

# Sensitivity to turnover rate in stock market of mainland China

Anhua Wei<sup>\*1</sup>, Zuojin Zhu<sup>2</sup>

<sup>\*1</sup>Faculty of Computer Science and Technology, USTC, Hefei, China.

<sup>2</sup>Faculty of Engineering Science, USTC, Hefei, 230026, China.

<sup>\*1</sup>weianhua@ustc.edu.cn; <sup>2</sup>zuojin@ustc.edu.cn

## Abstract

The sensitivity to turnover rate in stock market is an ad hoc topic for finance operation. To explore this sensitivity, the turnover rate should be used as a variable to evaluate stock market indicators, indicating that the usually used prediction approach must be improved. Using the improved approach, the data from the database of Shanghai and Shenzhen Stock Exchange (ShSE) over a period of about 16 years~(i.e., from 1th of January of 1996 to 17th of August of 2012) was analyzed. It was exhibited that the sensitivity to turnover rate significantly depends on the stock trading day, and for stock traders choosing a longer trading day is a better selection.

## Keywords

*Sensitivity of annual return rate; turnover rate; KDJ index*

## Introduction

Stocks and bonds are financial capital, also called securities, their prices are determined by the actions of buyers and sellers like the prices in any other market. The annual return from holding a stock is defined as the dividend plus the capital gain during the year. The rate of return is the return stated as a percent of the price of the share (Taylor, 1998). The sensitivity to turnover rate in stock market is an ad hoc topic for finance operation, since stock market plays a crucial role in financial and economical management. Hence, exploring the sensitivity is of great significance in academics and reality.

A brief literature review has shown that a stock market represents a disturbing departure from what would be predicted by existing models of efficient markets, where prices are influenced by traders who anchor on a comparison of year-to-year changes in quarterly earnings, much like the financial press does in its coverage of earnings announcements (Bernard and Thomas 1990). It has its own naivety. The market acts as if it does not use a simple seasonal random

walk model; as if it does exploit serial correlation at lags 1-4 in seasonally-differenced quarterly earnings; as if it does use the correct signs in exploiting serial correlation at each lag; but underestimates the magnitude of serial correlation by approximately 50% on average (Ball and Bartov 1996).

Using transactions data for a sample of stock in the ShenZhen Stock Exchange, Mu, et al. (2004) have applied the techniques of Madhavan et al. (1997) to investigate the bid-ask spread, which was split into the order-processing and asymmetric information components. They found that the bid-ask spread increases with turnover but decreases with the stock price. To study the effect of introducing index futures, Chen et al. (2013) employed a recently developed panel data policy evaluation approach (Hsiao, et al. 2012) construct counterfactuals of the spot market volatility. Their results provide empirical evidence that the introduction of index futures trading significantly reduces the volatility of the Chinese stock market.

We see that the prediction of stock market is useful especially for finance management. The commonly used prediction method, stochastic KDJ index approach (s-KDJ) was developed by Lane (1984). Now it is improved currently by taking the turnover rate as a variable in KDJ index calculation. The improved approach (e-KDJ) has been applied to calculate the mean annual return rate (thereafter called annual return rate) by using the data abstracted from the database of ShSE over the period of about 16 years (i.e., from the 1th of January of 1996 to 17th of August of 2012). The so-called mean refers to the arithmetic averaging to all kinds of stocks of ShSE.

## Index Prediction Method

The traditional s-KDJ index approach of Lane (1984) was first used in futures market, but in the recent years it has been widely used in stock market prediction. The s-KDJ index is a dynamic market

indicator. It can be used to detect market variation tendencies. Lane found that when the price is rising up, the end price closes to the top bound of price range of the trading day; when the price is dropping down, the end price tend to be at the bottom bound of the price range of the trading day. This causes the occurrence of the so-called K- line approach (see in Ref. Wei, 2004). The KDJ index is combined of the K-, D-, and J- indices, denoted respectively by  $K_n$ ,  $D_n$ , and  $J_n$ . The K- line is a smoothed Williams index (Wms) curve (Williams 1973), while D- line is a smoothed K index curve.

When the value of Wms is beyond 80%, the stock price is at a higher level, it needs to take care of the risk of investment. While when the value of Wms is less than 20%, the stock price is at a lower level, it is a signal of buy in. But even at this case, it is also necessary to care about the still further dropping down of stock price. The present e-KDJ index approach is improved from the s-KDJ index method.

Since never more new stock traders cannot merely take care of the price, and old traders cannot watch the amount alone, accordingly, the action criterion should be: when the amount-price relation is appropriate, it is the chance to increase the finance index; otherwise, it is time to decrease the finance index. Based on this criterion, remembering the turnover rate (TR) effect in stock market, the e-KDJ index approach is given by

$$\begin{cases} (Wms)_n = \frac{C_n - L(m)}{H(m) - L(m)}; \\ K_n = [(Wms)_n / 3 + 2K_{n-1} / 3] + \Phi \\ D_n = K_n / 3 + 2D_{n-1} / 3 \\ J_n = 3K_n - 2D_n \end{cases} \quad (1)$$

where  $C_n$  is the close price, with the subscript representing the trading day ( $d$ ),  $m$  is the time period, its time unit  $d$  can be assigned by a day, a week, or a month, depending on the exchange strategy of stock traders.  $\Phi$  is a function involved with turnover rate and stock close price difference, with a definition of

$$\Phi = \{(TR)_n \cdot \text{sgn}[\Delta(TR)_n] \cdot \text{sgn}(\Delta C_n)\} \quad (2)$$

and the stock turnover rate of the trading day is defined by

$$(TR)_n = \left[ \frac{(VS)_n}{(CS)_n} \right] \times 100\% \quad (3)$$

where  $(VS)_n$  is the volume of shares traded in the trading day, and  $(CS)_n$  is the circulation shares of the

trading day. Note that

$$\Delta(TR)_n = (TR)_n - (TR)_{n-1} \quad (4)$$

is the stock turnover rate difference, with

$$\Delta C_n (= C_n - C_{n-1}) \quad (5)$$

representing the close price difference. While  $\text{sgn}(x)$  is just a symbol function, it takes a value of -1 for the case of negative  $x$ , but equals +1 when  $x$  is positive. If the value of  $\Phi$  is set as zero, the e-KDJ index approach backs to s-KDJ index approach. The initial values of  $K_n$  and  $D_n$  for  $n=0$  are usually assigned to be 50%, since the influence of  $K_0$  and  $D_0$  should be vanished for the security processing over a long time period.

Notably, the observation of the exchanging waves in the mainland of China shows that the exchanging wave magnitude in the day is larger as soon as the stock turnover rate of the day is higher, and vice-versa. To recognize and clarify the characteristics of the exchanging waves properly, some security processing knowledge in the work (Wei, 2004) would be helpful. The real interest of proposing the e-KDJ originates from the subjective recognition that the turnover rate (TR) effect would be non-negligible.

The variation of  $K_n$  index has related to the dynamic evolution of stock turnover rate. The influences of turnover rate are related to other market features, such as the rate of stock holding target (i.e., portfolio rate)  $p$ , the stock holding period  $T$ , and the period of trading day  $d$ . Here, it is worth noting that the portfolio rate is just a pre-assigned value used to specify the stock trader action. As soon as the portfolio rate is reached or even beyond, the trader must sell out the holding shares.

The e-KDJ index approach has been used to analyze the data from ShSE of China over a period of about 16 years, in order to explore the sensitivity to turnover rate of stock market. The results are reported and discussed in the following section.

## Results and Discussion

At first, it is required to clarify the concepts of Kline and K-curve before the result discussion. The K-line is shown by a coarse vertical red or blue bar to the horizontal time-coordinate in the schematic figure for stock market. While the K-curve shows the temporal evolution of  $K_n$ , a market indicator illustrating the divergent or convergent tendency. In the analysis of K-index, the K- curve can reflect the open and close

prices of the trading day ( $d$ ), and the maximum and minimum prices over the stock holding period ( $T$ ). The K- curve is accompanied with the D- curve which gives the value of  $D_n$ , and the J- curve with a relatively high oscillation frequency.

Secondly, the time period  $m$  was set as  $9d$ , with the unit of trading day ( $d$ ) in the Eq. (1) assigned as a week, and a month. The stock holding period  $T$ , was assumed to be 60, 90, 120 day. In the action criteria of buyers and sellers, it is stipulated that not matter whether the exchange return rate per time is positive or not, when the holding time has reached to the  $T$  value, a sell out action for the holding stock must be executed.

Thirdly, for stock traders, the tendencies of KD curves are more crucial, since the buy-cheap & selldear maneuver needs the information of whether the cross-over or cross-below point of KD curves has occurred. Explicitly, the KD curves obtained by the e-KDJ index approach is different from that by the s-KDJ index approach of Lane (1984).

In general, the annual return rate depends on portfolio rate and the stock holding period. For a given portfolio rate, the sensitivity to turnover rate is defined by

$$\sigma_R = R_e - R_s \quad (6)$$

where  $R_e$  is the annual return rate predicted by e-KDJ index approach, with  $R_s$  being the relevant rate predicted by s-KDJ index approach. The relevant results will be discussed from two aspects relating to the portfolio rate effect and stock holding period effect.

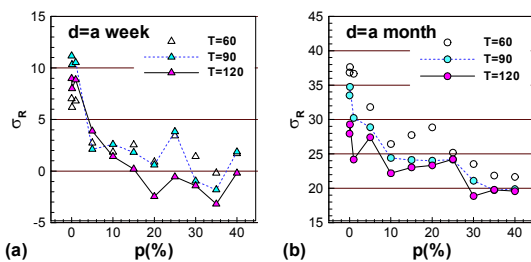


FIG. 1 ANNUAL RETURN RATE SENSITIVITY TO TURNOVER RATE PLOTTED AS A FUNCTION OF THE PORTFOLIO RATE  $p$ .

(a)  $d = \text{a week}$ ; (b)  $d = \text{a month}$

The portfolio rate values are given in the first column of Tables (1-2). Notably, in Tables (1-2), it is seen that in the first line, for  $p=0.1\%$ , the annual return rates are generally negative. This can be used to elucidate the common phenomenon in mainland China: almost certainly many exchangers without using suitable approaches in stock market analysis, have not security

gained, but more or less security lost. This suggests that the security information processing is crucial, especially for those stock market traders.

TABLE 1 COMPARISON OF ANNUAL RETURN FOR  $d = \text{a week}$ ,  $T = 60, 90, \text{ AND } 120 \text{ DAY}$

$p$	$T = 60$		$T = 90$		$T = 120$	
	$R_s$	$R_e$	$R_s$	$R_e$	$R_s$	$R_e$
0.1	-31.21	-25.02	-23.27	-12.95	-16.89	-8.88
1	-22.02	-15.22	-15.68	-5.15	-10.05	-1.19
5	-4.72	-1.99	1.17	3.29	1.83	5.72
10	2.72	4.57	6.44	9.04	7.92	9.34
15	5.95	8.50	9.54	11.36	9.79	9.99
20	9.65	10.53	13.12	13.72	13.70	11.24
25	12.69	16.11	15.65	19.48	16.31	15.76
30	16.15	17.57	20.32	19.36	18.87	17.46
35	17.53	17.35	21.78	19.97	22.52	19.33
40	19.30	21.00	22.04	23.91	22.59	22.41

TABLE 2 COMPARISON OF ANNUAL RETURN FOR  $d = \text{a month}$ ,  $T = 60, 90, \text{ AND } 120 \text{ DAY}$

$p$	$T = 60$		$T = 90$		$T = 120$	
	$R_s$	$R_e$	$R_s$	$R_e$	$R_s$	$R_e$
0.1	-44.25	-6.62	-34.62	<b>0.13</b>	-29.37	-0.08
1	-35.18	1.49	-27.10	<b>3.13</b>	-22.28	1.91
5	-16.68	<b>15.13</b>	-13.41	<b>15.47</b>	-12.24	<b>15.18</b>
10	-4.69	21.75	-3.72	20.69	-2.74	19.45
15	1.14	28.88	3.11	27.23	3.72	26.76
20	6.86	35.75	8.06	32.08	6.93	30.27
25	12.88	38.06	14.38	38.56	11.78	36.01
30	15.57	39.10	17.55	38.65	15.06	33.94
35	17.59	39.45	20.05	39.79	17.05	36.84
40	17.73	39.39	20.01	39.90	17.45	37.03

Table 1 shows that for  $d = \text{a week}$ ,  $T = 60, 90, \text{ and } 120$ , the annual return rate increases monotonically with the portfolio rate, in most cases, the annual return rate  $R_e$  is higher than  $R_s$ . At higher portfolio rates ( $p \geq 20\%$ ), the relative discrepancy of  $R_s$  in comparison with  $R_e$  is rather small. However, this does not occur at lower portfolio rates ( $p < 20\%$ ). However, as seen in Table 2, especially invaluable data are given by bold values at  $T=90$ ,

$$R_e = \begin{cases} 0.13, & \text{for } p = 0.1; \\ 3.13, & \text{for } p = 1. \end{cases}$$

for the those buyers and sellers who have set lower portfolio rates, it is merely possible to get a basic finance balance. According to the definition of Eq. (6), the sensitivity to turnover rate should be significant. For instance, for  $d = \text{a month}$ , the present e-KDJ index approach has predicted an annual return rate ( $R_e$ )

beyond 15% at  $p=5\%$ , while the s-KDJ index approach has calculated an annual return rate  $R_s$  less than -12%.

In Fig. 1(a), at portfolio rates larger than 5%, the absolute value of sensitivity is lower than 5%, and the influence from stock holding time period is almost negligible. At smaller portfolio rates, the sensitivity has not beyond 11.17%. In Fig. 1(b), it is seen that sensitivity decreases slightly with the increase of stock holding time period, and drops down in general with the growing of portfolio rate. The value of sensitivity is usually higher than 18.88%. This indicates the the annual return rate sensitivity to the turnover rate, depends significantly on the time period of trading day. The longer is the better option. The annual return rate is more sensitive to the stock holding period  $T$  at lower the portfolio rates.

With the increase of portfolio rate, the effect of stock holding period decreases, as indicated in Figs. 1(a-b). It was exhibited that for those stock traders with pre-assigned lower portfolio rate, the better option is set  $T=90$  day, which, just equals a quarter of one year.

## Conclusions

The sensitivity to stock turnover rate in stock market of mainland China was explored. An e-KDJ index approach was proposed in which the turnover rate is taken as a variable. It was found that at the portfolio rate  $p=0.1\%$  the annual return rate is almost all negative without regarding to prediction methods employed in this work. This finding can be used to elucidate why those stock traders having assigned lower portfolio rate are not easy to benefit from stock exchange. Comparing the results achieved by different KDJ index approaches, it was revealed that the sensitivity to the stock turnover rate depends significantly on the time period of trading day, and for stock traders choosing a longer trading day is a better option. These findings suggest that the presented prediction approach does have application potentiality.

## Acknowledgement

This work is partially supported by Natural Science Foundation of China (NSFC) (10972212).

## REFERENCES

Ball, R. and Bartov, E. How naive is the stock market's use of earnings information?, *Journal of Accounting and Economics*, 21(1996): 319–337.

Bernard, V.L. and Thomas, J.K. Evidence that stock prices do not fully reflect the implications of current earnings for future earnings, *Journal of Accounting and Economics*, 13(1990): 305–340.

Chen, H.Q., Han, Q., Li, Y.X. and Wu, K., Does index futures trading reduce volatility in the Chinese Stock Market? A panel data evaluation approach, *The Journal of Futures Markets*, 33(12)(2013): 1167–1190.

Graville, J.E. Graville's New strategy of daily stock market timing for maximum profit, (1976): Prentice-Hall Publisher, New Jersey.

Hsiao, C., Ching, H. S. and Wan, S. K. A panel data approach for program evaluation-measuring the benefits of political and economic integration of Hong Kong with mainland China. *Journal of Applied Econometrics*, 27(5) (2012): 705-740.

Lane, G.C., Lane's Stochastics, in: *Technical Analysis of Stocks and Commodities*, London, UK, May/June, (1984): <http://www.trade2win.com>.

Madhavan, A., Richardson, M. and Roomans, M. Why do security prices change? A transaction level analysis of NYSE stocks, *Review of Financial Studies*, 10(1997): 1035–1064.

Mu, Q.G., Wu C.F. and Liu, H.L., Components of the Bid-Ask Spread in the Shenzhen Stock Exchange, *Systems Engineering-Theory Methodology Applications*, 13(2004): 239–249.

Taylor, J.B., *Economics*, Chap. 13, 2nd Ed., New York: Houghton Mifflin Company, 1998.

Wei, A.H. *Security Information Processing*, (2004): USTC Publisher, Hefei, China(in Chinese).

Williams, L.R. How I made one million dollars in commodity market last year, Carmel Valley, California: *Conceptual Management* (1973).

**Anhua Wei** is Master of Computer Science and Technology, from University of Science and Technology of China (USTC). He has an interest of security information processing, for which a book was written and published in 2004.

**Zuojin Zhu** is PhD of Fluid Mechanics, from Shanghai Jiao Tong University. Dr. Zhu has just done some assistant work to this paper.