

Research on Cross-Sectional Returns of Industry Mergers and Acquisitions in China

--Based on ZEW-ZEPHYR and Maximum Deviation Method

Yaowen Chen

International Business School, Jinan University, Zhuhai 519070 Guangdong, China
1986374315@qq.com

Abstract. Using ZEW-ZEPHYR and the maximum deviation method to construct the industry mergers and acquisitions (M&As) index from the perspective of incremental and absolute values, this paper further discusses the cross-sectional relationship between M&A market vibrancy and industry stock market performance. It is found that a significant negative correlation exists between the M&A market vibrancy and the industry return when half a year is taken as the turnover rate. In addition, to explore whether the market response to M&A information is complete, this paper constructs a time series momentum strategy and obtains their long-term negative return relationship. Several factors that may cause this phenomenon are analyzed, including the risk of the M&A integration period, the influence of time spent in collecting M&A data, industry characteristics, and shareholder behaviors. Given these factors, this study provides investors and decision-makers with an in-depth understanding of industry selection and M&A market vibrancy.

Keywords: M&A Index ZEW-ZEPHYR, Maximum Deviation Method, Cross-Sectional return.

1. Research Background and Literature Review

Up against the development of economic globalization, global mergers and acquisitions have become an effective way for enterprises to invest abroad. So far, there have been six waves of mergers and acquisitions in the world. In the past 20 years, with China's economy entering a period of transformation and upgrading, the Chinese government is determined to build a multi-level capital market. Under the environment guided by national strategy with policy support, China's M&A market demand has surged, leading to a wave of M&A in China. According to the research report of PwC, China M&A 2021 Review and 2022 Outlook, China accounts for about 15% of the global M&A market in terms of transaction volume and transaction volume, which plays an increasingly significant role in the global market. The M&A market is an integral part of the financial market and an effective way for enterprises to develop and expand abroad, which can not only redefine the business boundaries of enterprises, but also promote resource reallocation (Jia, 2023). Therefore, it is of great importance to construct an effective index to evaluate the M&A market. At present, the internationally renowned indexes are the ZEW-M&A Index, the US Leading indicator, the US Technology M&A Index of Structured Solutions, the Australian Resource Industry M&A Index of Ernst & Young, M&A Attractiveness IndexScore (MAAIS) (Moeller, 2017) of Cass Business School, etc. To objectively and comprehensively reflect the real situation of China's M&A market, Shanghai United Assets and Equity Exchange took the lead in compiling and publishing M&A indexes: Shanghai Enterprise M&A Index, Shangpu M&A Index, Xinhua-Shangpu M&A Index, and China M&A Composite Index (Lou, 2022).

Many researches have emerged in China on the construction of the M&A index. Shi Xianda (2008) built a set of index systems to measure the marketization based on five standards of the M&A market, including macro-economy, industrial environment, financial market, institutional environment, and internal characteristics of the M&A market. Cui Yongmei (2010) proposed a simplified index of the corporate control market based on the total amount of M&A transactions, which is used to quickly evaluate and compare the market development, providing a vital reference for decision-makers. Other studies use the financial indicators of state-owned enterprises, the super-efficiency DEA model, and the Malmquist index to evaluate and analyze the performance of mergers and acquisitions (Chen,

2020). Currently, China's M&A focuses on the adjustment and upgrading of industrial structure, which is mainly realized through horizontal M&A in the same industry, supplemented by vertical and diversified acquisitions, so as to connect upstream and downstream of the industrial chain, promote business transformation, integrate resources, and pursue synergy (Bao, 2017). However, the research on the M&A index from the industry aspect is still relatively immature. Existing studies include China's industry-related M&A indexes compiled by the All-China Federation of Industry and Commerce, China Mergers and Acquisitions Association, and Shanghai United Assets and Equity Exchange. Wang Xiao (2012) used the revised ZEW-M&A index in 21 China's manufacturing industry to construct the M&A synchronization index, while some limitations still exist in the research from the industry aspect. At present, the ZEW-ZEPHYR M&A Index developed by the Leibniz Centre for European Economic Research (ZEW) and BvD Electronic Publishing (BvDEP) is still relatively common and widely accepted. This paper will also use ZEW-ZEPHYR and the maximum deviation method to build a comprehensive M&A index from the perspective of incremental and absolute values from the industry aspect, so as to fully reflect the real vibrancy of the M&A market in various industries.

The M&A market and the stock market, as key components of the capital market, show the splendid strategic development and investment opportunities of enterprises respectively. The study of these two markets is helpful in deeply understanding the capital flow and the shaping of enterprise value. According to the research, the volatility of the M&A market and stock market has a close mutual influence, and the interaction between M&A activities and financial market volatility may be the main factor in the cyclical fluctuation of overall M&A activities. At the same time, these studies point out that there is a causal relationship between real stock price index, real interest rate, and M&A activities, which provides a new perspective to deeply understand market behavior and decision-making (Fu, 2012). In the overseas M&A market, B. Yang (2021) who studied overseas M&A events from the perspective of market power found that the domestic market power of enterprises has a significantly negative impact on the stock market returns of overseas M&A, and proposed that attention should be paid to the continuity of domestic market power in overseas M&A. Moreover, there are studies on how the stock price crash risk affects the decision-making of overseas mergers and acquisitions in turn. It is concluded that the higher the crash risk, the greater the possibility of overseas mergers and acquisitions (Peng, 2023). The study also found that the value created by Chinese-listed companies in overseas mergers and acquisitions is intertwined with the cultural distance between the target countries. When such differences are large, overseas mergers and acquisitions often hurt the company's stock price, which reduces investors' positive expectations for mergers and acquisitions activities, thus affecting the stock price performance (Sun, 2018; Li, 2016). The discussion on domestic mergers and acquisitions focuses on the following aspects. On the one hand, it is the research on the relationship between M&A premium and stock price, especially the M&A premium and goodwill. During the M&A, excessive goodwill premium often occurs due to premium payment, brand, and reputation, which leads to a stock price collapse, which is called a "winner's curse" (Wang, 2022). However, the research finds that the accounting conservatism of enterprises is conducive to their reduction of agency costs and excessive goodwill formed in M&A (Francis & Martin, 2010). Secondly, it is the research on M&A premium and overvaluation of the stock price. Nowadays, more and more domestic enterprises adopt fixed-increase M&A. Besides, overvaluation of stock price before M&A will also increase fixed-increase discount and M&A premium (Liu, 2018). As for the overvalued stock price of M&A, some studies have held that cash payment by acquirers can alleviate stock mispricing by reducing agency costs and information asymmetry (Farinha, 2003), while others pay attention to how the stock price of Chinese listed companies affects M&A behavior and M&A motivation based on the theory that "stock mispricing drives M&A" (He, 2022). In addition, as for the relationship between M&A premium and performance commitment, some studies have found that the higher the growth rate of performance commitment, the higher the risk of M&A premium and stock price collapse after issuance, (Guan, 2019; Li, 2020). Meanwhile, the main explanation for the stock price crash is that hiding bad news

of performance commitment by those who occupy information advantage reaches the threshold (Hutton, 2009). Therefore, executives of listed companies with performance commitment agreements are more likely to reduce their holdings after the transaction is completed (Zhou, 2023). On the other hand, concerning the relationship between M&A performance and stock price, stock price performance is a critical index to evaluate M&A performance. As for the relationship between M&A performance and the internal management structure of enterprises, the shareholding ratio of directors and executives will affect M&A activities due to the size of the stock price (Li, 2020). The clearer the informal hierarchical relationship in the board of directors, the better the long-term performance of enterprises (He, 2021). However, managers' excessive self-confidence will underestimate risks and overestimate expectations for inefficient mergers and acquisitions, thus increasing the risk of stock price collapse (Schrand & Zechman, 2012). Secondly, as for the M&A performance and M&A diversification, M&A diversification is not as attractive as expected and its performance may not be as focused as a single business, resulting in the loss of shareholders' wealth (Li, 2006). Therefore, while reducing blind expansion, we should pay attention to the dependence mode and integration strategy of both parties. The M&A interdependence is positively related to integration advantage, while the positive impact of integration strategy on M&A performance will increase in the short term (Gong, 2022). Besides, continuous mergers and acquisitions will also significantly increase the risk of the stock price collapse, and agency problems within the company will strengthen this impact (Zhuang, 2021). The application of margin financing and securities lending system has inhibited the M&A market by improving the pricing efficiency of the stock market.

This paper will study the internal relationship between the M&A index and corresponding industry market return constructed by ZEW-ZEPHYR and the maximum deviation method, so as to reveal the relationship between the M&A market and the stock market, and deeply study the cross-sectional return produced by industry M&A.

The marginal contributions of this paper are as follows. Firstly, in the construction method of the M&A index, this paper not only uses the classical Zew-Zephyr to build the index of M&A data in China market from the perspective of incremental values, but also takes advantage of the maximum deviation method to construct the industry M&A index from the perspective of absolute values. Secondly, the M&A index built in this paper is from the perspective of industry, which comprehensively covers all the stocks of industries and further studies the cross-sectional return generated by industry M&A. Thirdly, given that most of the previous literature uses event research method to study the cumulative return of M&A events and corresponding companies, this paper studies the relationship between M&A index and stock cross-sectional return from the perspective of the whole industry in an innovative manner, which provides a comprehensive guide for M&A activities to securities investment behavior.

The following sections of this paper will be as follows. Firstly, from the aspect of the industry, this paper will use ZEW-ZEPHYR and the maximum deviation method to construct an industry M&A index and measure the M&A market vibrancy in various industries. On this basis, this paper will use the index to buy and hold industry stocks at the right time, build a long-short strategy, and record the return, so as to study the cross-sectional return relationship between the M&A index and industry stocks. Further considering the possible hysteresis of M&A transaction information, this paper will use the time series momentum to study and determine the appropriate transaction frequency. Finally, this paper will analyze the empirical results in detail.

2. Construction of Zew-Zephyr Exponent

2.1 Data Samples and Descriptive Statistics

The data of this paper is taken from the merger and acquisition database in the Wind database. Besides, the market-oriented acquisition events of listed companies in Shanghai and Shenzhen stock markets from 2000-2001 and 2022-2005 are selected respectively as research samples. According to the first-class industry classification standard of the Wind database, it is divided into 11 industries,

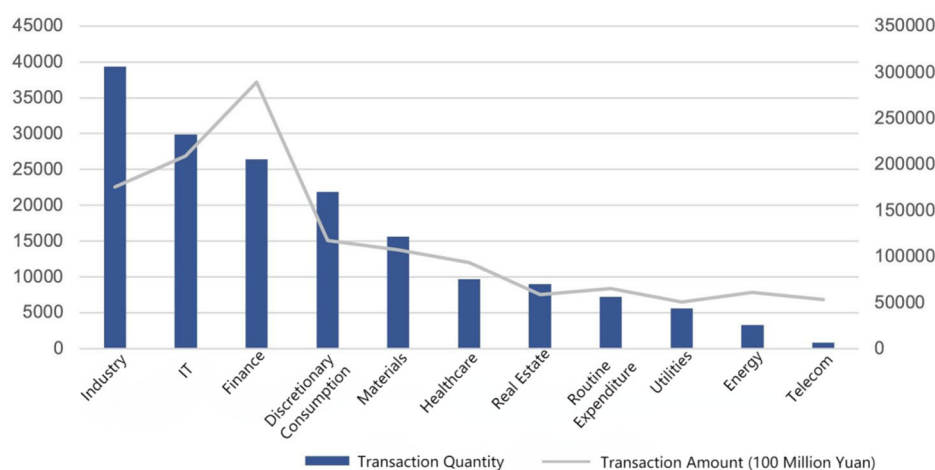
including telecommunications services, finance, health care, materials, industry, information technology, real estate, daily consumption, public utilities, energy, and optional consumption. This industry classification helps us better understand and compare economic activities in different fields.

Table 1. Descriptive statistics of the quantity of industry mergers and acquisitions

	Mean	STD	Min	25%	Medium	75%	Max
Materials	58.20	50.55	29.74	48.22	58.15	67.28	101.65
Telecom	3.15	3.57	0.48	1.68	2.72	4.32	7.52
Real Estate	33.39	24.40	16.09	24.77	31.74	40.17	59.91
Industry	146.18	152.32	78.04	123.01	146.59	170.50	255.17
Utilities	20.82	17.95	8.61	16.26	19.91	24.49	41.87
Finance	98.29	94.73	52.78	83.32	97.50	110.68	167.57
Discretionary Consumption	81.40	80.63	42.91	68.60	80.78	94.04	136.26
Energy	12.36	9.82	5.22	8.84	11.83	15.04	24.04
Routine Expenditure	26.86	24.66	12.48	20.76	26.13	33.09	47.74
IT	110.97	132.86	63.52	94.55	111.41	127.07	186.52
Healthcare	36.03	37.04	19.09	28.38	35.33	43.40	64.09

Table 2. Descriptive statistics of industry M&A amount

	Mean (10 ⁶)	STD (10 ⁶)	Min (10 ⁵)	25% (10 ⁵)	Medium (10 ⁶)	75% (10 ⁶)	Max (10 ⁶)
Materials	3.98	6.29	7.62	16.83	2.83	4.81	13.52
Telecom	1.98	7.16	0.03	0.46	0.36	1.44	14.26
Real Estate	2.19	3.06	5.68	12.14	1.86	2.65	6.16
Industry	6.52	7.62	24.68	42.15	5.50	8.09	15.09
Utilities	1.88	3.80	1.90	6.60	1.15	2.28	7.616
Finance	10.75	13.77	26.49	61.78	8.39	13.59	29.10
Discretionary Consumption	4.35	6.57	13.52	26.09	3.53	5.11	12.74
Energy	2.26	4.18	1.31	7.16	1.50	2.85	8.26
Routine Expenditure	2.44	5.36	1.81	5.82	1.11	2.46	12.59
IT	7.78	16.18	17.29	36.51	5.91	11.38	27.16
Healthcare	3.48	9.48	3.78	7.57	1.42	3.28	17.80



(Data source: WIND)

Figure 1. Overview of the quantity and amount of M&A transactions in various industries from 2000-2001 to 2022-2005

Table 1 and Table 2 show the monthly descriptive statistical results of the quantity and amount of M&A in each industry respectively, which summarizes the M&A activities of each industry during the sample period. As for the quantity of mergers and acquisitions, for example, the average quantity of mergers and acquisitions in the financial and industrial industries is relatively high, which is 98.29 and 146.18 respectively, while the average quantity of mergers and acquisitions in the telecommunications services and energy industries is relatively low, which is 3.15 and 12.36 respectively. With regard to the amount of mergers and acquisitions, this paper describes the statistical characteristics of the amount of mergers and acquisitions in industries. In terms of average M&A amount, the financial industry has the highest average, reaching 107.5 million RMB, while the average amount of daily consumption industry is relatively low, reaching 43.5 million RMB. According to Figure 1, the top three mergers and acquisitions are industry, information technology, and finance, while the top three inactive M&A markets are public utilities, energy, and telecommunications services.

2.2 Construction Method of M&A Index

In this paper, when measuring the vibrancy of M&A events, the indicators used are the quantity and amount of M&A with monthly frequency, which is the research variable of the M&A synchronization index. This paper first refers to the calculation method of ZEW-ZEPHYR-M&A-Index calculated by the ZEW in cooperation with BvDEP to track the development of M&A transactions worldwide since the beginning of 2000. This method is constructed according to the monthly transaction amount ($X_{a,t}$) and transaction times ($X_{v,t}$) of each industry. The specific calculation process is:

Firstly, to measure the trend of M&A activities, the monthly symmetric percentage change is calculated:

$$X_{a,t}' = 200 * (X_{a,t} - X_{a,t-1}) / (X_{a,t} + X_{a,t-1}) \quad (1)$$

$$X_{v,t}' = 200 * (X_{v,t} - X_{v,t-1}) / (X_{v,t} + X_{v,t-1}) \quad (2)$$

$X_{a,t}$ is the accumulated transaction amount in the t-th month; $X_{a,t}'$ is the symmetric change rate of the accumulated transaction amount in the t-th month; $X_{v,t}$ is the quantity of transactions in the t-th month; $X_{v,t}'$ is the symmetric change rate of the quantity of transactions in the t-th month.

The symmetric percentage change of transaction quantity and amount has different volatility. If the M&A index is calculated based on these unadjusted symmetric percentage changes, the constructed index will reflect this volatility, resulting in increased deviation and extreme trends. To avoid this situation, the standardized fluctuation adjustment factors R_a and R_v is introduced, with 1 as the sum.

$$R_a = \left(\frac{1}{\mu_a}\right) * \left[1 / \left(\frac{1}{\mu_a} + \frac{1}{\mu_v}\right)\right] \quad (3)$$

$$R_v = \left(\frac{1}{\mu_v}\right) * \left[1 / \left(\frac{1}{\mu_a} + \frac{1}{\mu_v}\right)\right] \quad (4)$$

μ_a is the average difference of the symmetric change rate ($X_{a,t}'$) ($t = 1 \dots 12$) of the accumulated transaction amount in the t-th month; μ_v is the average difference of the symmetric change rate $X_{v,t}'$ ($t = 1 \dots 12$) of the accumulated transaction quantity in the t-th month.

Multiply the corresponding symmetric percentage change by the normalized volatility adjustment factor to obtain the volatility-adjusted percentage change $M_{a,t}$ and $M_{v,t}$.

$$M_{a,t} = R_a * X_{a,t}' \quad (5)$$

$$M_{v,t} = R_v * X_{v,t}' \quad (6)$$

$M_{a,t}$ is the symmetric change rate of the adjusted accumulated amount; $M_{v,t}$ is the symmetric change rate of the adjusted quantity of transactions.

Finally, the adjusted percentage change after volatility $M_{a,t}$ and $M_{v,t}$ are summed with the weight to obtain the adjusted weighted symmetric change rate It .

$$It = 0.5 * (M_{a,t} + M_{v,t}) \quad (7)$$

With January 2000 as the selected base month, the initial value of the index is $I=100$. It' is the finally calculated industry M&A index.

$$It' = It - 1 * (200 + It)/(200 - It) \tag{8}$$

2.3 Synchronization Index Analysis of Mergers and Acquisitions

Using this method, this paper first calculates the industry-wide M&A index reflecting the vibrancy of China's M&A market, with the smooth curves for 3 months, 6 months, and 12 months shown in Figure 2.

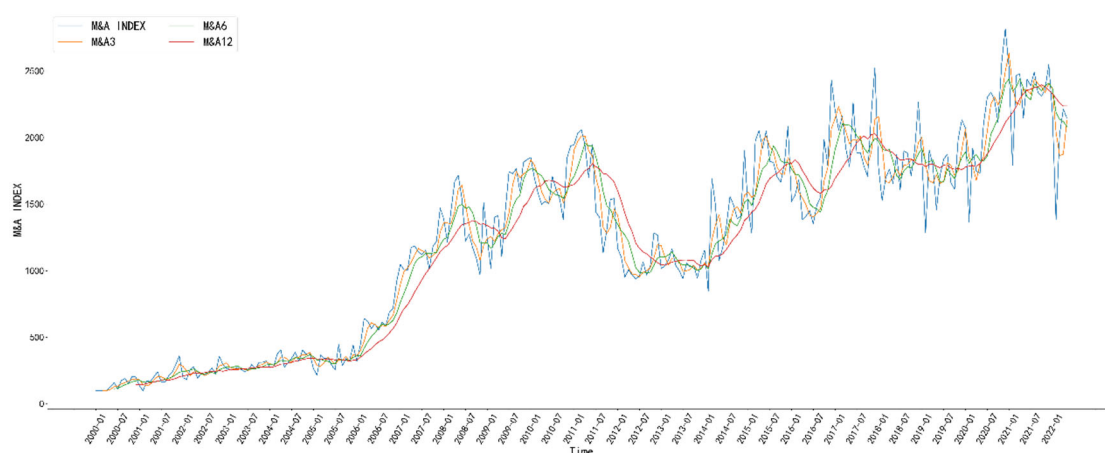


Figure 2. Industry-wide M&A Index in China Market

According to the overall trend in Figure 2, China's M&A market has shown a continuous trend of upward positive development in the past 20 years, which highlights the vitality and potential of the market. The market developed gradually from 2000 to 2006, which laid the foundation for the subsequent rapid growth. From 2006 to 2011, 2014 to 2017, and 2020 to 2022, China's M&A market expanded rapidly, which not only boosted production capacity upgrading and economic development, but also manifested China's crucial position in the global M&A market.

Using the ZEW-ZEPHYR calculation method combined with the M&A data of listed companies in 11 China industries from 2000 to 2022, this paper calculates their M&A synchronization index. Figure 3 shows the development of the M&A market in different industries.

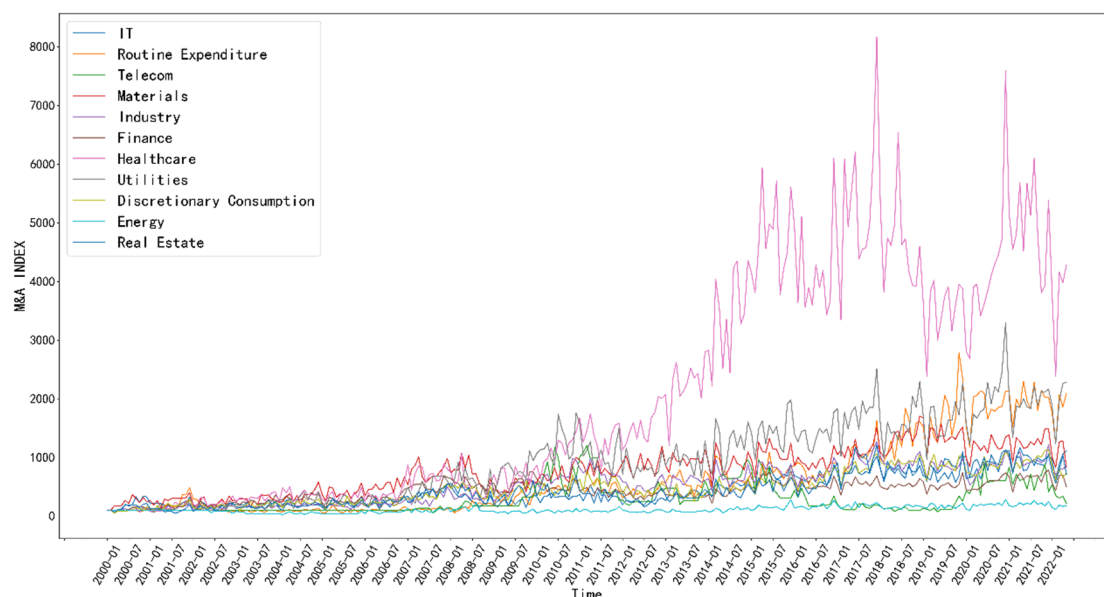


Figure 3. M&A index of various industries in China market

According to Figure 3, the M&A index of the health care industry among 11 industries has the largest increase, reaching a height of 8,000 in 2017, an increase of 80 times compared with 2000, and the M&A market is quite active. In addition, the M&A index of public utilities and optional consumer industries also showed high growth. However, the M&A index of the energy industry has remained almost unchanged, which indicates that the M&A market in this industry is inactive. The M&A indexes of other industries basically fluctuate below 1000 and the M&A market is relatively stable.

The industry M&A index calculated by this method can well depict the vertical development of the M&A market in various industries over time. However, it cannot compare the development of the M&A market in different industries horizontally and the conclusion inconsistent with Figure 1 is drawn in the horizontal comparison. Given that this method is constructed based on symmetric change rate, it is often difficult to compare the same kind and produce certain errors, because it only pays attention to incremental values and ignores absolute ones. Therefore, some studies have adopted the maximum deviation method to introduce relevant absolute values for correction, so as to truly reflect the changes in the M&A market (Liu, 2013).

3. Maximum Deviation Method

Aiming at the defects of the Zew-Zephyr index method, to make the index horizontally contrast to different industries, this paper further uses the maximum deviation method to construct the index based on the absolute values.

3.1 Data Standardization

When using the maximum deviation method to calculate the weight, to make different dimensions of the quantity and amount of mergers and acquisitions comparable, we need to carry out dimensionless processing. Specifically, the maximum and minimum values of M&A quantity and amount indicators in each industry are standardized. The normalized data represents the maximum and minimum values of the index in the sample, with each data point mapped to the interval of [0, 1], so that the units and value ranges of different indexes no longer affect the construction of the final index.

$$p_{ij} = \frac{P_{ij} - \min(P_{ij})}{\max(P_{ij}) - \min(P_{ij})} \quad (9)$$

P_{ij} is the original data of the i -th index in the j industry, and p_{ij} is the normalized data adjusted by the maximum and minimum values.

3.2 Weight Calculation

When using the maximizing deviation method to determine the weight of indicators, the goal is to determine the influence ability of evaluation indicators on the evaluation results. In other words, it identifies indicators that play a key role in the evaluation results or not. As a simple and objective weighting method, the maximum minimum method also has the advantage of dynamic adjustment over time.

Specifically, only two evaluation indexes exist in this model, including the quantity and amount of mergers and acquisitions. Thus, in each calculation period, this paper first calculates the dispersion of two indicators in various industries and adds them to get the total dispersion. The purpose is to measure the value difference of indicators in different industries. The greater the difference, the more information the indicators contain, and the stronger the ability to influence the evaluation results, which should be given greater weight. The specific calculation process is:

$$\omega_i = \frac{\sum_{j=1}^n \sum_{k=1}^n |p_{ij} - p_{ik}|}{\sum_{i=1}^m \sum_{j=1}^n \sum_{k=1}^n |p_{ij} - p_{ik}|} \quad (10)$$

ω_i is the weight of the i -th index, n is the number of industries to be evaluated, and m is the number of evaluation indexes. As for indicator i , the numerator $\sum_{j=1}^n \sum_{k=1}^n |p_{ij} - p_{ik}|$ represents the industry's total deviation of the indicator values from all other industries.

3.3 Exponent Construction by Maximum Deviation Method

After obtaining the data normalized by the maximum minimum method and the weight adjusted by the maximum deviation method, this paper sums them by weight to construct a comprehensive industry M&A index. The adjusted industry M&A index M_j can be expressed as:

$$M_j = \sum_{i=1}^m (p_{ij} \omega_i) \quad (11)$$

During the construction of the weighted index, data interpolation and 12-month rolling average processing are also implemented to ensure the integrity and smoothness of index data.

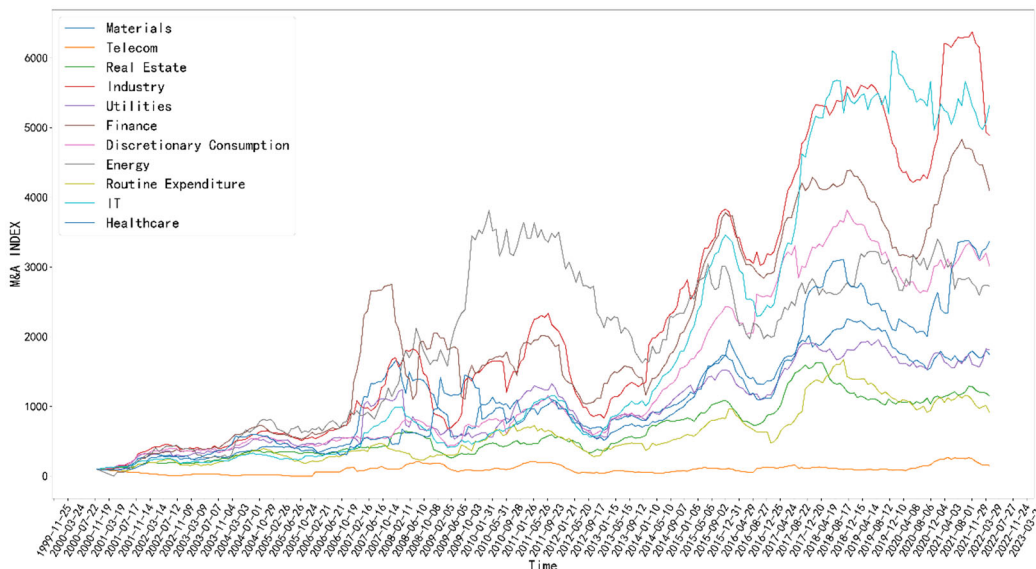


Figure 4. Industry M&A index (maximum deviation method)

According to Figure 4, the industry M&A index calculated by the maximum deviation method, the industries such as industry, information technology, and finance are the most active, while the telecommunications service industry is relatively inactive. This conclusion is consistent with that based on the quantity and amount of mergers and acquisitions in Figure 1, which shows the M&A performance in these industries from an absolute perspective. Therefore, the application of the maximum deviation method to some extent makes up for the defects of different industries' horizontal comparison when using Zew-Zephyr method. Through the maximum deviation method, the situation of mergers and acquisitions in different industries can be more objectively measured and compared, so as to describe mergers and acquisitions in various industries more comprehensively.

4. M&A Index and Cross-Sectional Return Analysis of Industry Stocks

4.1 Combinatorial Analysis

In this paper, Zew-Zephyr and maximum deviation methods are used to construct the M&A Index to describe the M&A vibrancy. To test whether the M&A Index can provide guidance for investment, this paper uses the portfolio analysis method. Specifically, taking 30% and 70% as breakpoints every month, this paper divides them into three groups according to the size of the M&A index, which is recorded as Low, Medium, and High. Therefore, the Low (High) group including the industries with the smallest (largest) M&A index buys and holds the stocks in the industry corresponding to the industries in each group until the end of the next month and calculates the return. The ups and downs of the stocks in the industry are measured by the industry index, which originates from the Wind database and is obtained by the weighted average of the prices of all stocks in the industry.

As for the calculation of intra-group return, this paper adopts the weighted average of market value and pays attention to a long-short combination strategy. Namely, buying more stocks in the High group and selling all stocks in the Low group to calculate the return of this strategy. In addition to

excess return, this paper uses the Fama three-factor model, the Carhart four-factor model (Carhart, 1997), and the Fama five-factor model to adjust return, with the factor data from China Asset Management Research Center. The following table reports the excess returns, the values adjusted by each factor model α , and the corresponding statistics t .

Table 3. Monthly excess returns and factor adjustments

	Low	Medium	High	High-Low
Excess Returns	0.931* (1.902)	0.893* (1.786)	1.070** (2.101)	0.140 (0.643)
FF3 Alpha	0.310** (2.128)	0.216* (1.778)	0.523*** (3.744)	0.214 (1.143)
CH4 Alpha	0.327** (2.244)	0.219* (1.790)	0.512*** (3.651)	0.185 (0.992)
FF5 Alpha	0.105 (0.684)	0.226* (1.753)	0.399*** (2.673)	0.294 (1.462)

Based on the data in Table 3, it is concluded that the return obtained by investing according to the group with the highest M&A index is remarkable, and the monthly excess return can reach 1.07%. Although the Medium group is significant at the significant level of 10%, the turn is generally lower than that of the Low group. The return of the Low group is better, but the significance is lower when adjusted by five factors. However, the performance of the long-short strategy of the M&A index is not ideal and the return is at the bottom. Meanwhile, no matter whether the factor model is adjusted or the adjusted excess return is not significant, investing in a portfolio with a high industry M&A index in this case is more likely to obtain significant excess returns relative to the benchmark.

Because the long-short strategy of monthly position adjustment can not obtain significant benefits, this paper further considers the rationality of time interval selection. Given that M&A is an important strategic behavior of enterprises that takes a long time, on the one hand, statistics based on the monthly dimension do not conform to the characteristics of M&A; on the other hand, few M&A events can be observed monthly, which hinders data research. Therefore, this paper combines the experimental data into quarterly, semi-annual, and annual ones to analyze the M&A index and industry returns.

Table 4. Quarterly excess returns and factor adjustments

	Low	Medium	High	High-Low
Excess Returns	2.807* (1.683)	2.171 (1.282)	2.479 (1.472)	-0.327 (-0.550)
FF3 Alpha	1.142** (2.449)	-0.180 (-0.701)	0.222 (0.780)	-0.920 (-1.587)
CH4 Alpha	1.084** (2.270)	-0.155 (-0.590)	0.228 (0.779)	-0.856 (-1.442)
FF5 Alpha	1.797*** (3.241)	0.067 (0.214)	0.186 (0.539)	-1.610** (-2.341)

Based on the returns analysis of quarterly data, the long-short strategy has consistent negative returns. However, except for the five-factor adjustment model, the significance is still low. It is worth noting that the return performance of the High and Medium groups with good significance is not significant, but that of the Low group in the four models is significant with good returns. The excess returns without factor adjustment reach 2.807%, which is the highest among the four strategies.

Table 5. Semi-Annual excess returns and factor adjustment

	Low	Medium	High	High-Low
Excess Returns	6.520 (1.623)	5.968 (1.456)	4.152 (1.018)	-2.368** (-2.009)
FF3 Alpha	1.903** (2.179)	1.162** (2.301)	-0.275 (-0.440)	-2.178* (-1.833)
CH4 Alpha	1.622* (1.699)	1.069* (1.926)	0.422 (0.677)	-1.200 (-0.964)
FF5 Alpha	4.713*** (4.164)	2.144*** (2.935)	-0.688 (-0.743)	-5.401*** (-3.392)

As for the semi-annual excess returns, the significance of the long-short strategy has been greatly improved. Except for the four-factor model, the adjusted returns are not significant and the returns are still consistently negative. Considering the characteristics of the factor adjustment model, it is believed that the insignificant performance after the four-factor adjustment may coincide with some changes in the M&A index and momentum factor. The Low group is still the group that has the highest returns with 6.52% as its excess returns. However, the performance of the High group is still not significant.

Table 6. Annual excess returns and factor adjustment

	Low	Medium	High	High-Low
Excess Returns	10.067 (1.001)	10.719 (1.098)	10.292 (1.082)	0.226 (0.105)
FF3 Alpha	0.172 (0.056)	0.977 (0.449)	1.646 (0.613)	1.474 (0.623)

Because the statistical data is from 2000-2001 and 2022-2005, insufficient data exists when studying the four-factor and five-factor adjustment models. Thus, only the three-factor model is adjusted for the annual data. According to the annual returns performance, all strategies are not significant under the annual data. This paper holds that this is related to the long time span. Firstly, the lack of annual data will make it difficult to ensure the accuracy and reliability of statistics. Secondly, the time span is too long to reflect the relationship between the M&A index and market returns as sensitively and carefully as monthly, quarterly, and semi-annual time spans.

Thus, it is more significant and effective to select semi-annual data to construct the M&A index for investment decision-making. According to the semi-annual four-factor model, some changes in the M&A index are explained by passive quantity factors.

4.2 Time Series Momentum Strategy

Considering that the long-short strategy is not significant in four regressions, this paper proposes that it is related to the insufficient response of stock price to M&A information. Because the market is not efficient (Tang, 2007), it is reasonable to believe that the change in the M&A index maps to the change in stock price with lag (Huang, 2021). Thus, it may be not effective to buy and hold stocks immediately according to the M&A index in the current period. Given the lag of information, this paper studies the return of long-short strategy according to the current M&A index in lagging 1 period to 12 periods.

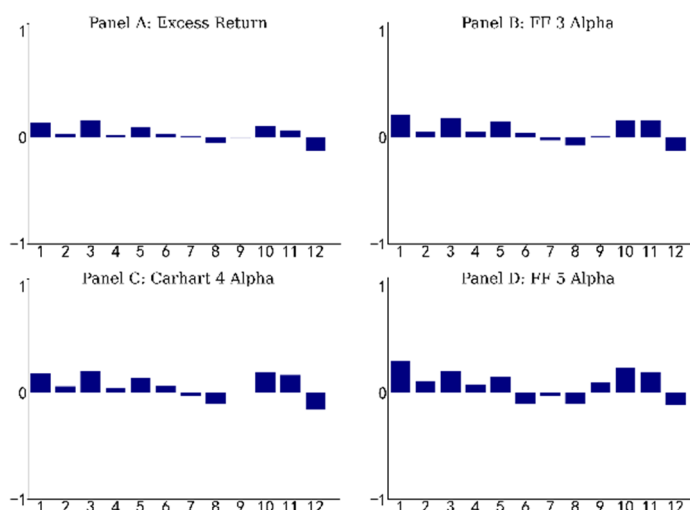


Figure 5. Monthly time series momentum trading (excess returns)

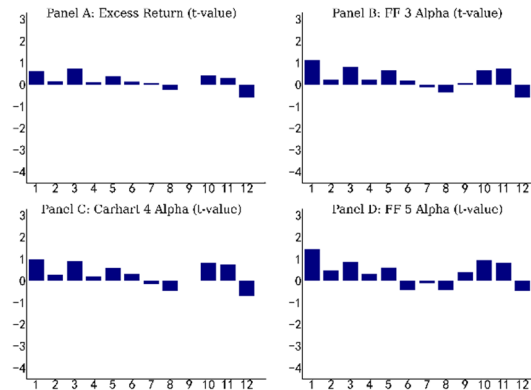


Figure 6. Monthly time series momentum trading (t-value)

Figure 5 shows the return of lagging transactions in the monthly interval. Although there is a reversal in some lagging periods, the overall return is basically positive, which is probably within 0.2% of the return. However, according to the monthly t-test in Figure 6, the results of four tests are not ideal and few t-test values can exceed 1. In other words, the returns are not significant in all lagging transactions.

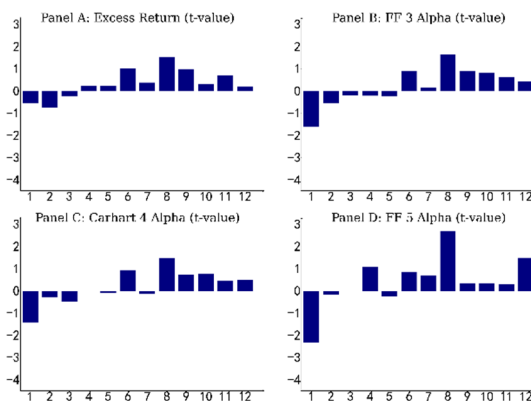


Figure 7. Quarterly time series momentum trading (t-value)

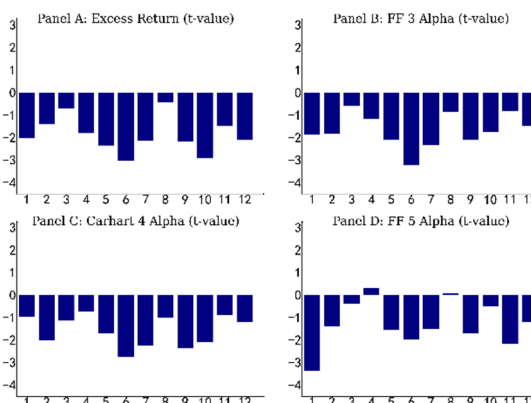


Figure 8. Semi-annual time series momentum trading (t-value)

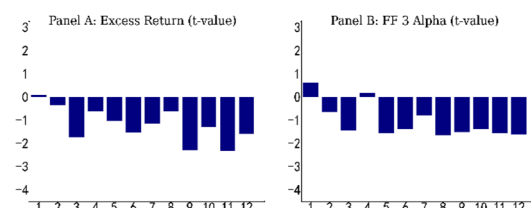


Figure 9. Annual time series momentum trading (t-value)

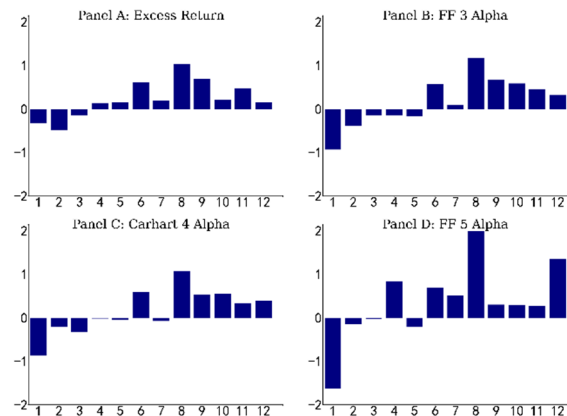


Figure 10. Quarterly time series momentum trading (excess returns)

In this paper, the time dimension is extended to quarterly, semi-annual, and annual dimensions to study the momentum trading of time series. By comparing Figure 7, Figure 8, and Figure 9, the momentum trading of time series with a half-year lag is the most ideal, the t-test is almost consistent and negative, and the significance is high. In contrast, quarterly and annual t-tests have obvious repetition and the significance is less than that of semi-annual one. Therefore, it can be considered that the half-year lag period is more reasonable.

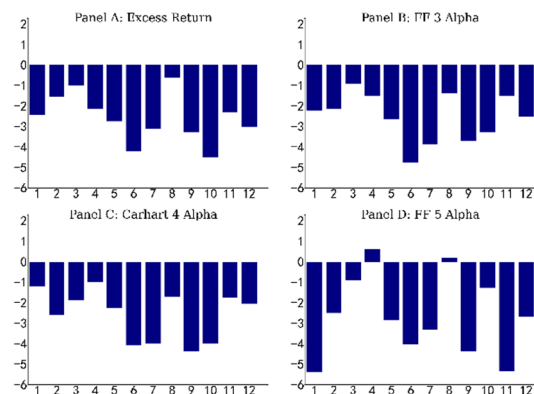


Figure 11. Semi-annual time series momentum trading (excess returns)

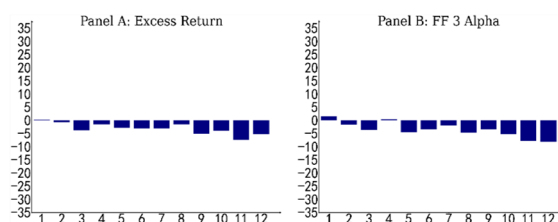


Figure 12. Annual time series momentum trading (excess returns)

According to Figures 10, Figure 11, and Figure 12 that further compare the return of lagging transactions in different time dimensions, the semi-annual returns remain ideal. Semi-annual returns, except for some reversals under the adjustment of the five-factor model, are all negative with very stable performance. Besides, the performance of annual return is approximately consistent negative. Quarterly returns in four models manifest the law that initial negative returns turn into positive ones with extensions of the trading period. Generally speaking, it is more effective to use the semi-annual time dimension to trade both in terms of the significance and consistency of returns.

4.3 Result Analysis

According to the analysis of the M&A index, industry return, and the time series momentum trading, the negative return of the long-short strategy is most obvious under the semi-annual data

frequency. Given that the long-short strategy constructed in this paper is to expand the industries with high M&A index and decrease the industries with low M&A index, based on the performance of negative returns, a conclusion can be drawn as follows. The industries with vibrant M&A markets have poor performance in the subsequent stock market returns. However, the industries with less vibrant M&A markets have better performance in the follow-up stock market. This paper proposes that the above-mentioned is related to the integration period of M&A, the collection time of M&A data, the characteristics of the M&A industry, and shareholders' behavior.

(1) Integration Period of Merger and Acquisition

M&A is generally divided into three stages, including planning, transaction, and integration. The data recorded in this paper are summarized by M&A events. Therefore, when the M&A index of a certain industry is higher, the M&A activities of the industry are more frequent and it can be considered that the industry has entered the M&A integration period. Post-merger integration (PMI) is considered the decisive factor of M&A performance (Heimeriks, 2012), including assets, organizational operation procedures, human resources, corporate culture, information technology, knowledge, and so on (Barney, 1986). Although the process of M&A may obtain a strong synergy effect and scale effect due to effective integration (Puranam, 2009), M&A integration is highly complex and challenging after all. For example, cultural differences, resource integration, employee resistance, and management decision-making may block M&A. It is found that about half of M&A fails to create value (Bower, 2001). Therefore, the industry with a higher M&A index will lead to the subsequent stock price decline due to the risk of the M&A integration period.

(2) Collection Time of M&A Data

The data used in this paper records the actual completion time of M&A. However, in the Chinese market, an M&A event is predictive and an M&A request is usually issued in advance. Except for some M&A events with strong confidentiality, it is possible that the impact on M&A events has been fully reflected in the stock price before the completion of M&A due to the role of public information or inside information. It is found that before the first disclosure of an M&A announcement, a serious information leakage exists and individual investors who only rely on public information have obvious information disadvantages (Ke & Petroni, 2004). That is to say, this paper uses the completed data of M&A events to make decisions with lag.

(3) Characteristics of the M&A Industry

M&As in different industries have various performances. Therefore, to study the consistent negative effects of the long-short strategy in this paper, the specific industries with higher and lower M&A indexes should be known to analyze the characteristics of industries in depth. After the previous argument, this paper sorts out the frequency of Low and High industries in the group under the semi-annual investment frequency.

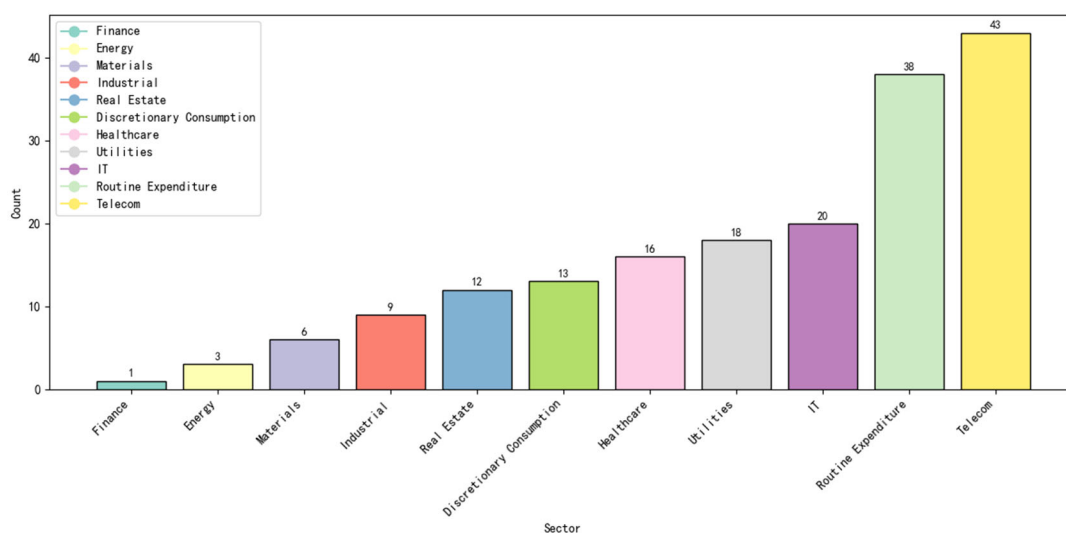


Figure 13. Semi-annual frequency statistics of the Low group

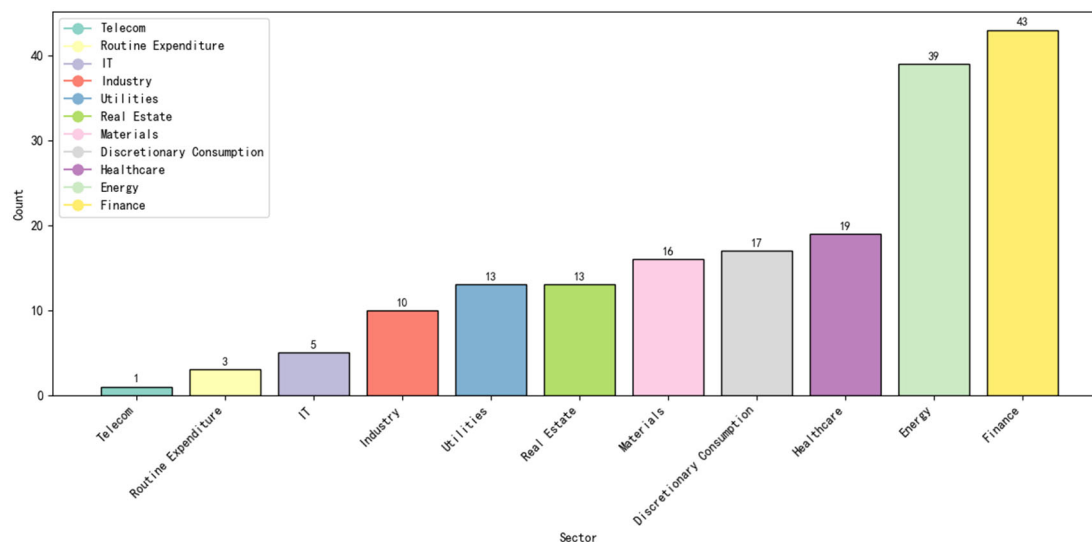


Figure 14. Semi-annual frequency statistics of the High group

In the semi-annual time dimension, the industries that are often included in the Low group are daily consumption and telecommunications services. The industries that are often included in the High group are finance and energy. Generally speaking, the cost of mergers and acquisitions is high in industries with high industry concentration. It is difficult for M&A companies to obtain mergers and acquisitions returns. However, when industries with low industry concentration carry out mergers and acquisitions, they will eventually generate M&A benefits due to the integration of resources, cost reduction, and competition (Jin, 2012). The financial industry is roughly composed of three major industries, including banking, securities, and insurance. Observing the industry concentration of three industries measured by CR4 (Bain, 1951), the insurance industry has the highest concentration, followed by commercial banks, while the lowest is the securities market. As a whole, China's financial industry is a highly concentrated industry (Xiao, 2004). The consumer industry has a low concentration due to its low entry threshold (Li, 2006). China's energy structure is dominated by coal, while the concentration of coal is low (Pan, 2010), which is also the reason why the country vigorously promotes the integration and optimization of energy enterprises. However, the resources of both parties have not been effectively integrated and the final performance is not desirable (Liu, 2016). China's telecom service industry is almost monopolized by the head. In addition, under the revision of the previous maximum deviation method, the telecom service is almost unchanged at the bottom, which has little influence on the results of the long-short strategy.

(4) Shareholder Behavior

After mergers and acquisitions, the operations taken by the original shareholders often affect the follow-up performance of the stock market of the industry. In China's capital market, M&A events have a significantly positive impact on the wealth of major shareholders. The higher the accumulated excess return rate, the greater the probability of major shareholders reducing their holdings after lifting the ban (Zhao, 2016). Even pseudo "market value management", earnings management, and information disclosure will be used to manipulate stock prices to cooperate with the illegal reduction of original shareholders (Zhang, 2021). Thus, in industries with active mergers and acquisitions, the insiders of their companies have the impulse to sell and cash out. Meanwhile, they will reduce their shares of the merged companies in large quantities when the stock is lifted, thus lowering the stock price. Besides, it will push up the expectation of M&A wantonly, then illegally reduce its holdings and cash out at a high level. However, such a selling tide is not common in industries where mergers and acquisitions are not active. Perhaps because of this reason, the follow-up stock market returns of industries with vibrant M&A are poor, while those with less vibrant M&A markets are better.

To sum up, this paper explains the reasons why the long-short strategy has negative returns in high M&A industries. First of all, high M&A industries are usually in the consolidation period, which is complicated and risky and may lead to a stock price decline. Secondly, the M&A information in

China market may be leaked before the actual completion, which makes the data lag behind in decision-making. The characteristics of different industries affect the performance of long-short strategy. Highly concentrated industries are difficult to obtain M&A performance, while those with low concentration are more likely to bring positive effects. Finally, in vibrant industries, the stock reduction after lifting the ban may depress the stock price. In the inactive industries, this situation is relatively less, which is conducive to the good performance of its subsequent stock market.

5. Conclusion

In this research, ZEW-ZEPHYR and the maximum deviation method are used, combined with incremental and absolute values, which successfully constructed the industry M&A index and accurately reflects the M&A vibrancy in various industries from the industry aspect. Based on this index, this paper expounds on the potential relationship between the vibrancy of the industry M&A market and the cross-sectional returns of the stock market. The research shows that the financial and energy industries present high M&A market vibrancy, while the telecom services and daily consumption industries are relatively not vibrant.

This paper uses portfolio analysis to analyze the relationship between the M&A industry and cross-sectional returns of stocks in various industries, which finds that this strategy can obtain significant returns under semi-annual trading frequency. It is worth noting that the long-short trading strategy at this frequency shows a trend of consistent negative returns. Given the possible lag of M&A market information, this paper further uses the time series momentum strategy to explore its performance over a longer time. Meanwhile, the results manifest that it obtains significant and lagging negative returns under the semi-annual turnover frequency, which provides more solid support for the previous research in this paper. In addition, this paper explains the negative relationship between index and industry from many perspectives. First of all, the industries with high M&A market vibrancy may lead to their subsequent stock price decline due to the risk of the M&A integration period, while the invibrant industries are more likely to maintain relatively stable performance. Secondly, in the Chinese market, due to information leakage and other reasons, M&A events may affect stock prices before the information is disclosed, which may reduce the effectiveness of transaction decisions based on completed M&A data. Moreover, the characteristics of different industries may have an impact on the performance of long-short trading strategies. For example, there is a negative correlation between industrial concentration and M&A performance. Finally, shareholders' behavior, especially the reduction of holdings during the lifting of the ban after mergers and acquisitions, may have a great impact on the short-term returns performance of industry stocks. To sum up, this study provides a convincing reference to better understand the relationship between industry M&As and stock market performance. It is not only helpful for investors to select industries more accurately and understand the vibrancy of the M&A market, but also provides useful insights for decision-makers on industry development and cross-sectional returns of the stock market.

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