A Study on the Relationship between the Yield and the Volume and Price of Chinese Stock Market

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Abstract

The price change of security investment is complex, and the filtering between each influence factor and the change factor cannot establish a durable and effective corresponding relationship. This makes the new rules could not be established, therefore, by drawing on the reverse trend of securities price fluctuation breakthrough in technical analysis and the index and volume factor combination, a measure method of stock price volume relation based on. The method can avoid the impact of short-term volatility on the securities correlation relationship, and has strong operability. This paper briefly introduces the current common based on the relationship between volume and price fluctuations in stock price and measurement based on this method, advantages and limitations, and puts forward the measure method and turning, break through the empirical analysis to verify the superiority based on.

Keywords: KDJ, Break, Transition, Information Discovery, Trend Follow.

1. INTRODUCTION

Volume and price relationship is the basic relationship of the stock market, through the change of the volume and the relationship between price change, you can find the trend of the stock market price changes. Combination of the basic elements of the combination of the market found that the small or huge changes in the energy, followed by the rise and fall of prices. The volume contains abundant trade information, can measure the mass scale and emotional temperature, also can reflect the long and short game, the volume for the stock market to provide energy is the cause of price fluctuations, the price volatility is simply the result of changes in supply and demand. The volume of stock price is the driving force, according to the law of conversion of energy, according to the mechanism of transformation of energy "volume down to" maintain the price of energy required "and promote the stock price to rise to a higher energy needed to" two parts can be divided into the same volume "to maintain the equilibrium price potential volume (amount to maintain), and promote the turnover of stock price change" (promote the quantity). This factor will weaken the accuracy of volume effect on the price, so it is necessary to decompose the volume effect, filter manipulation and hand trading noise.

Charles Mcgee in "Extraordinary Popular Delusions and the madness of crowds" mentioned with historical average volume, while paying attention to relations with the total market value of the market. So it has important theoretical and practical significance to study the relationship between volume and price. The increase in volume is caused by the new stock and ex additional reasons. The extreme volume of each stage has a change in the price trend, or the ability to short-term trend. Burst is triggered by changes in the message or the underlying surface, but the nature of these messages is not enough to change the fundamentals. The reason for the rapid changes in the short term is the overreaction of investors to the news. That is, the mood and behavior of investors, emotions and behavior is repeated. Technical analysis is effective, because the graphic record of both behavior and mood of the masses and. Professor Mackie, founder of the random walk, acknowledges that the "often profitable" financial market is a calm, rational, predictable market.

Volume of research mainly concentrated in several areas. Study on the volume exchange rate, with the trend of the formation of the bottom area of the exchange rate is relatively high, when reaching the high turnover rate
and relatively high completion of the trend cycle. Study on the volume value, volume and stock price index rise. To promote the consistent and market direction, appear at the top or bottom of the reason is the kinetic energy depleted. So by comparing the current volume is equal to or higher than the previous high or low volume to determine whether there is sufficient energy to rise to a new high low.

2. RESEARCH ON THE RELATIONSHIP BETWEEN PRICE CHANGES AND TRADING VOLUME

A) This is determined by a moving average trend, assuming the fitting index above, namely stock equilibrium price fluctuations in the vicinity of average stock trading temporarily to balance the potential energy and kinetic energy equal shares into shares, the stock investment funds to maintain the share price or volume in the vicinity of average volatility. Moreover, shares in the slight fluctuations near the trend, each time period of volatility is not large, then, N days, the average volume is required to maintain the volume of potential energy potential energy and kinetic energy are equal, when the T is greater than the average daily turnover volume of more than 50% is regarded as a volume anomaly, in order to promote the amount of the decomposition.

B) Visual trading volume

According to the theory of distribution of the traditional price theory and the mixed distribution hypothesis asset returns and trading volume is driven by the same factors of price fluctuation of unobservable information of potential flow determines the traditional proxy trading volume as the flow of information. Crouch (1970) found that there is a positive correlation between the absolute value of price changes and volume; by analyzing the market index, confirm that the price change unit to date for the absolute value and the changes in the volume of positive correlation. Morgan (1976) acquisition of 51 stocks data show that in the month of the price change is the absolute value of the unit and the volume is positively correlated. Based on the theory of mixture distribution and above, based on volume decomposition, analysis the relationship between volume and price with the original data, decomposition of the price distribution theory based on the volume distribution and analyzes the relationship between trading volume and price change. In order to facilitate the follow-up study, we must first solve the problems of the original data, and carries on the pretreatment, non-trading volume related sequences, combined with the above data to proxy information index.

C) Transaction volume data processing

The asymmetric information model to analyze the dynamic relationship between volume and price based on the transaction data of the original sequence exists correlation between non-stationarity and time, the mixed distribution hypothesis means that when not using empirical analysis of the original data volume. Therefore, we need to deal with the transaction volume data, and get a stable, non-related trading volume sequence as the agent of information index. Trading volume decomposition methods mainly include the time trend of the removal of trading volume.

1) Trends in the removal of trading volume

According to the Chinese stock market, the two cities of the scattered point chart to observe the volume of the sequence, found in 1990 to two years, the 2015 cities have increased volume trend.

Gallant (1992) believes that the trading volume series which contains the linear time trend with nonlinear time trends, in order to remove the time trend of trading volume in the stock market, according to China, we still assume that Shanghai and Shenzhen two volume with linear trend, and nonlinear trend, at the same time using the regression method to determine the influence of linear trend outside:

\[ V_t = a_0 + a_1 t + a_2 t^2 + \mu_t \]  \hspace{1cm} (1.1)

Among them, \( V_t \) is the original trading volume sequence of two cities, \( t \) is the linear time trend, and \( t^2 \) is the nonlinear time trend. After the ordinary least squares (OLS) regression of the formula (1.1), the residual value of the residual is removed after the time trend of the transaction volume sequence, referred to as the "castration trading volume", denoted as \( v_t \).
2) To remove the transaction amount of sequence correlation

For \( v_t \), there is still a high degree of sequence correlation. To eliminate this correlation, we can use the autoregressive moving model ARMA \((P,Q)\) on the amount of castration trading volume \( v_t \), regression:

\[
v_t = \sum_{i=1}^{P} \alpha_i v_{t-i} + \sum_{j=0}^{Q} \beta_j v_{t-j}
\]

Formula (1.2) the regression residuals of the estimated value of the sequence excluding the sequence correlation does not include the time trend, so it is not expected trading volume, it is recorded as \( v_{1t} \) at the same time

\[
v_{2t} = v_t - v_{1t}
\]

And call it the expected trading volume. The decomposition method of the trading volume determines the average value of the non-expected trading volume \( v_{1t} \) is 0, so the non-expected trading volume over the mean part can be expressed as \( I_{tv_{1t}} \):

\[
I_t = \begin{cases} 
1, & v_{1t} > 0 \\
0, & v_{1t} \leq 0
\end{cases}
\]

Admati&Pfleiderer (1988) the number of transactions is related to the number of traders, trading volume are the main value of traders and traders and followers, so with the continuous fluctuation time series process and market. The increasing participation of the market, the volume of transactions in the market as a whole is in the rising trend. The growth trend of trading volume increases the volatility of prices and the non-stability of the relationship between volume and price. Through the logarithm of the transaction amount of processing, to analyze the volume of transactions to analyze the relationship between price volatility and trading volume and the number of traders

4) Statistical features of the original trading volume

Study on the data used in this section for the daily closing index of Shanghai Composite Index and Shenzhen component index and the corresponding sequence of daily volume (units / million), the time span for the January 1, 1990 -2015 year in December 31st.

Table 1.2 and 1.3 are listed in the sample period of the Shanghai and Shenzhen stock markets in the original (log) trading volume sequence of the basic statistical characteristics and self-correlation coefficient. Table 1.2 shows that both Shanghai market and Shenzhen market, the original trading volume have negative skewness. And the kurtosis is slightly more than 3:Jarque-Bera statistics show that the two sequences are from normal distribution, show leptokurtic features to some extent. Table 1.3 shows the autocorrelation coefficient, trading volume series are highly significant correlation, both trading volume is highly predictable, this is the trading volume decomposition provides a theoretical basis for the two parts of the expected and unexpected trading volume.

5) Transaction volume decomposition results

According to the equation (3-1) to remove the time trend, the original trading volume of VT in Shanghai and Shenzhen stock markets were obtained as follows:

SH stock market

\[
\bar{v}_t = 4.5617 + 0.0022 \times t - 4.777 \times 10^7 \times t^2
\]

\[
(3.5) (116.26) (32.46) (-19.41) R^2 = 0.56, D.W. = 0.26, Q(20) = 17132 [0.00]
\]

(4.5)
SZ stock market--

\[ \tilde{v}_t = 4.3679 + 0.0027 \times t - 4.54 \times 10^7 \times t^2 (3.5)(103.61)(37.42) \]

\[ (3.5)(103.61)(37.42) \]

\[ (-28.17) \]

\[ R^2 = 0.47, \text{ D.W.} = 0.22, Q(20) = 17132[0.00] (1.6) \]

Where \( t \) is the time trend variable (\( v_t \)) for estimation of original volume value.

The results show that the various coefficients of the two models are significantly less 0, and the model's goodness of fit is higher, which shows that the original trading volume in the Shanghai and Shenzhen two cities have significant dominant and nonlinear time trends. According to the definition, the castration trading volume \( v'_t \) is the equation (1.5) and (1.6) the fitting residual, that is, the:

\[ v'_t = v_t - \tilde{v}_t (1.7) \]

Two equations of the D.W and Q (20) statistics show that there is a high degree of self-correlation in the amount of \( v_t \), so it is necessary to use the ARMA model to remove the related components. After comparison and selection, the Shanghai and Shenzhen two city, the model of the fitting of the volume of trade volume \( v'_t \):

**SH market stock------**

\[ \tilde{V}_t = 0.7271 \times v'_{t-1} + 0.0502 \times v'_{t-2} + 0.0819 \times v'_{t-3} + 0.0604 \times v'_{t-8} (37.71), (2.10), (4.09) (1.8) \]

\[ R^2 = 0.77, \text{ AIC} = 0.60, Q(20) = 23.55[0.26] (1.9) \]

**SZ market stock------**

\[ \tilde{V}_t = 0.7590v'_{t-1} + 0.0891v'_{t-3} + 0.0455v'_{t-4} + 0.0467v'_{t-6} + 0.0566v'_{t-7} + 0.0309v'_{t-9}(48.81)(4.15)(2.11)(-2.17)(2.65) (1.10) \]

\[ R^2 = 0.81, \text{ AIC} = 0.52, Q(20) = 13.87[0.46] (1.11) \]

The \( (v'_t) \) for the estimation of castration trading volume value, \( v'_t (t-1) \) for castration Trading Volume I phase lag. The results of equation fitting show that the trading volume in \( v'_t \) castration had significant serial correlation, and the size of \( v'_t \) is mainly composed of the \( v_t \) trading volume in ovarioectomized \( (t-i) \) decided, according to the definition of non-expected trading volume for the \( v'_t \) equation (1.8) or (1.9) of the residuals, i.e.:

\[ v_{1t} = v'_t - \tilde{V}_t (1.12) \]

Two equation Q(20) statistics show that there is no significant correlation between the non-expected trading volume of \( v_{1t} \) in the Shanghai and Shenzhen stock markets. According to the original \( v_t \) trading volume, non-expected trading volume \( v_{1t} \) and related definitions, can calculate the mean over part of the \( v_{1t} \) and the expected trading volume expected trading volume in Shanghai and Shenzhen two \( v_{1t} \), as shown in Figure 4.2 the decomposition of the Shanghai and Shenzhen two city trading volume.

Table 1.4 shows the correlation coefficient between each trading volume can be seen very high expected trading volume trading volume \( v'_{2t} \) and the original \( v_t \) correlation, rather than the expected low correlation between trading volume and trading volume of the original \( v_{1t} \) \( v'_t \) non-expected trading volume expected trading volume \( v'_{1t} \) and \( v'_{2t} \) orthogonal.
3. THEORETICAL MODEL: A BASED ON THE MIXED DISTRIBUTION HYPOTHESIS (MDH) OF THE VOLUME AND PRICE RELATIONSHIP MODEL

From the perspective of the distribution characteristics of the mixed distribution hypothesis of asset price volatility to explain the positive correlation between volatility and trading volume, it believes that the price of financial assets and changes unrelated, symmetrical and obedience to an approximate relative peak normal distribution. The joint distribution of price volatility and trading volume is driven by a potential mixture of variables, and the mixed variable is often assumed to be an information flow. New information into the market and the impact on the market, to stimulate the large trading volume and price fluctuations. Clack (1973) believes that the trading volume sequence can be used as a factor to produce price volatility. Epps and Epps (1976), it is assumed that there is a causal relationship between trading volume and volatility, trading volume is the cause. Tauchen and Pitts (1983) pointed out that the variance of the price change is proportional to the information variable; therefore, volatility and trading volume is proportional to 2 trading volume on information agents and volatility interpretation.

In the first t days from the first I-1 days of the equilibrium price to the first I days of the equilibrium price of the transaction volume is expressed as

The interpretation of the trading volume on the information of agents and Volatility

The t days from the first I-1 days I days in the equilibrium price equilibrium trading volume price expressed as \( v_{it} \), "V" is the daily trading volume can be expressed as \(_t:

\[ V_t = \sum_{i=1}^{n_t} v_{it} \]

This means that the daily trading volume is generated by the random process of a subordinate, namely "V" from the \(_t belongs to \( v_{it} \), assuming \( V_t \sim N(\mu_t, \sigma_t^2) \).

\[ V_t \sim N(\mu_t, \sigma_t^2) \]

With the positive covariance relationship between volatility and trading volume, namely \( \text{cov}(\_v_t, \ V_t) > 0; \) return the absolute value of residual covariance and trading volume also has positive relation, namely \( \text{cov}(|\epsilon_t|, \ V_t) > 0. \)

According to the mixed distribution hypothesis, trading volume can be divided into two parts: non-information transaction volume and information transaction volume. Non-information trading volume trading volume can be predicted, by average trading volume is expected to represent the trading volume; information trading volume is caused by the arrival of new information, can’t be used to explain the history of trading volume series, so is the non-expected trading volume.

If the amount of non-information transaction is expressed as a sequence of stationary random sequence \( v_{i}'t \), then the transaction quantity can be expressed as:

\[ V_t = V_{i}' + \sum_{i=1}^{n_t} v_{it} \]

It is assumed that the price return fluctuation caused by the non information transaction on the T date is \( h_t \), and the conditional variance of the first t returns is expressed as:

\[ \text{Var}(\epsilon_t|h_T) = h_t + n_t \times \text{var}(\delta_t) \]

The random rate of \( n_t \) is a potentially non-observable variable, which can be seen from the formula (4-29), which can be used as a proxy indicator of the random rate \( n_t \) of the information flow entering the market. In this way, (4.31) can be written:
Therefore, to explain the different nature of the trading volume on the volatility is reflected in the following two aspects: first, the ability to explain the persistence of volatility two B, if persistent effect after addition of trading volume volatility is weaker, while the trading volume on the volatility of the ability to explain the stronger; second, trading volume the volatility of marginal explanatory power, the absolute value of coefficient is bigger, the volatility of trading volume The interpretation ability is stronger.

In addition, MDH's interpretation of the information trading volume and the amount of non-information transactions have the following three implicit conclusions. First, the non-expected trading volume on the volatility of the explanatory power is significantly greater than the expected volume; second, non-expected trading volume on the volatility of the explanatory power is greater than the original volume itself; third, non-expected trading volume in more than mean part of ability to explain the volatility to non-expected Trading volume itself.

B Research on the relationship between price volatility and trading volume

1 Model introduction

The core of the trading volume on the impact of stock price volatility is adding trading volume volatility factors in the equation, the GARCH model with time-varying conditional variance, with good find price volatility clusters, persistent and time-varying ability, so we can use GARCH-M model to describe the volatility of stock price.

GARCH-M (mean GARCH) model

The main difference between this model and the GARCH model is the introduction of conditional variance or conditional standard deviation in the original equation of the regression model. GARCH-M (1, 1) model forms are as follows:

\[ \sigma_t^2 = \alpha_0 + \alpha_1 \epsilon_{t-1}^2 + \alpha_2 \sigma_{t-1}^2 \]

Among them, \( \epsilon_t^2 \) for the original equation of the conditional variance, which had people | \( \Omega \epsilon_{t} \) (t-1) ~ N (0, 1^2); \( \Omega \) (t-1) T-1 information set. The parameter \( \alpha_1 \) describes the market impact _ stage T-1 epsilon (t-1) effect on the conditional volatility Sigma _t^2 t phase, parameter \( \alpha_2 \) describes the _ conditional volatility sigma T-1 phase (t-1)^2 effect on the conditional volatility Sigma _t^2 t phase; (\( \alpha_1 + \alpha_2 \)) reflects the price return volatility the persistent.

TARCH model

The conditional variance of TARCH (1, 1) model can be expressed as:

\[ \sigma_t^2 = \alpha_0 + \alpha_1 \epsilon_{t-1}^2 + \gamma \epsilon_{t-1}^2 d_{t-1} + \alpha_2 \sigma_{t-1}^2 \]

Among them, if \( d_t = 1 \) or \( d_t = 0 \); in this model, the good news (\( E_t > 0 \)) and bad news (\( E_t < 0 \)) have different effects on the conditional variance. The impact caused by the favorable news is the alpha _1, while the negative message is caused by the impact (\( \alpha_1 + \alpha_2 \)). If gamma = 0, news shocks are asymmetric

2 Model setting

According to the empirical results, the non-expected trading volume of \( V_{t+1} \) nonlinear model can better reflect the relationship between trading volume and return, so we chose the non-expected trading volume for the \( V_w \) model (4.33) in equation \( X_t \) as explanatory variables, and set in the equation \( f (X_t) = v_1 V_{t+1} + v_2 \beta \) At the same time, set up a =1, that is, in the original equation to consider the impact of the standard deviation on the yield. In this way, the original equation can be expressed as:
In this paper, we chose TARCH (1,1) analysis of the impact of trading volume on the volatility of the -M model, in order to study the different effects of trading volume on the volatility of the trading volume, we will order respectively with different properties in the volatility equation in model. The TARCH (1,1) -M model of the variable name, which is a continuation of the variable name, respectively, is expressed as follows:

Wave equation of TARCH (1,1) -M model:

Model A: \[ \sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma \varepsilon_{t-1}^2 d_{t-1} + \alpha_2 \sigma_{t-1}^2 (2.35) \]

Model B: \[ \sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma \varepsilon_{t-1}^2 d_{t-1} + \alpha_2 \sigma_{t-1}^2 + \theta_1 \varepsilon_{t}^2 (2.36) \]

Model C: \[ \sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma \varepsilon_{t-1}^2 d_{t-1} + \alpha_2 \sigma_{t-1}^2 + \theta_2 \varepsilon_{t1}^2 (2.37) \]

Model D: \[ \sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma \varepsilon_{t-1}^2 d_{t-1} + \alpha_2 \sigma_{t-1}^2 + \theta_3 \varepsilon_{t1}^2 (2.38) \]

Model E: \[ \sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma \varepsilon_{t-1}^2 d_{t-1} + \alpha_2 \sigma_{t-1}^2 + \theta_4 \varepsilon_{t2}^2 (2.39) \]

Model F: \[ \sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma \varepsilon_{t-1}^2 d_{t-1} + \alpha_2 \sigma_{t-1}^2 + \theta_5 \varepsilon_{t3}^2 (2.40) \]

Model G: \[ \sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma \varepsilon_{t-1}^2 d_{t-1} + \alpha_2 \sigma_{t-1}^2 + \theta_6 \varepsilon_{t4}^2 (2.41) \]

3 Research on the relationship between price volatility and trading volume

We first use the relevant data of Shanghai and Shenzhen two city to the original equation shown by the regression analysis, and calculate the review of the residual sequence of the LM statistic. An empirical study on the relationship between volatility and trading volume in the two market returns, as shown in table 2-10 and 2-9. Table 2-8 shows that the two markets of the original equation regression residual sequence of LM (1), LM (5), LM (10) and LM (20) statistics at 99% level significantly, so the story in Shenzhen and Shanghai have obvious ARCH effect in the story. This shows that there is a difference between the stock market and volatility clustering, that is, a large range of volatility is always concentrated in a certain period of time. If the stock market is relatively large fluctuations in the phenomenon, then in the subsequent time will still be a significant change in the, which indicates that the China stock market returns have significant and lasting characteristics, is from Shenzhen which character is more significant. Shanghai and Shenzhen two city model A in the coefficient of the standard deviation of the 10% levels are significant, which shows that the standard deviation of the rate of return on the changes have significant impact. As we expected, the coefficient is positive, which indicates that the standard deviation of the large condition will lead to high yield. At the same time, the coefficient is significantly positive, which shows that the impact of the stock market on the yield of good or bad news is not symmetrical: the volatility of bad news is higher than the good news. Average height of about 30%. We cannot be difficult to understand the original transaction volume and volatility is negatively correlated. So, the two trading volume continued to fluctuate without explanation. Not only that, because of the lead of the two trading volume, the coefficient of the wave equation is not significant, thus weakening the asymmetry of the impact of good and bad news on volatility. And 5.

Comparison of model C and model F can be found, the persistent volatility model F parameter \((\alpha_1 + \alpha_2)\) higher than that of C model, which shows the expected volume of \(V_{2t1}\) and \(V_{3t}\) at the same time to join the non expected trading volume volatility equation, the trading

4. RESEARCH ON THE RELATIONSHIP BETWEEN PRICE VOLATILITY AND TRADING VOLUME CHANGE

A) research method of quantity and price causality

1) Granger Cause and effect test
Granger(1969) The causal relationship between the two variables is defined according to the predictive ability of the variables: Let $x_t$ and $y_t$ be two time series, $F[x_t|\Omega_{t-1}]$ azulene is $x$ at a given information set $\Omega_{t-1}$ under the condition of probability distribution. Where $t=(t-1)$ including

$$y_{t-1x} = (x_{1-1y}, y_{t-1y}, ..., y_{t-1} \text{ and } x_{t-1x} = (x_{1-1x}, x_{t-1}x_{x+1} \text{ and } x_{t-1}) \text{If the equation } F[x_t|\Omega_{t-1}] = F[x_t|\Omega_{t-1} - y_{t-1y}] \text{establish, Then we say } y_t \text{ not Granger Cause and effect } x_t; \text{ If the equation } F[x_t|\Omega_{t-1}] = F[x_t|\Omega_{t-1} - y_{t-1y}] \text{ establish, Then we say } x_t \text{ not Granger cause and effect } y_t$$

1 If variable $x_t$ and $y_t$ is a smooth process, or for the same order integral process and does not have the co integration relation, the vector autoregressive (VAR) model is considered:

$$\begin{bmatrix} x_t \\ y_t \end{bmatrix} = \begin{bmatrix} a_0 + a_1 x_{t-1} + \cdots + a_k x_{t-k} + b_1 y_{t-1} + \cdots + b_k y_{t-k} + \varepsilon \\ c_0 + c_1 x_{t-1} + \cdots + c_k x_{t-k} + d_1 y_{t-1} + \cdots + d_k y_{t-k} + \eta \\ \end{bmatrix} (2.51)$$

Respectively judge $b_1 = b_2 = \cdots = b_k = 0$ and $c_1 = c_2 = \cdots = c_k = 0$ Whether to set up. If $b_1 = b_2 = \cdots = b_k = 0$ establish, then $y_t$ not Granger cause and effect $x_t$ if $c_1 = c_2 = \cdots = c_k = 0$ establish, then $x_t$ and Granger cause and effect $y_t$. If both were established, then $x_t$ and $y_t$. There is no two-way causality between Although the formula can only be used to test the linear causality, the form of the regression equation is usually linear, so the formula is the main method to test the causality. 2 If there is a significant cointegration relationship between the variables $x_t$ and $y_t$, the vector error correction (VECM) model is considered:

$$\begin{bmatrix} \Delta x_t \\ \Delta y_t \end{bmatrix} = \begin{bmatrix} a_0 + a_1 \Delta x_{t-1} + \cdots + a_k \Delta x_{t-k} + b_1 \Delta y_{t-1} + \cdots + b_k \Delta y_{t-k} + \omega_1 (y_t - \beta_0 - \beta_1 x_t) + \varepsilon \\ c_0 + c_1 \Delta x_{t-1} + \cdots + c_k \Delta x_{t-k} + d_1 \Delta y_{t-1} + \cdots + d_k \Delta y_{t-k} + \omega_2 (y_t - \beta_0 - \beta_1 x_t) + \eta \end{bmatrix} (2.52)$$

Among $y_t - \beta_0 - \beta_1 x_t$ Co integration equation

Respectively judge $b_1 = b_2 = \cdots = b_k = 0$ and $c_1 = c_2 = \cdots = c_k = 0$ Whether to set up. In order to determine $x_t$ and $y_t$. The existence of causality between.

3 If the variables $x_t$ and $y_t$, for the different order of the integration process, you can not use the Granger method of causality test.

**A Research variable selection of quantity and price causality**

In order to study the price and trading volume of the Cointegration and Grange causality, the price variables were selected: $p_{1t}, p_{2t}, y_{1t}$ price yield, yield absolute value; trading volume variables: original (log) trading volume $v_{1t}$, expected volume $v_{2t}$, non expected trading volume expected the trading volume in more than the average $v_{1t} l_{1t}$ In accordance with the corresponding relationship between price class variables and transaction variables, the cointegration relationship between variables of unit root is investigated. Then, according to whether there is a co integration relationship among variables, the GRANGER causality between the formula (4.51) or the type (4.52) is selected. Definition of variables and numerical results.

**B Research results of quantity and price causality**

(1) Granger cause and effect test results

As the price $P_i$ is an integral process, and all transactions are a smooth process of variables, and therefore can not be used GARANGE method to test the causal relationship between price and trading volume. The yield and its absolute value and trading volume is a smooth process, so you can use the VAR model (2-59) to test the GRANGER causality between them. After the selection of the order of 2, the rate of return of the class and trading variables of the model estimates and the results of GRANGER causality test values shown in the table, the results show that: The return of Shanghai and Shenzhen two rate coefficient of trading volume in the VAR model $c_1 c_2$ has at least one in 5% yield level is not significantly 0 and corresponding to the trading volume of the GRANGER causality test value ($F$ statistic) are the 5% level significantly. This shows that for the four-different trading volume, the yield changes are GRANGER causality led to changes in the amount of trading.
2 Shanghai and Shenzhen two rate of return - the original expected trading volume, trading volume, non expected trading volume coefficient VAR model $b_1$ and $b_2$ are not significant at the 5% level, this shows that for these three different trading volume, trading volume did not change GRANGER change causal inversion yields. Shanghai market returns - expected $b_1$ coefficient VAR model than the average part of the trading volume in the 5% level significantly to 0, and the corresponding trading volume to yield causality test value ($F$ statistic) was significant at the 5% level, which indicates that the change of GRANGER causality exceed the mean part of the Shanghai market non expected trading volume leads to changes in the rate of return, which further proves the non-expected trading volume in the market of Shanghai more than partial lack of effective information extraction and the mean income first off, have a certain role in prediction of yield changes. The absolute value of the revenue - 3 Shenzhen two city trading volume rate VAR model coefficients of $C_1$, $C_2$ has at least one of the following is not significantly 0% of the level, and the corresponding rate of return the absolute value of GRANGER causality to volume test value ($F$ statistic) are the 5% level significantly. Description for the four different trading volume, the rate of return on the absolute value of the changes are GRANGER causality led to changes in the amount of trading. The absolute value of the rate of return - 4 Shanghai market trading volume in the VAR model, $b_2$ $b_1$ coefficient of at least one of the 5% level is not significantly 0, and the corresponding transaction volume to return the absolute value of GRANGER causality test value ($F$ statistic) are the 5% level significantly. This shows that in the Shanghai market, for four different trading volume, the change in the volume of transactions are GRANGER causality led to changes in the yield of the absolute value. Shenzhen market returns the absolute value of volume VAR model coefficients of $b_1$, $b_2$ in the 5% level is not significant for 0, and the corresponding transaction volume to return the absolute value of GRANGER causality test value ($F$ statistic) are the 5% level is not significant. Shows that in the Shenzhen market, for four different trading volume, trading volume changes are not GRANGER cause and effect of the absolute value of the change in yield. The results show that: in the Shanghai and Shenzhen market, the change in the rate of return and the absolute value of the rate of return GRANGER causality has led to changes in the four trading volume.

5. RESEARCH ON PRICE CHANGE STRATEGY BASED ON TRADING VOLUME

In a certain range of time series, the number of shares traded is trading volume, based on the relationship between price volatility and trading volume and trading volume in the stock price volatility prediction. The same shape position in the late stage of the trend is different, so this part of the main observation reference volume factor after the stock portfolio and the combination of comprehensive income changes, verify the price of the kinetic energy, at the same time, based on the exchange rate for reference, because the flow of capital between the stocks are not the same, does not have comparability, in order to make the trading volume comparable.

(A) Strategy building steps

The main procedure of the strategy is:

First selected two time periods J,K among J Strategy formation period. K Strategy holding period. Corresponding strategies are called strategies. [j,k], Or called J-K cluster.

Next in the period t-K, All the shares in the sample are calculated in the form of (Period of time (t-K) to (t-K)) The total continuous turnover and return, Decomposition is extremely $R_{t-K}$ and $V_{t-K}$.

Again, all the shares in accordance with $R_{t-K}$ Sort from low to high, and divided into 10 groups. The highest rate of return of a group called the winners, Marked as $R_{10}$; The lowest yield is a group called the loser portfolio, marked as $R_{1}$.

And then all the stock in accordance with $V_{t-K}$ Sort from low to high, and divided into 3 groups. A group called the highest turnover rate for high volume portfolios, Marked as $V_1$; A group called the lowest turnover rate for low volume, marked $V_3$. After the two criteria in accordance with the above separate groups to take the intersection, there are 30 combinations. We focus on extreme combination, The winner is respectively high trading volume portfolio $V_1R_{10}$, High trading volume portfolio $V_1R_1$, Low volume winners portfolio $V_2R_{10}$ and low volume loser portfolio $V_3R_1$. According to the combination of long and short of the different typical structures of different investment strategies, are expressed as:

Strategy A: The winner buys high trading volume portfolio $V_1R_{10}$
Strategy B: The winner of buying low volume portfolios \(V_l R_{10}\)

Strategy C: Buy low trading volume \(V_t R_{10}\)

Strategy D: Buy high trading volume \(V_h R_{10}\)

Strategy G: Long strategy A strategy B.\((V_h R_{10} - V_t R_{1}) - (V_l R_{10} - V_t R_{1})\) Strategy H: Long strategy C strategy D.\((V_h R_{10} - V_l R_{1}) - (V_t R_{10} - V_t R_{1})\)

At the same time, calculate the average buy and hold the excess return rate of the four kinds of extreme combination during the holding period. (charge as \(R^K_{P,t+1-K}\), \(P=1, 2, 3, 4\)), so in the period between \(t+1-K\) to \(t+1\), the monthly average of the combination of buying and holding the excess yield of:

\[
\bar{R}^K_{P,t+1-K} = \frac{\sum_{t=1}^{T-K+1} R^K_{P,t+1-K}}{T-K+1} - 1, \quad P=1, 2, 3, 4 \tag{2.53}
\]

Eight typical investment strategies of the average monthly buy and hold the excess yield can be expressed as:

- **Strategy A**: \(\pi_{A,t+1-K}[J,K] = \bar{R}^K_{1,t+1-K} - \bar{R}^K_{2,t+1-K} \tag{2.54}\)
- **Strategy B**: \(\pi_{B,t+1-K}[J,K] = \bar{R}^K_{3,t+1-K} - \bar{R}^K_{4,t+1-K} \tag{2.55}\)
- **Strategy C**: \(\pi_{C,t+1-K}[J,K] = \bar{R}^K_{1,t+1-K} - \bar{R}^K_{4,t+1-K} \tag{2.56}\)
- **Strategy D**: \(\pi_{D,t+1-K}[J,K] = \bar{R}^K_{2,t+1-K} - \bar{R}^K_{4,t+1-K} \tag{2.57}\)
- **Strategy E**: \(\pi_{E,t+1-K}[J,K] = \bar{R}^K_{1,t+1-K} - \bar{R}^K_{2,t+1-K} \tag{2.58}\)
- **Strategy F**: \(\pi_{F,t+1-K}[J,K] = \bar{R}^K_{2,t+1-K} - \bar{R}^K_{3,t+1-K} \tag{2.59}\)
- **Strategy G**: \(\pi_{G,t+1-K}[J,K] = (\bar{R}^K_{1,t+1-K} - \bar{R}^K_{2,t+1-K}) = (\bar{R}^K_{3,t+1-K} - \bar{R}^K_{4,t+1-K}) \tag{2.60}\)
- **Strategy H**: \(\pi_{H,t+1-K}[J,K] = (\bar{R}^K_{1,t+1-K} - \bar{R}^K_{2,t+1-K}) = (\bar{R}^K_{3,t+1-K} - \bar{R}^K_{4,t+1-K}) \tag{2.61}\)

In the end, the time \(t\) is increased by one-time unit, and the above step 2-6 is repeated, and the average yield sequence of four kinds of extreme combination of momentum and eight kinds of typical investment strategies are calculated in turn. Integration of the above steps for any one of the typical investment strategy, in the period \(T\) are holding K portfolio strategy. One of these investment strategies is constructed in the present period (T), and the rest are formed in the early period (K-1) and continue to be held this month. K portfolio strategy in a period of T months to buy and hold the average yield of: \(\bar{\Omega}_{Y,t+1-K}[J,K] = \sum_{t=T-K+1}^{T} \pi_{Y,t+1-K}[J,K] \)

According to the monthly average of the investment portfolio strategy to buy and hold return sequence \(\bar{R}^K_{Y,t+1-K}[J,K]\) \((Y=A,B,C,D,E,F,G,H)\), calculate the corresponding average yield and standard deviation and carry out t test. In the actual analysis, we take the formation period as 1,2,3,4,5,6,7,8,9,10,11,12 month; At each formation stage, the holding period is respectively 1,2,3,4,5,6,7,8,9,10,11,12 month. So that a total of 144 A different formation period - holding period strategy (strategy \([j, k]\)).

(B) **Explanation and analysis of several strategies**

In the stock market, investors due to the amount of money, usually do not operate on all stocks, but by certain standards to select the part of very prominent stock investment, through the trading volume and returns the index of the stock two fine points, one of the methods is to find out which part of the performance of the most prominent
Eight strategies of front structure, it is also studied from different angles within a period of time, including trading volume factors and the selected stock according to stock more than simply whether the investment value of the selected trend. A and B is the study of different levels of stock trading volume. A strategy reflects the price momentum high trading volume in stock; strategy of C and D are of different yield levels of stock were investigated. The strategy of C reflects the high yield differences of total portfolio level stock, and strategy of D it reflects the difference between low level of yields in a trading portfolio amount; strategy of E and F are two other kinds of momentum strategy, E strategy is the winner selling momentum strategies high trading volume portfolio, selling low volume loser portfolio strategy, F is selling the winner low trading volume set, selling high trading volume loser the combination of momentum strategies. AB\CD\EF strategy is composed of extreme value stock portfolio, usually there will be at least a single strategy and momentum strategy in high yield, and less of these strategies contain any number of stocks, so the operation is more suitable for smaller investors.  G strategy and may become the diagonal strategy, it can be seen as selling strategy A, short selling strategy of B, can also be seen as the strategy of C is short and short selling strategy of D is constructed, it only reflects the concept of momentum income differences in the stock trading volume. Strategy H also known as the trading volume strategy, which can be seen as short selling strategy F, short selling strategy E structure, it only reflects the level of trading volume on the impact of extreme stock returns. G and H using this strategy can be more than just a view of the differences in the performance of the two strategies; while the role of the two strategies are superimposed on each other to generate greater revenue. These two strategies are suitable for the operation of large institutional investors.

(C) Research results based on the volume of strategies

Inathan Lee&Swan (2000) pointed out that, from the trading point of view, the price momentum in the high and low trading volume of the stock in the presence of the stock, but the former more than the latter momentum profit. Thus, proposed the existence of momentum life cycle hypothesis of stock operation.

The amount of stock market trading opportunities China momentum strategy empirical results as shown in table 4-4 and table 4-5. The analysis results can be found: low volume loser portfolio in 1-12 months showed significant inertia than the market average price. Minimum yield occurs within 6 months of the holding period; High trading volume portfolio in the 1-12 months of the holding period occurred significant price reversal, the performance is stronger than the average level of the market. Monthly average yield showed high and low U changes. In the 1-4 months of the holding period, the excess return difference is smaller, but in the holding period of 5-12 months, the excess return difference. All combinations have been reversed. The different formation period of high-volume winners combination shown in the formation of high trading volume winners 11-12 months showed a certain price inertia.

According to the results, in the consideration of the trading volume factors, the strategy of B, A, E, F of the excess return, although positive, negative, but mostly significant. This once again shows that in the Chinese stock market, the trading volume provides information outside the price, and the price change trend has a certain role in the forecast. The excess return of the strategy A was significantly negative, while the excess return of the strategy B was significantly positive. This shows that there is no price momentum in the high trading volume, and there is a significant price momentum in the low trading stock. High trading volume does not exist in the stock price momentum is due to release the winners show trading price inertia, high trading volume loser portfolio the price reversal, have a positive excess returns, but in high trading volume losers get excess returns was significantly higher than that of negative excess returns in the corresponding cluster high trading volume the winners take. Is the source of low trading volume in the stock price momentum, the price reversal low trading volume winner portfolio, and trading volume showed a low inertia, low volume and short transmission combination of positive excess returns the negative excess returns higher than in the corresponding clusters for low volume portfolios. Strategy E is a strategy that can obtain significant momentum benefit in the classical sense. Strategic analysis of the structure of the F can be seen in the winner loser portfolio holding period combination of low volume and high transaction volume have undergone a significant reversal, such a long low trading volume winner portfolio, selling high trading volume losers have significant negative excess returns. Thus the reverse strategy of the strategy F also obtained significant positive abnormal returns. And the excess return of strategy F is significantly negative. Note that the strategy E has gained significant momentum gains. Analysis of construction strategy of E can be seen in the winner's high trading volume over the holding period and low volume loser portfolio showed significant price inertia.

That is, the investment strategy A\B and diagonal strategy E are able to obtain significant positive returns. From
the yield point of view, the low trading volume of the stock than the draft deal better performance of the stock, this phenomenon is more significant in the loser portfolio. That is to say C strategy and D gain were negative, but the strategy C yields absolute value is smaller than D. Further shows that the transaction volume provides important information outside the price, the analysis and forecast of the stock’s future revenue has an important role. At the same time, it also shows that the amount and price combination of extreme performance is the choice of strategy.

6. CONCLUSION AND PROSPECT

There is a static causal relationship between price volatility and trading volume, and there is a positive correlation between trading volume and the volatility of the absolute value of the price. The main influence is more than average trading volume, and average trading volume; because trading volume of more than the mean part of the price changes with the dynamic nonlinear correlation and significant, so research on the prediction of the part information trading volume on the price change has feasibility and significance.

The price change and trading volume, volatility and trading volume as well as the causal relationship between the results show that not only the existence of static dependency relation, and there is a significant dynamic dependency relation and there is a significant dynamic dependency relation; through the above described Shanghai and Shenzhen A stock market contains the information of the level of trading volume, but also reflects the effectiveness of technical analysis the market mechanism and temporary failure, negate the effectiveness of the market.

Based on the above conclusions, for the strategy, all the losers and winners have reverse requirements. At the same time after adding the volume factor, found that in the case of the bottom of the market is not short of the reverse can get excess returns. High trading volume and low trading volume at the bottom will show a strong reversal of the price volatility characteristics. It is proved that the trading volume provides information about the price of the price, So in the later focus on high volume breakthrough form and bottom shape, and one of the bottom combined low trading volume is the key form of price reversal.

Research shows that the winners and losers of high price combination had significant price reversal, high price and low price winner loser portfolio showed a significant price inertia. Low long-term oversold stocks have strong inversion and large profit space, ultra low price stock up long-term profit continued strong, performance for the trend market, these two stocks worth investors focus on. But in the long term, whether it is a long-term or short-term stock price rose over the soaring stock price, have undergone a significant reversal, without considering the short sales situation, buy cheap shares with the trading volume of extreme can obtain better excess returns. Through the depth of the stock varieties in the relationship between price volatility and trading volume in the two-dimensional relationship between the depth of the breakdown of the extreme performance of the stock investment. At the same time, adding the factor of time the next step through time series segmentation to select and frequency of variety selection, through time series to improve the Shanghai and Shenzhen A stock market China verification stock market exists a low trading volume low price combination - high trading volume and low price combined trading high combination of low price trading volume portfolio the time period, through the above analysis not only confirms the validity of technical analysis, verify the failure part of market, technology analysis is a supplement of market failure time. So, by introducing the time period parameter to the above technical analysis model, we introduce our next chapter.

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