE 10 Absolute value integrated average speed

To pick out the Top 10 results of Speed  $v_4$  in descending order, shown as the Table 2:

TABLE 2  $v_3$  and  $v_4$  of stock on June 28

stock code	avg increase speed	avg decrease speed	speed $v_3$	speed $v_4$
20110628002309	0.00915	-0.02631	-0.00022	-0.01368
20110628002304	0.00908	-0.02472	-0.00015	0.01321
20110628002313	0.00775	-0.02330	-0.00046	0.01186
20110628602317	0.00780	-0.02314	-0.00037	0.01186
20110628302315	0.00774	-0.02306	-0.00039	0.01179
20110628602311	0.00764	-0.02272	-0.00038	0.01163
20110628602316	0.00757	-0.02269	-0.00043	0.01157
20110628602319	0.00752	-0.02265	-0.00045	0.01152
20110628002312	0.00753	-0.02264	-0.00044	0.01152
20110628302318	0.00747	-0.02263	-0.00048	0.01148

From the Table 2, the stock No 002309 is the leading indicator, whose speed  $v_3$  is - 0.00022. That is to say, the prices of other stocks are tending to decline after a period of time. We can select two stocks from the data on 29<sup>th</sup> to verify the leading indicator method:

- verification of the stock code No 002304: As per the time ratio equation determined by the time analysis, we will calculate the time ratio  $(0.01368-0.01321)/0.01321=0.03545\approx 3/85$ , which indicates that it takes 3/85 of the initial time for the stock to show the decline trend. Shown in the Figure 11, we can see the trend of stock code No 002304 on 29<sup>th</sup>. The part in the red circle is near 3/85, at which point the stock is moving to the low price, and it proves that the leading indicator is feasible.

- verification of the stock code No 002313: Following the time ratio equation, we will figure out that the time ratio is  $(0.01368-0.01186)/0.01186=0.15370\approx 6/39$ , which indicates that it takes 6/39 of the initial time for the stock to show the decline trend. From the Figure 12, showing the trend of stock code No 002313 on 29<sup>th</sup>, we will see that the part in the red circle is near 6/39, where the stock is moving to the low price, and it proves the leading indicator is feasible.

In conclusion, the stock code No 002309 is the leading indicator, and the microscopic leading indicator method is proved feasible.

2011-6-29 Stcok 002304 Price Trend Chart

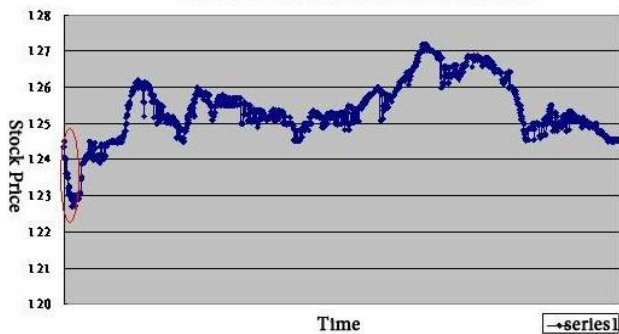


FIGURE 11 Price trend of stock 002304 on June 29

2011-6-29 Stock 002313 Price Trend Chart

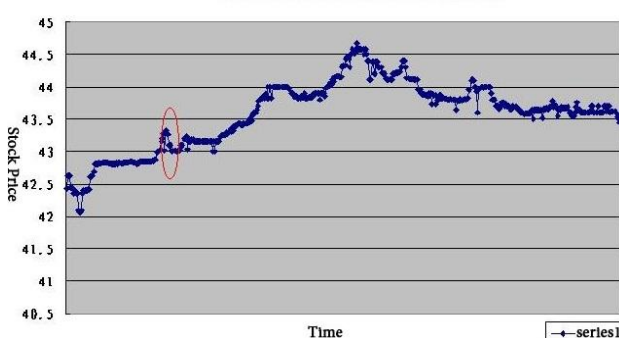


FIGURE 12 Price trend of stock 002313 on June 29

3) Result analysis and verification for the data on 2011-6-29:

using Excel, we built a two-dimensional rectangular coordinate consisted of speed  $v_4$  and the correspondent stock codes. The stock quantity and the speed rate of the leading indicator belonging to each speed value can be

viewed directly from the Figure 13.

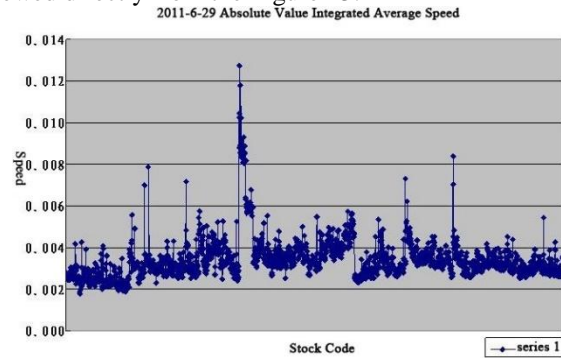


FIGURE 13 Absolute value integrated average speed

To pick out the Top 10 results of Speed  $v_4$  in descending order, shown as the Table 3:

TABLE3 v3 and v4 of stock on June 29

stock code	avg increase speed	avg decrease speed	speed v3	speed v4
20110629002304	0.00863	-0.02416	-0.00004	-0.01273
20110629002310	0.00790	-0.02261	-0.00016	0.01179
20110629002306	0.00677	-0.02071	-0.00049	0.01045
20110629602305	0.00664	-0.02040	-0.00051	0.01027
20110629302311	0.00685	-0.01963	-0.00014	0.01023
20110629602322	0.00590	-0.01875	-0.00061	0.00930
20110629602313	0.00574	-0.01863	-0.00070	0.00914
20110629602315	0.00559	-0.01831	-0.00072	0.00895
20110629002309	0.00557	-0.01823	-0.00072	0.00892
20110629302327	0.00557	-0.01798	-0.00065	0.00885

From the Table 3, the stock, code No 002304, is shown as the leading indicator, whose speed  $v_3$  is - 0.00004. That is to say, the prices of other stocks are tending to decline after a period time. We can select two stocks from the data on 30<sup>th</sup> to verify the leading indicator method:

- verification of the stock code No 002310: As per the time ratio equation determined by the time analysis, we will calculate the time ratio  $(0.01273-0.011-9)/0.01179=0.08031\approx 20/249$ , which indicates that it takes 20/249 of the initial time for the stock to show the decline trend. Shown in the Figure 14, we can see the trend of stock code No 002310 on 30<sup>th</sup>. The part in the red circle is near 20/249, at which the stock is moving to the low price, and it proves that the leading indicator is feasible.

- verification of the stock code No 002306: Following the time ratio equation, we will figure out that the time ratio is  $(0.01273-0.01045)/0.01045=0.21810\approx 100/458$ , which indicates that it takes 100/458 of the initial time for the stock to show the decline trend. From the Figure 15 showing the trend of stock code No 002306 on 30<sup>th</sup>, we will see that the part in the red circle is near 100/458, where the stock is moving to the low price, and it proves the leading indicator is feasible.

In conclusion, the stock code No 002304 is the leading indicator, and the microscopic leading indicator method is proved feasible.

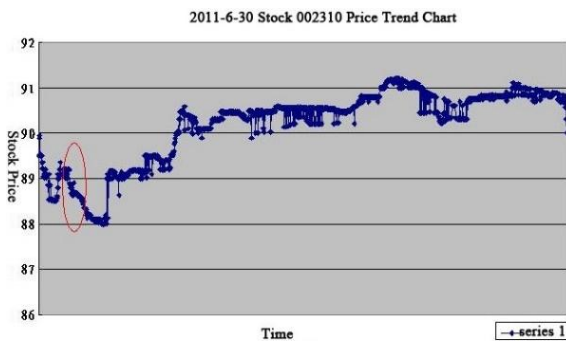


FIGURE 14 Price trend of stock 002310 on June 30



FIGURE 15 Price trend of stock 002306 on June 30

4) Result analysis and verification for the data on 2011-6-30: using Excel, we built a two-dimensional rectangular coordinate consisted of speed  $v_4$  and the correspondent stock codes through Excel. The stock quantity and the speed rate of the leading indicator belonging to each speed value can be viewed directly from the Figure 16.

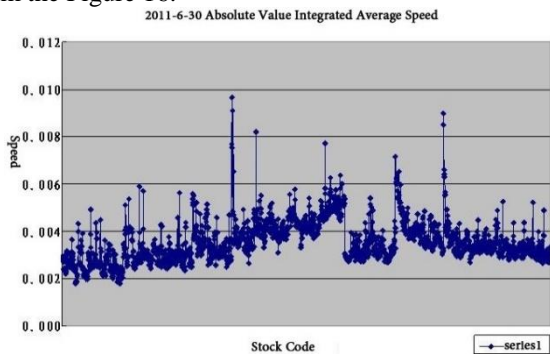


FIGURE 16 Absolute value integrated average speed

To pick out the Top 10 results of Speed  $v_4$  in descending order, shown as the Table 4:

TABLE 4  $v_3$  and  $v_4$  of stock on June 30

stock code	avg increase speed	avg decrease speed	speed $v_3$	speed $v_4$
20110630002304	0.00647	-0.01848	-0.00012	-0.00965
20110630002310	0.00615	-0.01726	-0.00004	0.00909
20110630600519	0.00577	-0.01796	-0.00050	0.00900
20110630600520	0.00533	-0.01728	-0.00064	0.00849
20110630002407	0.00587	-0.01467	-0.00044	0.00819
20110630300124	0.00502	-0.01520	-0.00032	0.00771
20110630002306	0.00490	-0.01533	-0.00044	0.00766
20110630002305	0.00462	-0.01564	-0.00073	0.00754
20110630600259	0.00480	-0.01372	-0.00098	0.00716
20110630600523	0.00372	-0.01456	-0.00111	0.00659

From the Table 4, the stock, code No 002304, is the leading indicator, whose speed  $v_3$  is -0.00012. That is to say, the prices of other stocks are tending to decline after a period time. But the speed is declining more slowly since the speed  $v_4$  is 0.00965.

Though few stocks are taken from the above 4-day data to verify the leading indicator method, it turns out that the leading indicator is surely workable.

## 2.2 MACROSCOPIC LEADING INDICATOR METHOD

Differing from microscopic aspect research on each stock price's trend, macroscopic aspect research is used to analyse the whole stock market using the method of the leading indicator. Actually, the macroscopic leading indicator is a method based on the microscopic leading indicator since the stock market is made up of many single stocks, and the change of the whole market is the sum of each stock's change.

### 2.2.1 Definition

As we know, the sample stocks of A-shares are all listing stocks that reflect the price change status of A-shares. Hence, when the trend of A-shares is figured out, the trend of the whole stock market will be predictable. Shanghai composited securities index series uses the Paasche Composite Index equation for calculating, and the equity quantity of sample stock's for weighting it [12]. The equation is:

$$\text{Report Period Index} = \frac{\text{Total Report Period Value}}{\text{Total Based Period Value}} = \text{Based Period Index} \quad (3)$$

In the above equation, the amount =  $\sum$  (stock price \* authorized shares). The equation makes it clear that the stock price change effect the report period index, and finally, that A-shares follows the trend of stock price change.

There is a description about the microscopic leading indicator: the share of greater speed  $v_4$  will show the trend earlier than the smaller one. Therefore, we can pick out the shares whose speed  $v_4$  is listed among the top 10 shares every day according to the microscopic leading indicator analysis. The share showing its trend earlier every day than the others represents the trend of whole stock market.

We can conclude that the macroscopic leading indicator aims at finding the shares whose speed  $v_4$  are listed among top 10 based on the analysis of microscopic leading indicator, and the share always listing in the top 10 is the leading indicator. What's more, the whole market trend in the future will be predictable when we work out the trend of stock index  $A$  after a period time. The trend of stock index  $A$  can be known by figuring out the whole market trend after a period time based on the

speed  $v_3$  trend of the macroscopic leading indicator. However, I would like to draw to your attention that the leading indicator figured out by macroscopic leading indicator method is different from that of microscopic leading indicator method.

Two situations can happen when using the macroscopic leading indicator method. In one situation, some shares of smaller speed  $v_4$  show the trend earlier than some of leading indicator of higher speed  $v_4$ , in the other situation, the leading indicator of smaller speed  $v_4$  shows earlier than other shares of smaller speed  $v_4$ . In this case, we need to select an intermediate time value. It is the time point when stock index A mostly presents the trend of leading indicator. It can be determined by selecting the average value of the time ratio between the shortest and the greatest time that the speed  $v_4$  smaller than macroscopic leading indicator takes to show the trend of leading indicator. It will neither take too much time for the shares of great speed to leave, nor too much time for the shares to show the trend.

2.2.2 Application and verification on microscopic leading indicator method

It is easy to see from the above four-day speed analysis results based on microscopic leading indicator method that the stock code No 002304 always ranks in the top 10, even the top 3. According to the theory of the macroscopic leading indicator, the stock code No 002304 is the leading indicator, whose current speed  $v_3$  trend is exactly the trend of A-shares after a period time. We will work out the medium time ratio according to the time calculated by the progressive analysis:

1) 27<sup>th</sup>: the speed  $v_3$  of stock code No 002304 is -0.00015, which shows that the stock price is going to decline. The time ratio for other stocks to show the same trend earliest is:

$$(0.01009-0.00776)/0.00776=0.30148.$$

The time ratio for other stocks to show the same trend latest is:

$$(0.01009-0.00156)/0.00156=5.49026,$$

$$(0.30148+5.49026)/2\approx 3.$$

It means that the A-shares is supposed to show the same decline trend as stock code No 002304 after 3 days (with 27<sup>th</sup> included), that is on 29<sup>th</sup>.

2) 28<sup>th</sup>: the speed  $v_3$  of stock code No 002304 is 0.00015, which shows that the stock price is going to increase. The time ratio for other stocks to show the same trend earliest is:

$$(0.01321-0.01186)/0.01186=0.11419.$$

The time ratio for other stocks to show the same trend latest is:

$$(0.01321-0.00190)/0.00190=5.94365.$$

The medium time ratio is:

$$(0.11419+5.94365)/2\approx 3.$$

It means that the A-shares is supposed to show the same increase trend as stock code No 002304 after 3 days (with 28<sup>th</sup> included), that is on 30<sup>th</sup>.

3) 29<sup>th</sup>: the speed  $v_3$  of stock code No 002304 is -0.00004, which shows that the stock price is going to decline. The time ratio for other stocks to show the same trend earliest is:

$$(0.01273-0.01179)/0.01179=0.08031.$$

The time ratio for other stocks to show the same trend latest is:

$$(0.01273-0.00180)/0.00180=6.08081.$$

The medium time ratio is:

$$(0.08031+6.08081)/2\approx 3.$$

It means that the A-shares is supposed to show the same decline trend as stock code No 002304 after 3 days (with 29<sup>th</sup> included), that is on 1<sup>st</sup>.

4) 30<sup>th</sup>: the speed  $v_3$  of stock code No 002304 is -0.00012, which shows that the stock price is going to decline. The time ratio for other stocks to show the same trend earliest is:

$$(0.00965-0.00909)/0.00909=0.06153.$$

The time ratio for other stocks to show the same trend latest is:

$$(0.00965-0.00178)/0.00178=4.41990.$$

The medium time ratio is:

$$(0.06153+4.41990)/2\approx 2.$$

It means that the A-shares is supposed to show the same decline trend as stock code No 002304 after 2 days (with 30<sup>th</sup> included), that is on 1<sup>st</sup>.

A-shares status collected between 27/06/2011 and 01/07/2011 is as follows:

TABLE 5 Opening price of A-shares of 5 days

date	opening price	closing price
01/07/2011	2899.58	2890.61
30/06/2011	2859.94	2893.53
29/06/2011	2888.61	2858.35
28/06/2011	2891.14	2890.51
27/06/2011	2877.62	2889.59

The table verifies what we predict above, on 29<sup>th</sup>, the stock code No 002304 declines as what predicts on 27<sup>th</sup>; on the 30<sup>th</sup>, it goes up as was predicted on 28<sup>th</sup>; on 1<sup>st</sup>, it declines again as was predicted on 29<sup>th</sup> and 30<sup>th</sup>. In a word, the stock code No 002304 is the leading indicator, which proves that the macroscopic leading indicator method is feasible.



## 2.3 THE CONCLUSION

The first two parts clearly describe the definition of the microscopic or macroscopic leading indicator method, which was also proved workable by analysing the 4-day stock price data based on the leading indicator method.

The microscopic leading indicator method is used to analyse a single stock by figuring out the trend of leading indicator to predict the trend of other stocks after a period time; while the macroscopic leading indicator is used to analyse the whole stock market status by figuring out the trend of the leading indicator to predict that of the A-shares after a period time. The stock investors will get more reference information by combining the two methods to avoid the risky investment and so maximize profit.

Therefore, it is better for investors to have a general idea of what the market will be after a period time through the macroscopic leading indicator. The trend of decline or increase is predictable by the speed value and is unique and fixed. Investors can analyse the trend of the stock they count on based on the microscopic leading indicator method. Since the speed is unique and fixed, it is easy to choose a right time to buy or sell in order to reduce the risks on investment.

However, the analysis result concluded by leading indicator method is better used only for a reference since it is processed under a perfect condition, which is far away different from a real situation. Hence, investors are better off analysing the market situation not only with reference to the leading indicator analysis results, but also by a comprehensive study in other ways in order to make a better decision [13, 14].

## 3. Advantages of leading indicator method

### 3.1 ADVANTAGE OF MICROSCOPIC LEADING INDICATOR METHOD

The way that initial analysis methods select a right time for buying or selling stocks or predicting the future of stock prices is according to ready figure rules from the records, line charts, or curve charts. Even though we use the figure rules that are already known to analyse the trend charts, we will soon realize that the same trend can be explained in different ways when analysed from different aspects.

For example, according to the morphology theory, the head-and-shoulder pattern is actually the reversal pattern. However, when observed from a wide range, it will probably turn out to be a mid-way continuous pattern (shown in Figure 17).

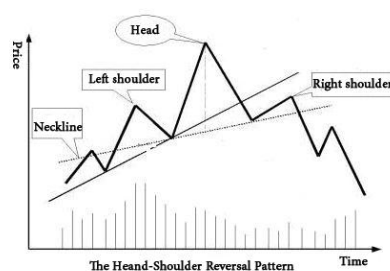


FIGURE 17 Head and shoulders shape

When we use the wave theory to analyse the trend charts, people holding different opinions have different descriptions of the same pattern, and they all make sense. A falling wave can be considered as the second wave or “a” wave. If it is the second wave, the third one will be attractive. If it turns out to be an “a” wave, it will be falling sharply (shown as Figure 18).

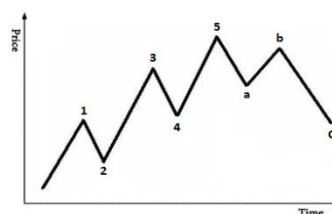


FIGURE 18 Stock price changing trend

Ambiguous opinions from different viewpoints stop people from selecting a right investment time. What makes it worse is that people cannot read the stock price speed simply from the figure laws, and people are too depressed to make a right decision.

As we know what the speed of the physical quantity to the moving level of an object and is same in stock speed to the changing speed of stock price in securities market. A big speed value always means a quick change on stock price, while a small speed value means a slow change. Microscopic leading indicator method focuses on analysing the change speed of stock price. That the speed value is unique and fixed keeps the ambiguities away to help the investors choose a right time for investment. What's more, investors can figure out the precise trend and time to make a better decision by working out the leading indicator through Matlab program and the filtering function of Excel.

For instance, from the results of speed analysis and time analysis of data from the 29<sup>th</sup>, we know that stock code No 002304 is the leading indicator whose trend indicates that the price of other stocks will be declining after a period time. The time ratio of stock code No 002310:  $(0.01273-0.01179)/0.01179 \approx 20/249$  expresses that it takes around 20/249 of the initial time to start the trend of decline, which is proved to be true from the trend Figure 19 of the 30<sup>th</sup>. Therefore, investors can make a better decision with the analysis results shown by the leading indicator method instead of original analysis methods, for it is more clearly with no ambiguities.



FIGURE 19 Price trend of stock 002310 on June 30

### 3.2 ADVANTAGES MACROSCOPIC LEADING INDICATOR

The summary of leading indicator methods indicates that the original analysis methods only focus on a certain stock instead of the whole market. The one-side analysis is good for those investors who are interested in one certain stock, while not suitable for the investors who prioritize the whole market. Macroscopic leading indicator perfectly corrects the shortcomings of the original analysis methods and microscopic leading indicator by presenting the whole market situation. It helps investors to get a better and clearer understanding of the stock market situation through the method of

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combining the macroscopic leading indicator with the original analysis method or the microscopic leading indicator.

Similar to the advantages of microscopic leading indicator, the leading indicator can be figured out by studying the speed. The trend and time are predictable based on the leading indicator and can help investors make a specific judgment on the trend of whole stock market without any ambiguities [15].

### 4 Conclusion

The paper briefly introduces the leading indicator as well as its feasibility and advantages. Investors can figure out the leading indicator by analysing the historic data information via Matlab program. Studying the leading indicator, investors will predict the trend of other stocks or the trend of whole stock market. In this way, they will choose a perfect time for investment to reduce the risks to a minimum.

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