# 4. SHOCK EFFECTS FROM INTERNATIONAL STOCK PRICE VOLATILITY ON INVESTMENT STYLE DRIFT IN CHINESE OPEN-END FUNDS

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## Abstract

*According to international capital market statistics, shock effects from stock price volatility are a principal determinant of investment style drift in open-end funds. Data for 266 open-end funds were selected from China's capital market between 2008 and 2014. The R/S analysis method and the box fractal dimension were utilised to produce a drift index of investment style (DIIS). Based on the empirical results, three conclusions are noteworthy. First, the six types of pure style CITIC assets index return series have a long-term memory characteristic in the daily, weekly and monthly dimensions; the fractal characteristic of the pure value style of the asset is more significant than that of the pure growth style. Second, the 266 open-end funds are heterogeneous with respect to investment style drift; the serious investment style of the open-end fund was associated with about one third of these funds. Third, the foreign stock index lasted for a long time. HSI 000001, 399001 and 000300 contribute about half of all the variables to DIIS; they are the main factors in investment style shift. Further, the shock effect of international stock price volatility to DIIS exhibited a long-term time-lag effect; while, the domestic series has stronger shock effect on fluctuation range of DIIS.*

**Keywords:** open-end fund; investment style property; investment style drift; international stock price ; shock effect

**JEL Classification**: G15

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# I. Introduction

Since 1924, open-end funds have exerted a powerful force across the world. With international experiences of dissemination and innovation in the fund market, the varieties, size and turnover of open-end funds has risen rapidly. The rate of open-end funds is more than 90% of funds in Europe, the United States, China and Hong Kong. The fund industry in China is the product of bottom-up development. In 2001, the first open-end fund came into operation. As competition in financial markets is becoming increasingly fierce, open-end funds have taken professional advantage in meeting the financial needs of Chinese residents. At the end of 2013, the number of open-end funds in China had risen to 1421; the number of equity funds totalled 610 or 43%, with blend and bond funds constituting 21% and 26%, respectively. Monetary funds were the least utilised, accounting for less than 10% of the total funds. Fund shares total 29213.24 hundred million with total assets of 28023.98 hundred million in 2013. The shares of the funds and the turnover of the funds both has the same overall upward trend with the volatility of China's stock market.

Recently, determinants of the international stock price volatility of the open-end funds have been widely researched. It has been common knowledge that when modifications in stock compositions occurred, the possibility of change of the investment style of the funds rose. The volatility of stock prices is a principal reason why investment style drift of open-end funds occurs. Importantly, what are the features of open-end funds in China's capital market? Has the investment style drifted compared to the original style? If any drift has occurred, how should it be measured? What are the main international stock indexes which determine the investment style drift of the open-end funds? How international stock indexes contribute to shock do effects vis-à-vis the DIIS? These questions guide the research presented herein and are explored from a quantitative point of view; further, this study is based on the fractal theory in the nonlinear science.

# II. Literature Review

There is burgeoning literature on the reasons why investment style drift occurs. Wayne Ferson and Rudi Sehadt[1] applied the traditional pricing model to predict price volatility in fund markets. They found that changes in the expectations of managers towards the market may lead to changes in investment style. Gallo & Lockwood [2] indicated that about 65% of funds were associated with the drift phenomenon vis-à-vis investment style for data spanning 1983–1991; this reflected the fact that management-induced changes easily resulted in changes of investment style. Chan, Chen and Lakonishok [3] conducted research using monthly data on mutual funds in the US; their results testified to the impact of competitive pressures between fund managers, when they found that the possibility of changes in the investment style of poor funds was larger than that of better performing funds. Lynch, Musto [4] and Louis K.C [5] came to the conclusion that there is a relationship between the performance of funds and changes in investment style; if the manager had a record of poor performance before, he would be more likely to experience investment style drift. Cooper, Gulen and Rau [6] found that changes of the fund name also led to changes in the drift of investment style, and more importantly,

the irrational investment behaviour of investors might result in the situation that investors put more money into the funds. Andrew, Kingsley and David [7] indicated that managers with better performance records were more likely to change investment style. Cumming D J and Johan S A [8] posited that younger managers were less likely to exhibit drifts in investment style. Babalos V, Caporale G M and Philippas N [9] selected 358 stocks in European mutual funds; there is no significant difference between men and women, but the management style between men and women had different quantile.

In the Chinese context, Xiaojie Zeng, Song Huang and Guoqiang Chu[10] determined that the unregulated investment of fund investors, the non-standard issue of fund products and immature development of China's securities market are the three main reasons explaining drift of the investment style of funds. Shengjun Xiong and Zhaojun Yang [11] indicated that the instability of fund managers, fund managers' expectations towards the securities market and pressure on fund managers, vis-à-vis past performance of the fund, were all important determinants of the drift. Jin Sun and Yuanhua Qiu [12] came to the conclusion that the rank of the fund has a substantive effect on investment style through the analysis of data from closed-end funds between 2001 and 2003 and open-end funds in 2003. Dan Zhu[13]stated that the manager and the stock market investment style affected the style of fund investment and drift. Jindong Ouyang [14] indicated that the determinants of fund investment style consistency and drift included pressure on managers to perform limited financial system innovation, which means less choice for investors, leading to a convergence of investment styles. Hongde Ai and Cong Liu [15] found that work hours and educational background were important determinants, with gender and age having less effect. Guanghui Song and Lin Xu [16] suggested that the frequency at which fund managers change educational background and experience in the operation of funds exhibited negative correlations with the drift of investment style. Jianguo Liu and Linjun Zhang [17] found that the volatility of the securities market is an important factor which causes fund managers to adjust investment style. Zhibo Liu [18] conducted research based on the SDS using the SHARP model to analyse relationships between heterogeneity of fund managers and investment style drift in China's open-end equity funds. They established that fund manager turnover, working hours of managers and educational background had significant effects on investment style. Cuncun Zhao [19] found that managers' ability was a function of gender. Females had higher ownership concentration and industry concentration and were associated with smaller drift compared to their male counterparts. However, when the market demonstrates a bull trend, the frequency with which female managers change style is higher than that of males. He Gao, Minfei Li and Feng Gao[20] researched the effect of gender on the investment style of funds based on data for managers in open-end funds from 2006 to 2011 in China. They selected managers of different genders who had similar characteristics and found that there were no obvious differences between female and male managers in terms of the investment styles of funds, although females exhibited higher risk aversion.

The foregoing research is mainly based on qualitative analysis; limited studies utilised quantitative techniques.

# III. Sample Selection and Data Processing

## III.1 Sample Selection

The data consists of 266 open-end funds that were founded before June 2008. The research period is the 25 quarters between 1 October 2008 and 31 December 2014. In this period, the securities market could be characterised as a bull market followed by its subsequent collapse. In the latter stage, the situation presented a bull market for a short period and then volatility and a bear market, followed by a new bull market. The period includes the entire bull market, the bear market and the volatility and, thus, provides good representation in terms of the diversity of empirical dynamics.

As the six indexes of the S&P/CITIC Style index have been widely used, three types of pure growth indexes were chosen, specifically the long market of pure growth index (LPG), the market of middle pure growth index (MPG) and the small market of pure growth index (SPG). Three counterpart pure value indexes were also chosen: the long market of pure value index (LPV), the market of middle pure value index (MPV) and the small market of pure value index (SPV). These six indexes constitute the style property index.

According to the principles of domestic and overseas influence and wide coverage of stock indexes, nine international stock indexes and five domestic stock indexes were selected, as follows: the Dow Jones Industrial Average (DJI), the FTSE 100 Index (FTSE), the S&P 500 (GSPC), the Hang Seng Index (HSI), the Nasdaq index (IXIC), Russia's Micex Index (MCIX), the Nikkei 225 (N225), India's SENSEX, Taiwan's weighted Index (TWII), the Shanghai Stock Exchange Comprehensive Index (000001), the Shenzhen Component Index (399001), the Shanghai and Shenzhen 300 Index (CSI 300, 000300), the SSE SME composite Index (399005) and the GEM Index (399006).

## III.2. Data Collection and Processing

Data pertaining to the open-end funds and the domestic and overseas stock indexes are contained in the database of CRMAR. There are 1519 daily net values, 319 weekly net values and 75 monthly net values of each fund. The international stock indexes are associated with 1519 daily closing values, 75 monthly closing values and 25 quarterly closing indexes. The domestic indexes consist of 1519 daily closing values, 75 monthly closing values and 25 quarterly closing values.

The aim, to deal with the net value of funds, is to have the yield of the funds (Equation 1).

$$r_{i,t} = \frac{NAV_{i,t} - NAV_{i,t-1}}{NAV_{i,t-1}} \quad (1)$$

$r_{i,t}$ is the yield of i fund at time t (day, week or month); $NAV_{i,t}$ is the unit net value of i fund at time t (day, week, month).

The aim, to deal with the closing price of the style property index and the closing price of the stock indexes, is to have the yield of the style property index and the closing price of the stock indexes (Equation 2).

$$R_{i\,,\,t} = \ln(1 + r_{i\,,\,t}) = \ln(1 + \frac{p_{i\,,\,t}}{p_{i\,,\,t-1}}) \approx \ln\frac{p_{i\,,\,t}}{p_{i\,,\,t-1}} = \ln p_{i\,,\,t} - \ln p_{i\,,\,t-1} \quad (2)$$

$R_{i,\,t}$ is the natural logarithmic yield of i style property at time t (day, week, month), $p_{i,\,t}$ is the unit net value of i style property at time t (day, week, month).

## III.3. Empirical Analysis

After necessary pre-treatment of the original data, it is essential to test and explore stability, normality and Granger causality. For the sake of exposition, DJI, FTSE, GSPC, HIS, IXIC, MCIX, N225, SENSEX, TWII from foreign and five domestic stock indexes was chosen to be examined in this way as shown in Table 1.

(1) Stability

Focussing on the international stock indexes, the results of stability testing are delineated in Table 1.

**Table 1**

**Results of ADF Tests on the Yield of International Stock Indexes**

| Name | DJI | FTSE | GSPC | HIS | IXIC | MCIX | N225 |
|---|---|---|---|---|---|---|---|
| ADF | −5.59*** | −4.96*** | −5.14*** | −4.13*** | −4.65*** | −5.07*** | −2.60* |
| Stability | Stability | Stability | Stability | Stability | Stability | Stability | Stability |
| Name | SENSEX | TWII | 1 | 399001 | 300 | 399005 | 399006 |
| ADF | −3.39** | −4.96*** | −2.88* | −3.07** | −2.79* | −3.82*** | −3.51** |
| Stability | Stability | Stability | Stability | Stability | Stability | Stability | Stability |

*Note: */**/*** represent passing the ADF test at the 10%/5%/1% significance levels, respectively.*

The results show that all indexes passed the ADF test, at least at the 10% level; thus, we deem them to be suitable for empirical analysis.

(2) Normality

Q-Q plots can be used to determine the extent to which data series adhere to normal distributions. Figure 1 presents Q-Q plots for the yield of six S&P/CITIC Style indexes.

The Q-Q plots of the six S&P/CITIC Style indexes suggest deviations from normality in all cases, because they converge towards 'S' shaped distributions away from the diagonals.

(3). Granger Causality

Granger causality tests are used to clarify the relationships between the volatility of international stocks and investment style drift of the open-end funds based on the yield of the international and domestic quarterly closing data and the data from China's quarterly open-end funds in drift. The results are presented in Table 2.

**Figure 1**

**Q-Q Plots for the Daily Yield of Style Properties**

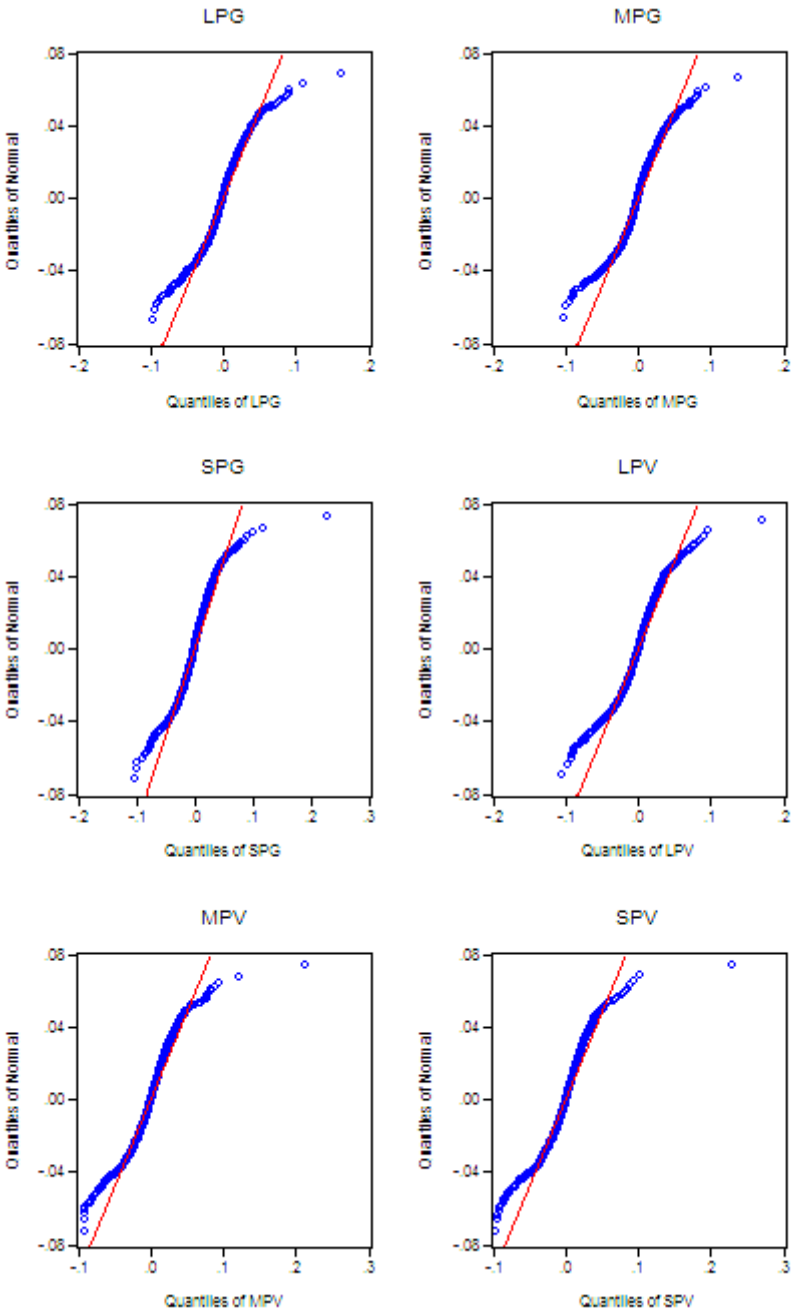


**Table 2**

**Granger Causality Testing for Domestic Stock Index Yield and DIIS**

| Null Hypothesis | F-Statistic | P | Result |
|---|---|---|---|
| DIIS does not Granger cause 000001 | 0.08372 | 0.7752 | Accepted |
| 000001 does not Granger cause DIIS | 4.55276 | 0.0448 | Rejected |
| DIIS does not Granger cause 399001 | 0.02672 | 0.8717 | Accepted |
| 399001 does not Granger cause DIIS | 4.98638 | 0.0366 | Rejected |
| DIIS does not Granger cause 000300 | 0.09970 | 0.7553 | Accepted |
| 000300 does not Granger cause DIIS | 4.64909 | 0.0428 | Rejected |
| DIIS does not Granger cause 399005 | 0.14868 | 0.8629 | Accepted |
| 399005 does not Granger cause DIIS | 2.658482 | 0.0976 | Rejected |
| DIIS does not Granger cause 399006 | 0.36879 | 0.6967 | Accepted |
| 399006 does not Granger cause DIIS | 7.62193 | 0.0306 | Rejected |

The results suggest unidirectional causality whereby the stock indexes Granger cause DIIS, and DIIS does not Granger cause the stock indexes.

## IV. Fractal Characteristics of the Open-end Fund Market in China

Rescaled Range Analysis belongs to the family of nonparametric statistical methods; H.E. Hurst, a British hydrologist, put forth the Hurst index to measure the statistical correlation of time series based on the Rescaled Range Analysis. The range of the Hurst index is from 0 to 1. The nearer the value of this index is to 0, the higher the persistence of the time series. When the Hurst index is 0.5, it shows that the time series exhibits random walk features, which have nothing to do with the future. The values of the index between 0.5 and 1 suggest that the time series has long memory.

When using Rescaled Range Analysis for the purpose of empirical analysis, it is important to pay attention to the length of the time series. As the data of the style properties in China's capital market is a few for its short term development, the length of the scale is as following: $10，11，\cdots，\mathrm{int}(\frac{N}{2})$. For the purposes of fractal analysis, the software Matlab 7.0 is used herein. The long market of the pure growth index was used as an exemplar series, using daily, weekly and monthly yields (Tables 3 and 4).

**Figure 2**

**Logn-logRS for LPG Daily Yield**

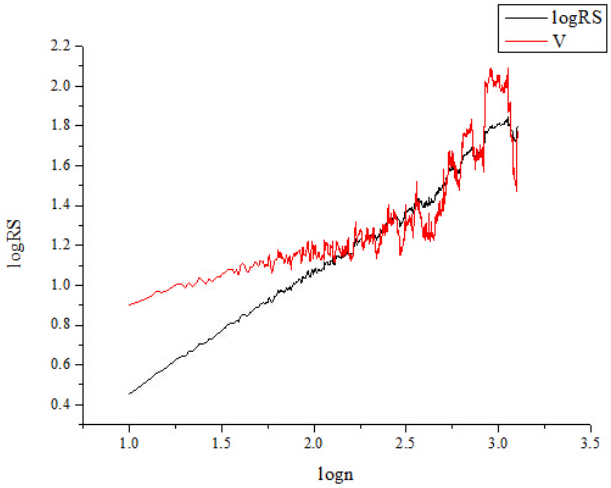



**Table 3**

**Results of R/S Analysis on Three Pure Growth Yield Indexes**

| INDEX | time | Hurst | Cycle | R-squared | Pearson's r |
|---|---|---|---|---|---|
| LPG | daily yield | 0.6949 | 913 | 0.9722 | 0.986 |
| | weekly yield | 0.7634 | 225 | 0.9707 | 0.9853 |
| | monthly yield | 0.844 | 47 | 0.9482 | 0.9743 |
| MPG | daily yield | 0.6804 | 901 | 0.9735 | 0.9867 |
| | weekly yield | 0.7364 | 225 | 0.9696 | 0.9847 |
| | monthly yield | 0.8268 | 47 | 0.9357 | 0.9679 |
| SPG | daily yield | 0.6708 | 875 | 0.9721 | 0.986 |
| | weekly yield | 0.7286 | 225 | 0.9661 | 0.983 |
| | monthly yield | 0.804 | 47 | 0.9232 | 0.9616 |

**Table 4**

**Results of R/S Analysis of Three Pure Value Yield Indexes**

| INDEX | time | Hurst | Cycle | R-squared | Pearson's r |
|---|---|---|---|---|---|
| LPV | daily yield | 0.6932 | 1128 | 0.9809 | 0.9904 |
| | weekly yield | 0.7501 | 225 | 0.9789 | 0.9894 |
| | monthly yield | 0.8138 | 57 | 0.9648 | 0.9826 |
| MPV | daily yield | 0.6766 | 1128 | 0.9839 | 0.992 |
| | weekly yield | 0.7395 | 225 | 0.9808 | 0.9904 |
| | monthly yield | 0.8179 | 57 | 0.9575 | 0.9789 |
| SPV | daily yield | 0.6857 | 1128 | 0.9792 | 0.99 |
| | weekly yield | 0.7452 | 225 | 0.9785 | 0.9892 |
| | monthly yield | 0.839 | 57 | 0.9572 | 0.9788 |

In Table 3 and Table 4, the Hurst index of LPG is larger than that of LPV, indicating that the fractal characteristic of the former is more significant than the latter. The Hurst index of SPG is larger than the Hurst index of SPV; this shows that the fractal characteristic of SPG is more significant than that of SPV. The average daily and monthly cycle length of the pure growth style properties is less than those of the pure value style properties. The average weekly cycle length of the pure growth style properties is the same as those of the pure value style properties (225 weeks). Thus, we can conclude that the fractal characteristics of the pure growth style properties are more significant than that of the pure value style properties.

Rescaled Range Analysis of the two random series from the yield of the S&P/CITIC style properties was conducted, and we test whether the Hurst index is reliable. The monthly yield was chosen to compare the later Hurst index and the Hurst index of the random series (Table 5).

**Table 5**

**Later Hurst Index versus Hurst Index of the Random Series**

| INDEX | LPG | MPG | SPG | LPV | MPV | SPV |
|---|---|---|---|---|---|---|
| Hurst | 0.8440 | 0.8268 | 0.8040 | 0.8138 | 0.8179 | 0.8390 |
| Random series 1-Hurst | 0.5280 | 0.6067 | 0.4982 | 0.5360 | 0.5240 | 0.5352 |
| Random series 2-Hurst | 0.4846 | 0.5247 | 0.5195 | 0.5415 | 0.5418 | 0.4733 |

Table 5 shows that the monthly yield series of the S&P/CITIC style properties have changed in two situations. Further, the random Hurst index is less than the normal Hurst index, indicating that the monthly yield series of the S&P/CITIC style properties have the long memory characteristic. The Hurst index is around 0.5, showing that the random monthly yield series of the S&P/CITIC style properties have random walk properties.

# V. Analysis of Investment Index Drift in Chinese Open-end Funds

## V.1. Model Construction

The Gini coefficient is a widely-used measure of income distribution; for the first time, we invoke the DIIS to measure the degree of drift in the investment style of funds (Equation 3)

$$DIIS = 1 + \frac{1}{n} - \frac{2}{n^2\overline{D}}\left[D_1 + 2D_2 + 3D_3 + \cdots + (n-1)D_{n-1} + nD_n\right], \quad (3)$$

where n is the period, $\overline{D}$ is the mean of the fractal dimension and $D_1, D_2, \cdots, D_{n-1}, D_n$ is the ranked series from large to small of each dimension. The box fractal dimension method is used to measure fractal dimension D, as follows:

(1) Assuming that the size of the cover box is δ, and the range of δ is as follows:

$$\frac{N}{2^1}, \frac{N}{2^2}, \frac{N}{2^3}, \cdots, \frac{N}{2^{\mathrm{int}\left[\log_2(N)\right]}}$$

(2) The number of boxes is M(δ), which states the numbers of time series which have the fractal characters covered by δ. Then having the value of $1/\delta$ and M (δ), the problem is contained by the double logarithmic graph of logM (δ)−log(1/δ).

(3) The least squares method was used to fit the slope of the double logarithmic series from (2). The slope measures the number of box dimensions that have fractal characteristics.

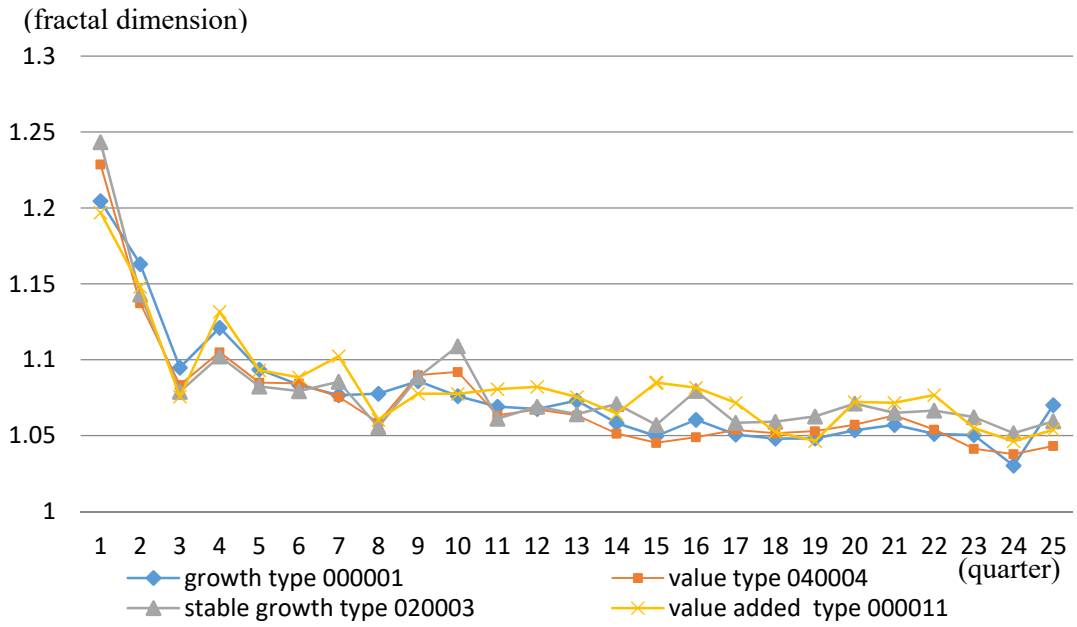
The dimensions reflect the non-smooth degree of the curve. D ranges from 1 to 2; the maximum value of the DIIS index is 1/6 and the minimum is 0. The degree of investment style drift is positively related to the value of DIIS. When DIIS is between 0.11 and 0.039, it shows that there is consistency between actual and stated investment style; the possibility of drift is small. When DIIS is between 0.04 and 0.08, it indicates that the degree of the drift is serious; the other shows that the investment style has totally changed when DIIS is over 0.08.

## V.2. Measuring the Quarterly Investment Style Dimension of Funds

MATLAB was used to measure the box fractal dimensions of 266 open-end funds in 25 quarters. The box fractal dimensions of different funds are qualitatively identical through time; indeed, the time factor reflects the fluctuations of the market. One of the investment styles is chosen for measuring the box fractal dimension.

**Figure 3**

**Box Fractal Dimension in Four Investment Styles Over 25 Quarters**

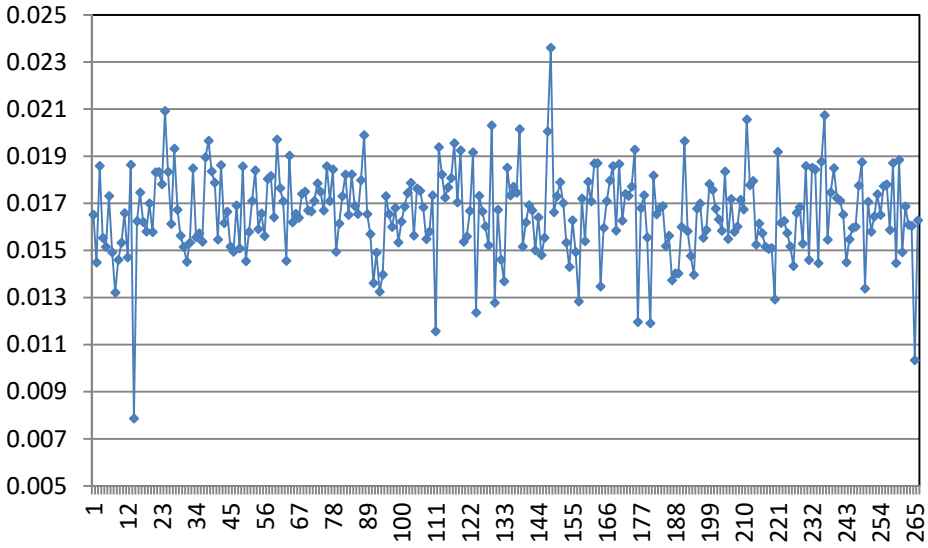


## V.3. Measuring the Drift Index of the Quarterly Investment Style in Funds

**Figure 4**

**DIIS of 25 Quarterly Open-end Funds**

n = 25. The results are as follows:




Over 266 data points, there is only one whose DIIS is between 0 and 0.01 (020018). A total of 231 funds' (96.99%) DIIS is between 0.01 and 0.02. The number of funds whose DIIS is over 0.02 but under 0.03 is 7 (05007, 21001, 217010, 241001, 253010, 510180, 519601), accounting for 2.63% of the data. The situation shows that only one fund's style did not change. The other 265 funds has drifted from reserved style, which accounts over 99%.

To get 25 quarterly time series data of the drift index of the open-end funds in China, MATLAB was used to calculate the index of DIIS. Table 6 displays the results of the mean DIIS of each quarter of the funds.

**Table 6**

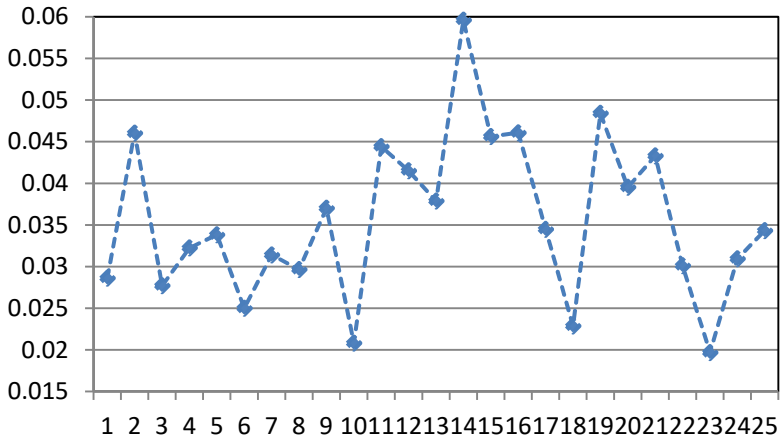
**DIIS of the Drift Index of the Investment Style in China' Open-end Funds**

| Quarter | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| DIIS | 0.02862 | 0.04604 | 0.027714 | 0.03225 | 0.033832 | 0.025005 | 0.031408 | 0.029661 | 0.037016 |
| Quarter | 10 | 111 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| DIIS | 0.020805 | 0.044413 | 0.041514 | 0.037881 | 0.059605 | 0.04564 | 0.046081 | 0.034492 | 0.022864 |
| Quarter | 19 | 20 | 21 | 22 | 23 | 24 | 25 | | |
| DIIS | 0.048412 | 0.039532 | 0.043301 | 0.030115 | 0.019682 | 0.030952 | 0.034333 | | |

Figure 5 shows the fluctuations of the DIIS.

**Figure 5**

**DIIS of the Drift Index of the Investment Style in Open-end Funds**




All the open-end funds' DIIS are over 0.01; all data exhibit drift in the 25 quarters. There are 17 quarters (68%) in which the drift index is in the range of 0.01 and 0.04, showing that there is a moderate drift in investment style. There are 8 (32%) quarters in which the drift index is in the range of 0.04 and 0.08, showing that there is serious drift in investment style, accounting for about 32%. There are no DIIS over 0.08, showing that there is not a style rotation phenomenon across the 25 quarters.

# VI. DIIS and International Stock Price Volatility

## VI.1. Analysis of DIIS Impulse Response with International Stock Price Volatility

The impulse response function is a method to measure one variable's shock on another variable, including its influence path. Figure 6-11 shows the impulse response charts of the yield of the closing index of the international stock impulse response with the drift of open-end funds in China using the VAR method. Six impulse response charts are presented. The first is HIS. The second contains the following aspects: DJI, FTSE, GSPC and SENSEX. The third comprises IXIC and N225, and the last comprises MCIX and TWII. There are two impulse response charts pertaining to domestic stock: one contains 00001, 399001 and 000300; the other corresponds to 399005 and 399006. Table 7 summarises these results.

**Figure 6**

**HSI Impulse Response Chart for DIIS**

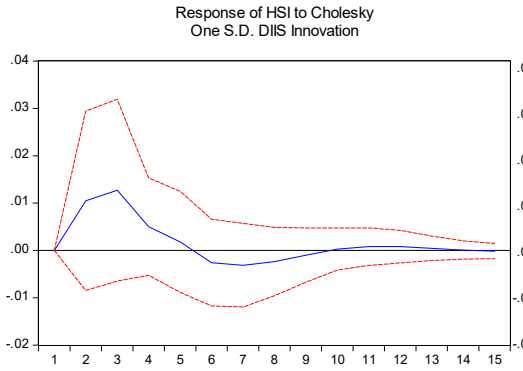



**Figure 7. DJI Impulse Response Chart for DIIS**

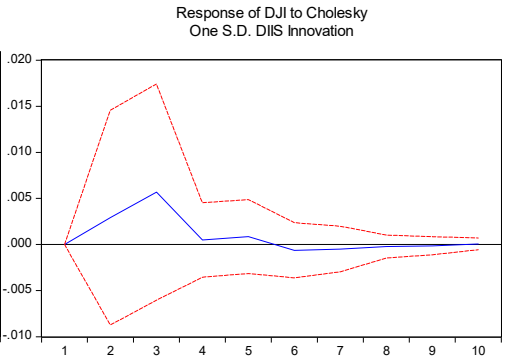



**Figure 8**

**XIC Impulse Response Chart for DIIS**

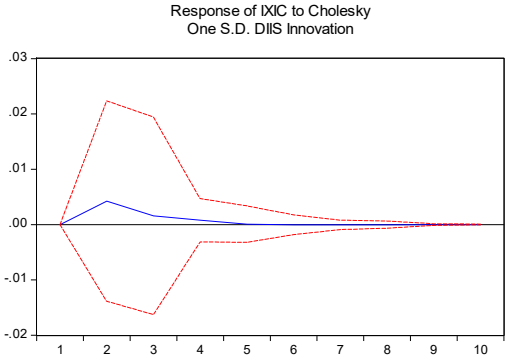



**Figure 9.MCIX Impulse Response Chart for DIIS**


**Figure10**

**000001 Impulse Response Chart for DIIS**

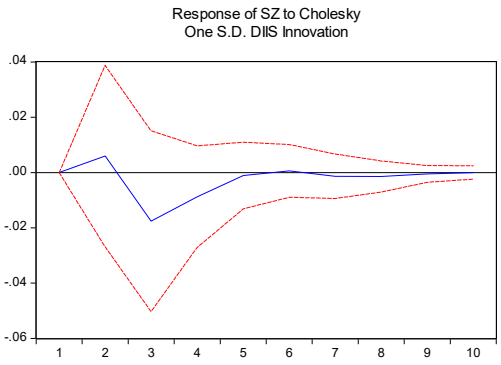



**Figure11. 399005 Impulse Response Chart for DIIS**

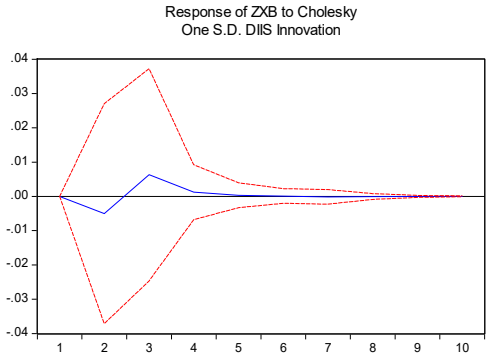


**Table 7**

**Summary of Stock Indexes' Impulse Responses with DIIS**

| Category of stock indexes | Impact variable | Impulse response interval | Impulse response amplitude | C1 | L1 | La | Lb | Lc |
|---|---|---|---|---|---|---|---|---|
| Results of nine international stock indexes' impulse responses with DIIS | | | | | | | | |
| First category | HIS | （−0.0030，0.0130） | 0.0160 | 13 | 15 | + | + | - |
| Second category | DJI | （−0.0006，0.0057） | 0.0063 | 9 | 10 | + | + | - |
| | FTSE | （−0.0003，0.0041） | 0.0044 | 8 | 10 | + | + | - |
| | GSPC | （−0.0006，0.0060） | 0.0066 | 9 | 10 | + | + | - |
| | SENSEX | （−0.0008，0.0056） | 0.0064 | 9 | 10 | + | + | - |
| Third category | IXIC | （0.0000，0.0042） | 0.0042 | 5 | 10 | + | + | |
| | N225 | （−0.0010，0.0080） | 0.0090 | 4 | 10 | + | - | |
| Forth category | MCIX | （−0.0080，0.0120） | 0.0200 | 6 | 10 | - | + | |
| | TWII | （−0.0020，0.0090） | 0.0110 | 6 | 10 | - | + | |
| Results of five domestic stock indexes' impulse response with DIIS | | | | | | | | |
| First category | SZ | (−0.0180，0.0060) | 0.0240 | 5 | 10 | + | - | |
| | SCZ | (−0.0130，0.0030) | 0.0160 | 5 | 10 | + | - | |
| | HS | (−0.0170，0.0060) | 0.0230 | 5 | 10 | + | - | |
| Second category | ZXB | (−0.0050，0.0060) | 0.0110 | 5 | 10 | - | + | |
| | CYB | (−0.0010，0.0070) | 0.0080 | 5 | 10 | - | + | |

*Notes. C1 is the number of convergence periods; L1 is the number of lag phases; La is the trend of lag phase 1-2; Lb is the trend of lag phase 3-5; Lc is the trend of lag phase 6-9.*

The trends in impulse responses reveals that in the first and the second period, HIS, DJI, FTSE, GSPC, SENSEX, IXIC, N225, and 000001, 399001, 000300 have positive effects on the DIIS, while MCIX, TWII, 399005 and 399006 exhibit negative effects. From the third to the fifth period, N225, 000001, 399001, 000300 have negative effects. After the sixth period, only HIS, DJI, FTSE, GSPC and SENSEX exhibit impulse response effects, and those effects are negative. Thus, over the entire period, the stock indexes' impulse responses with DIIS have positive effects in the first five periods, following which the response is smooth. This testifies to the fact that there is a positive effect on the drift and volatility of the stock market. In the presence of volatility, open-end funds in China will be associated with drift, and the effect period is 5.

The maximum range of volatility vis-à-vis the international stock indexes' impulse response with DIIS is 0.02. The maximum range of volatility associated with the domestic stock indexes' impulse response with DIIS is 0.024. The smallest range of volatility, vis-à-vis the international stock indexes' impulse response with DIIS, is 0.0042. The smallest range of volatility associated with the domestic stock indexes' impulse response with DIIS is 0.008. This shows that the domestic stock indexes have the maximum volatility while the shock from the international stock indexes on the open-end funds is stable; the open-end funds are more sensitive to the domestic stock indexes.

The maximum convergence period number of the international (domestic) stock indexes' impulse response with DIIS is 13 (5); thus, there is a wide difference between domestic and international stock indexes in this respect. The smallest convergence

period number of the international stock indexes' impulse response with DIIS is 4. This shows that the shock from international stock indexes on the open-end funds is longer.

### VI.2. Analysis of DIIS Variance Decomposition of International Stock Price Volatility

To measure the contribution of shocks on the investment style drift index in open-end funds in China, one typical stock index was selected from each category for analysis. The chosen series is as follows: HIS, DJI, IXIC, MCIX, 000001 and 399005.

When conducting variance decomposition, results are sensitive to the order in which variables are inserted. After according full consideration to the strength and lasting time of shocks, the order of the variables is as follows: 000001, HIS, MCIX, 399005, DJI, IXIC and DIIS. The results of variance decomposition are shown in Table 8.

**Table 8**

**Results of Variance Decomposition of 10 Periods' Time Series' DIIS**

| Variance Decomposition of DIIS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Period | S.E. | SZ | HSI | MCIX | ZXB | DJI | IXIC | DIIS |
| 1 | 0.083846 | 0.570101 | 0.224628 | 0.128172 | 9.739496 | 16.36522 | 6.706062 | 66.26633 |
| 2 | 0.097816 | 4.972040 | 2.768261 | 0.153507 | 6.213775 | 27.95970 | 5.603917 | 52.32880 |
| 3 | 0.119999 | 14.82132 | 19.46851 | 0.184521 | 4.866623 | 20.42996 | 4.077325 | 36.15174 |
| 4 | 0.125064 | 21.41261 | 21.64135 | 1.931272 | 3.508792 | 19.19901 | 4.925464 | 27.38149 |
| 5 | 0.131480 | 26.84872 | 22.35277 | 1.543289 | 2.872467 | 16.89136 | 3.906874 | 25.58452 |
| 6 | 0.132781 | 23.99336 | 23.47960 | 2.488231 | 3.636336 | 15.24716 | 3.471704 | 27.68361 |
| 7 | 0.135336 | 28.14979 | 21.92937 | 2.653952 | 3.412886 | 14.14229 | 3.597703 | 26.11401 |
| 8 | 0.136771 | 27.93201 | 20.96856 | 3.737105 | 3.104091 | 16.42016 | 3.267610 | 24.57046 |
| 9 | 0.140171 | 30.35257 | 20.22915 | 3.968092 | 3.390877 | 15.38532 | 3.099676 | 23.57431 |
| 10 | 0.143429 | 29.89379 | 20.34929 | 4.004655 | 3.644504 | 15.27422 | 3.102848 | 23.73070 |
| Cholesky Ordering: SZ HIS MCIX ZXB DJI IXIC DIIS | | | | | | | | |

From Table 8, it is evident that shock contribution of 000001 is the largest of all the indexes, accounting for about 30%; whilst the shock contribution of HIS is 20%; thus, they are principal determinants of the drift of investment style, which is in consonance with the conclusion provided above.

Further, the contributions of DIIS and DJI are at the same level; they are in the second level. Moreover, FTSE, GSPC, SENSEX are in the same category as DJI, whose contribution accounting for 15%.

The others including MCIX, 399005, IXIC are in the third level, the contribution of which are 4%, 3.6%, 3.1%.

## VII. Conclusion

Data for 266 open-end funds were selected in China's capital market between 2008 and 2014. The R/S analysis method, box fractal dimension and VAR were all utilised to avail of a DIIS pertaining to shock effects from international stock price volatility in the context of open-end funds in China. The main conclusions are as follows:

(1) Analysis was conducted into the fractal characteristics of the S&P/CITIC style indexes using the R/S method, finding that the yield of six kinds of S&P/CITIC style

indexes exhibit long memory. The fractal characteristics of LPG and SPV are more significant than those of LPV and SPG. The average daily and monthly cycle period of the pure growth style of the property are less than that of the pure value style of the property. The average weekly cycle period of the pure growth style of the property is less than that of the pure value style of the property, the number of which is 225.

(2) The DIIS index, based on the box fractal dimension, was used to measure the degree of investment style drift of the open-end funds. In 25 quarters, 266 open-end funds exhibited drift of investment style. More specifically, the results indicate that in 17 quarters, funds have a drift of investment style to some degree. Whilst in 8 quarters, funds were associated with a serious drift in investment style.

(3) The VAR model was constructed based on DIIS and SPI to analyse the shock effect from international stock price volatility on investment style drift. The international stock indexes have a positive effect on investment style drift of open-end funds in China. When there is volatility, the drift would be affected by the domestic stock market more easily, and the effect period is 5 stage. The domestic stock market has larger amplitude of fluctuation of the shock effect. The effects of volatilities in international stock indexes on investment styles lasts longer compared to the domestic case. The contributions of 000001, 399001, 000300 and HIS to DIIS account for over 50% of all variables; thus, these are the main factors that affect the drift of open-end funds in China. The open-end market of China is sensitive with the volatility in the domestic motherboard market and the Hong Kong stock market.

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