Research on Medium-term Momentum Effect and Reversal Effect of The Science and Technology Innovation Board Stock

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Abstract. Since the opening of the Science and Technology Innovation Board(STAR Market) in 2019, it not only plays an important role in the strategic layout of science and technology development of China, but also has been widely concerned by investors, who have generated the demand to study the stock price trend of the stocks affiliated to the STAR Market. Because the listed companies on the Science and Technology Innovation Board involve relatively concentrated industries, have relatively close listing time and operate in a similar environment, their stock price trends show similar characteristics. Based on the characteristics of the stocks in the STAR Market, this paper sampled and grouped the STAR Market stocks according to the medium-term observation data, and formed an arbitrage portfolio to explore the momentum effect and reversal effect within 3-12 months. This study provides ideas for constructing feasible investment strategies.

1 Introduction

On June 13, 2019, one year after it was proposed as an idea, the Science and Technology Innovation Board (STAR Market) was officially launched, marking that this innovative platform is officially in line with the strategic development of contemporary China.

Compared with the main board and the main board enterprises, the Science and Technology Innovation Board and its enterprises have their own unique distinctive characteristics, and the enterprises within the science and technology innovation board often show strong consistency in development. The reasons can be summarized as follows:

First, the STAR Market is independent of the existing main board market in terms of organization, and because the science and technology innovation board has only been established for less than 4 years, the listing time of enterprises is highly concentrated compared with the main board enterprises, which divides the boundary between the Science and Technology Innovation Board enterprises and the main board enterprises.

Second, the Science and Technology Innovation Board has a series of clear innovative or experimental task orientation, including the registration system pilot, aiming to enhance the ability to serve science and technology innovation enterprises, enhance market inclusiveness, strengthen market functions, and participate in the major reform tasks of the existing capital market. However, the main board has been established for decades, and its initial experimental tasks are no longer the focus.

Third, the Science and Technology Innovation Board mainly serves the operation of high-tech industries and strategic emerging industries that are in line with the national strategy and break through key core technologies. Therefore, the industry distribution concentration of listed companies on the science and technology Innovation Board is much higher than that of the main board. The industries themselves involved in these enterprises have also established close ties that generally surpass the traditional links between industries on the main board by means of big data, Internet and cloud computing. This enables STAR Market enterprises to share some characteristics and be more consistent in development.[1]

For stock market investors, they are concerned about the changes of various indicators of listed companies' stocks and the arbitrage opportunities contained in them. When analyzing arbitrage opportunities, due to the particularities of the STAR Market mentioned above, the stocks contained in it can be analyzed as a whole to a certain extent.

The method of analyzing a class of stocks as a unified whole is mainly based on the exploration of their commonalities. For example, the style rotation model classifies stocks by indicators such as large cap, middle cap, small cap, value stocks and growth stocks, and the industry rotation model classifies stocks by industry. Both models hope to find the common characteristics of the stock market performance by commonalities. In particular, the reaction to certain indicators. Therefore, the analysis of momentum and reversal effects in the stock market plays an important role in this type of method. This paper also focuses on the momentum effect and reversal effect of the Science and Technology Innovation Board.

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2 Brief description of Momentum Effect and Reversal Effect

Jegadeesh and Titman (1993) first gave the definition of momentum effect, that is, stocks will continue the original trend of movement: stocks with high returns in a certain period of time in the past will still maintain a high level of return in the future, while on the contrary, stocks with low returns in the past will still have low returns in the future. [2]

The reversal effect can be defined as the stock has the opposite trend to the past, the stock with a higher return in the past period will achieve a lower return in the future, on the contrary, the stock with a lower return in the past will have a higher return in the future.

There are many indicators that can be used to measure the momentum effect and the reversal effect, and this paper chooses the average return of the portfolio with equal investment in each stock as the indicator.

3 Basic setting and Experiment Design

3.1. Basic setting and sampling

Generally speaking, in the past studies on momentum effect and reversal effect, the time span of selected data segments is very long. For example, Du Xingqiang and Nie Zhiping (2007) studied the medium-term and long-term momentum effect and reversal effect of China's capital market based on the Fama-French three-factor model, and collected the empirical data of China's stock market from 1994 to 2004.[3] Luo Yehua and Yang Xiangyang (2012) of China Merchants Securities collected 69 sets of monthly data from April 2006 to December 2011 based on the reversal effect and momentum effect of the industry rotation model, among which 57 samples were used for the optimization and test of the prediction model.

On the one hand, the momentum effect and the reversal effect can be divided into short term, medium term and long term according to the time point when the two types of effects appear after holding assets. To observe the long-term effect, it is necessary to hold the asset portfolio for more than one year. Considering that a long observation period is needed before holding assets, the research on the long-term momentum effect and the reversal effect must collect a long-time span of sample data. On the other hand, even without considering the study of the long-term effect, a longer time span is also conducive to optimizing the model and improving its accuracy and credibility.[4]

However, the overall length of the history of the science and technology innovation board must be taken into account when selecting the sample data of the science and technology innovation board. The Science and Technology Innovation Board only has a history which is shorter than four years. In Du et al. 's study, the holding period and observation period of the asset portfolio used to study the long-term effect were set at 18, 24, 30 and 36 months, while the same time span is unrealistic for a similar study of the Science and Technology Innovation Board. Therefore, this paper excludes the possibility of studying the long-term momentum effect and reversal effect of the stocks on the Science and Technology Innovation Board. Even for the study of the medium-term effect with a holding period between 3 and 12 months, due to the limited time span and the small number of stocks on the Science and Technology Innovation Board, it is difficult to construct and further optimize the prediction model similar to that of China Merchants Securities.[5]

Therefore, before sampling, this paper makes the following basic Settings.

First, taking the stocks of all listed companies existing on the Science and Technology Innovation Board at a certain time point T as the whole, the ST stocks at this point and the stocks which would be delisted after that point are excluded.

Second, Because the stock price of the newly listed stocks fluctuates greatly, it needs to wait for a period of time to become relatively stable. Therefore, the period of data should start from T+X(X>=3, by month), and the closing price of each stock at the end of each month from T+X to T+X+24 should be obtained.

Third, sampling randomly in these stocks and select n(n>=50) of them to be classified.

Fourth, T+X+12 is taken as the time point of starting to hold assets. The observation period before it and the holding period after it both can be divided into four categories: 3 months, 6 months, 9 months and 12 months.

According to the second step, T should be in 2019 or 2020. Considering that there were still only 61 listed companies in the STAR Market until the end of 2019, and the summary of momentum effect and reversal effect is timeliness, T is set as July 2020, and X is set as 5 months.

The first program was written to obtain data the list of all A-share listed enterprises on July 31, 2020 from baostock, a third-party database, and thus obtained the closing price of each stock on the last trading day of each month from December 2020 to December 2022. The data was sorted and saved as a .csv format file.

Since .csv files could also be opened with Excel, the author screened these data with Excel, and retained the data of the stocks with code beginning with 688 (i.e., the stocks on the Science and Technology Innovation Board). After excluding ST stocks in July 2020 and the stocks which were delisted later, the dataset contained 3575 records from 143 stocks in the end.

The second program was written to get the data at 9 time point T+5, T+8, T+11, T+14, T+17, T+20, T+23, T+26 and T+29. The end of the observation period and the beginning of holding were both set as T+17. The program calculated the expected stock returns of different observation periods and holding periods and outputted the results in the form of a .csv file, then 50 random numbers are generated to sample 50 stocks from it.

3.2 Experiment Design

In order to measure the momentum effect and the reversal effect, their respective definitions should be reviewed. In simple terms, the momentum effect is the continuation of

the previous performance of the stock, while the reversal effect is the reverse of the previous performance of the stock.

Some measurement methods start with excess returns. For example, through the observation period data, the best and worst performing stocks in the market are selected to construct winner portfolio and loser portfolio, and their respective returns in the holding period are compared with the average market return. This method is very intuitive, and can be tested by z-statistic or t- statistic. However, it may be the case that the winner and loser portfolios have similar excess returns and the same sign because the portfolios with the highest or lowest returns become the portfolios in the middle at the end of the holding period. In such cases, the momentum and reversal effects cannot be judged solely on the basis of the value of the excess returns.

Therefore, the method adopted in this experiment is to use t-statistics to test whether the difference between the returns of the winning portfolio and the losing portfolio at the end of the holding period is significantly different from 0. If it is significantly greater than 0, it indicates that the winning portfolio still maintains an advantage over the losing portfolio in terms of returns, and the performance of the observation period is continued, and there is a momentum effect. If it is significantly less than 0, it indicates that the performance of the stock in the holding period is opposite to that in the observation period, and there is a reversal effect. The level of effects can be measured by the level of significance.

In the first step of the experiment, the 50 selected stocks are arranged in descending order according to the returns of 3 months, 6 months, 9 months and 12 months observation period respectively. The corresponding stock returns of each observation period are divided into 5 groups from high to low. The first group is regarded as the winner portfolio, and the fifth group is regarded as the loser portfolio, so there are 4 winners and 4 losers portfolios in total.

The second step is to construct momentum strategy arbitrage portfolio. The portfolio consists of a long position of a winner portfolio and a short position of a loser portfolio in the same observation period. It is assumed that the value of the two portfolios is equal to achieve self-financing, and the two portfolios are equally invested in their respective constituent stocks. Finally, the arbitrage portfolios of momentum strategy in 3 months, 6 months, 9 months and 12 months are formed. Record the return of each arbitrage portfolio in 3 months, 6 months, 9 months and 12 months (the return of the winning portfolio minus the return of the losing portfolio) and record it in a table (The table is shown in the

"Experimental Results and Analysis" section).

The third step is to test the hypothesis of the return rate of the arbitrage portfolio. Among them, the null hypothesis H0 means that there is no significant difference between the future return of high-return stocks represented by the winner portfolio and the future return of low-return stocks represented by the loser portfolio at the end of the holding period, and there cannot be obvious momentum effect or reversal effect, while the alternative hypothesis H1 indicates that the momentum effect or reversal effect exists. The specific one is determined by the direction of the statistic sign.

The t-statistic is:

$$t = \frac{(\overline{x_1}-\overline{x_2})-(\mu_1-\mu_2)}{s_p\left(\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}\right)} \quad (1)$$

Where:

$$s_p^2 = \frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_2-2} \quad (2)$$

4 Experimental Results and Analysis

4.1 Experimental results

The experiment was carried out in the same way as previously designed. The result is shown in Table 1.

Table 1 Experimental results

Observation period i Holding period j	Nature of portfolio	i=3	6	9	12
j=3	Winning portfolio	0.2809	0.2702	0.2314	0.2247
	Loser portfolio	0.3026	0.2388	0.2012	0.3025
	Arbitrage portfolio	**0.0217 (4.09008 *)**	0.0314 (2.43764)	0.0302 (1.84597)	0.0778 (1.28385)
6	Winning portfolio	0.2848	0.2862	0.2100	0.2028
	Loser portfolio	0.3544	0.2917	0.2577	0.3188
	Arbitrage portfolio	**0.0696 (7.02239 *)**	0.0055 (0.45528)	**0.0477 (2.89190)**	**0.1160 (10.32964*)**
9	Winning portfolio	0.2539	0.2960	0.3242	0.3227
	Loser portfolio	0.4371	0.4020	0.3656	0.3752
	Arbitrage portfolio	**0.1832 (6.23978 *)**	**0.1060 (4.25047*)**	0.0414 (1.79531)	0.0525 (1.97966)
12	Winning portfolio	0.3511	0.3661	0.4230	0.4107
	Loser portfolio	0.4386	0.3424	0.3124	0.3045
	Arbitrage portfolio	**0.0875 (3.23878)**	0.0237 (1.24245)	**0.1106 (9.84648 *)**	**0.1062 (-7.29332*)**

In Table 1, bold indicates significance at the level of 1% and * indicates significance at the level of 1 ‰

If significance at the level of 1% is taken as a sign of momentum effect or reversal effect, then:

The momentum effect occurs in: all the cases when observation period is 3 months; the case when the observation period is 6 months and the holding period is 9 months; the case when the observation period is 9 months and the holding period is 6 months; the case when the observation period is 12 months and the holding period is 6 months. It occurs 7 times in total.

The reversal effect occurs in the case when the observation period is 9 months and the holding period is 12 months and the case when the observation period is 12 months and the holding period is 12 months. It occurs 2 times in total.

If a more stringent standard is adopted, changing the significance at the 1% level to the significance at the 1‰ level, then the momentum effect at the observation period of 3 months, the holding period of 12 months and the momentum effect at the observation period of 9 months, the holding period of 6 months will not be significant.

4.2 Analysis of results

The experiment was carried out in the same way as previously designed, resulting in a table like below.

It can be seen from the experimental results that the momentum effect occurs later than the reversal effect, whether it is calculated from the beginning of the observation period or the beginning of the holding period.

If we start the calculation from the beginning of the observation period, then the first reversal effect occurs in the case when the observation period is 9 months and the holding period is 12 months, that is, $i + j = 21$. However, when $i + j = 6$, 9, 12, 15, and 18, there are corresponding cases of momentum effect. The frequency of reversal effect is significantly less than that of momentum effect. Even relaxing the criteria to be significant at the 10% level adds only one more case of reversal with $i = 6$ and $j = 3$.

Although the reversal effect is not dominant in terms of the number of occurrences in the medium term, the average significance of the reversal effect is greater than that of the momentum effect in the experimental period. Both reversal effects that are significant at the 1% level are also significant at the 1% level. The momentum effect is not.

Analysis by holding period length from short to long:

1. In the 3 months holding period, except for the observation period of 3 months, the momentum effect or reversal effect of the corresponding portfolios in other observation periods are not significant.

2. In the 6 months holding period, except for the case with the observation period of 6 months, the momentum effect of the portfolios corresponding to the other observation periods is significant.

3. In the holding period of 9 months, the momentum effect of the portfolios corresponding to the observation period of 3 months and 6 months is still significant, while the momentum effect of the portfolios corresponding to the observation period of 9 months and 12 months disappears.

4. In the holding period of 12 months, only the portfolios corresponding to the 3 months observation period still have significant momentum effect, while the portfolios corresponding to 9 months and 12 months observation period show a reversal effect.

Based on these observations, the following investment advice can be given when constructing the arbitrage portfolio:

1. Based on the performance of the stock in less than 3 months, the arbitrage portfolio is constructed according to the momentum strategy, with the portfolio holding period adjusted between 3 and 12 months depending on the situation.

2. Based on the performance of the stock in more than 3 months, the arbitrage portfolio is constructed according to the momentum strategy. The longer the observation period, the shorter the holding period, and the holding period is not less than 6 months.

3. Based on the medium-term and long-term performance of the stock, the arbitrage portfolio is constructed according to the reversal strategy and held in order to make profits in the medium-term and long-term (such as 12 months).

5 Conclusion

On the whole, this experiment achieves its design goal, and gives some rules in the occurrence of momentum effect and reversal effect of the Science and Technology Innovation Board stocks.

However, there are still some shortcomings in the method adopted in this paper. On the one hand, the phenomenon is presented only through experiments, and it is not credibly explained by models such as Fama-French three-factor model. On the other hand, the design of the experiment itself is relatively rough, and the grouping of stocks is not reasonably adjusted, and the simple equal division method is adopted, and the weight of stocks in the arbitrage portfolio is not considered. Finally, the analysis of the phenomenon is relatively simple. Therefore, the method used in this paper needs to be further improved in order to study the momentum effect and reversal effect of the Science and Technology Innovation Board more accurately and comprehensively.

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