A Study of Calendar Effects in China

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Abstract: This paper conducts an empirical study on whether there is a significant calendar effect in the electronics industry in China's main board market. This paper examines whether there is a week effect in this industry and analyzes its specific features and commonalities through the EGARCH-M model based on the t-distribution. Considering the specificity of China's stock market, our sample interval is selected as January 4, 2000-February 25, 2020. After the empirical test, we can find strong evidence that there is a calendar effect in this industry. This effect is characterized by a significantly negative "Thursday effect".

Keywords: bar effect; volatility agglomeration; expectation risk

1. Introduction

A large number of empirical studies have shown that there is always a part of the stock market that can make excess profits above the market returns, so we call this phenomenon market anomalies. These market anomalies are mainly calendar effect, stock premium mystery, herd effect, scale effect, underreaction and overreaction. The emergence of stock anomalies means that we cannot discuss market prices in the framework of classical pricing theory, but must consider the above factors.

Among them, calendar effects mainly refer to the emergence of date-linked return irregularities and volatility anomalies such as price in financial markets. Calendar effect mainly includes week effect and month effect, which was first pointed out by American analysts in 1942 as the "Monday effect". Compared to the stock markets in Europe and the United States, the Chinese stock market has a history of only 30 years, and in this short period of time, China has made dazzling progress. The number of stocks listed in the market has increased from 7 to 3,783 (as of January 15, 2020) in the A-share market today.

Calendar effect refers to an anomaly in financial markets such as securities, i.e., it is linked to the date and shows abnormal fluctuations or abnormal returns. Modern research shows that week effect, month effect, early month effect and holiday effect all belong to the category of calendar effect. The calendar effect varies from country to country. The "January effect" was first seen in the United States. The "January effect" is then common in the Asia-Pacific region. In China, different scholars have put forward a variety of claims, the mainstream "February effect", "December effect", "Chinese New Year effect" and so on.

The herd effect initially referred to the phenomenon of crowds following the crowd and following the herd. Under the efficient market hypothesis, the theory strongly impacted the rational man assumption theory. In recent years, with the rise of behavioral economics, people are studying it more and more deeply. People gradually apply the herd effect to the stock market to analyze market anomalies. The herd effect is used in the stock market refers to an investment group, the majority of investors' investment choices are usually the future of a single investor to follow the choice, or to follow the institutions and other funds of a larger investment collective choices, which makes the stock market fluctuations asymmetric, the funds suddenly gathered or suddenly dispersed, and ultimately makes the stock market is prone to false bull market or a collective plunge.

The speed of development of the market scale is changing day by day, which provides a capital channel for companies to expand the scale of production and operation, accelerates the flow of capital in the market, and promotes the sustained and healthy development of the capital market.China's GDP was 1,866.7 billion yuan when the stock exchange appeared in 1990, and to this day, in 2019, the GDP has reached 990,865,000,000,000 yuan, which is an increase of about 53 times. And during the same period, the total market capitalization of AB shares grew from 648.6 billion yuan to 59 trillion, an increase of about 91 times, and the value of the A stock market accounted for 60% of the GDP in 2019, so it is evident that the development of the stock market plays an indispensable role in the development of the

economy. However, reviewing the stock market index trend and GDP growth rate in the past ten years, we can significantly find that their growth rates do not match, for example, the two markets in 2001-2005 continued to be in the doldrums, the Shanghai market in June 2005 fell below 1,000 points, but China's real GDP growth rate from 2001 to 2005 to maintain a high growth rate of 8% per annum. Looking at the post-financial crisis era, during the decade from 2008 to 2018, China's economy has basically completed its transformation and upgrading, with urbanization penetrating from the first-tier big cities to the third- and fourth-tier cities, and the resilience of China's economy is far greater than that of the BRIC countries, including Russia, India and Brazil. GDP has been maintained at a growth rate of more than 6% during the same period. Yet the SSE and SZSE indices have been essentially flat with historical levels this decade. U.S. nominal GDP growth rate of 6.6% over the past 53 years, the stock market has also shown bulls long and bears short. Looking back at the U.S. stock market, especially after 1980, the risk-free yield represented by the 10-year Treasury yield continued to decline, and eventually the stock market continued to go bullish. The U.S. stock market saw the first longest bull market (1982-1999) and the second longest bull market (2009-2019) in history. China's stock market does not fully reflect the development of the economy. This is mainly due to the fact that China is a "policy market" and "investment market", as well as an inadequate delisting system. It is these factors that make it difficult to explain and analyze China's stock market trend using the efficient market hypothesis, and the calendar effect problem, herd behavior, volatility aggregation, spikes and thick-tailed distributions are becoming more and more prominent. To a certain extent, "policy market" and "speculative market" negate the theory of efficient market hypothesis proposed by Fama. Because in the Chinese market, the policy intervention index always exists, and the Chinese market belongs to the macroeconomic regulation market. In recent years, up and down stops set, the release of large and small non-circulating shares, the implementation of the QFII system, the "national team into the field", on the one hand, this belongs to the improvement of the stock market system, and on the other hand, this is the policy for the stock market to intervene. China's stock market prices can not reflect the past history in a timely manner, there is a certain degree of lag, for the weak effective market ineffective technical analysis at this time in China's stock market has been meaningless, but there are still a lot of people happy. In addition, people for the so-called "insider information" lack of rational judgment, easy to produce a herd effect, flocking into the short-term stock prices and the actual value of a huge deviation, and with the passage of time, the price of the stock has fallen significantly. In addition, from the perspective of behavioral finance, the introduction of a policy will not have an immediate effect and often requires a certain reaction time. It is these factors that make the market appear irrational characteristics: calendar effect, herd effect, scale effect, etc., so that the mathematical statistical characteristics are manifested as: non-normal distribution, sharp peaks and thick tails distribution, waveform aggregation and so on. At present, the international research on financial market asymmetry is more in-depth, and its existence has been generally recognized. However, its strength and weakness as well as the analysis of its causes are still unclear. At the same time, China as a rapidly emerging economy in recent years, the corresponding stock market by the asymmetry caused by the causes of the calendar effect is not clear that the short and good for the stock market impact is not consistent. In this case, different information is accumulated on different trading days, which may lead to different market reactions. Assuming that the calendar effect exists, there is a profit-taking range for the stock market. Therefore, the study of the calendar effect will help investors to construct a more reasonable risk aversion portfolio and choose a good investment timing, and this paper is born in this context.[1,2]

2. Data processing and theoretical modeling

2.1. Sample Selection

Based on the industry perspective, this paper analyzes the calendar effect and other anomalies of the stock market from the perspective of different industries. In order to make the data coverage broader and more representative, based on the consideration of various primary industry indices in the current market, we selected the daily closing price index of Shenwan Electronics Manufacturing Index from January 4, 2000 to February 25, 2020, which is the most important index in the market. The sample size is 4872, which well meets the large sample requirements of the GARCH model. All data are from the official website of Shenwan Hongyuan Research. In order to reduce the error, the daily return is in logarithmic form, so that $R_t = \ln(p_t/p_{t-1})$ where p_t is the closing price of day t, p_{t-1} is the closing price of the day before day t, where t≥2 . In this paper, we mainly use Eviews to process the data.

2.2. Data verification

In order to verify that the data satisfy the basic conditions for applying the family of GARCH models, a non-normality test is first performed. Secondly, to ensure the validity of the model, the serial smoothness test is also performed. Furthermore, modern research generally shows that financial data have obvious inertia and lag, showing a certain degree of autocorrelation, so it is also necessary to carry out serial autocorrelation and partial autocorrelation test, and select the lag order according to the autocorrelation coefficient trailing and partial autocorrelation coefficient truncation. Finally, the ARCH effect test is performed, and if it exists, the GARCH model family is applied for simulation.

2.2.1. Nonnormality Test

At 99% confidence level, the concomitant probability of their JB statistic is 0, which is much smaller than 0.05. Meanwhile, from the K value and S value, it can be seen that they are left skewed to different degrees, and there is the phenomenon of "peak thick tail". Therefore, these samples do not obey normal distribution.

2.2.2. Smoothness check

In order to avoid the appearance of pseudo-regression, we need to test the data for smoothness. In this paper, the ADF unit root test will be used. The test results show that at 1% significant level, the Mckinnon critical value is -3.4319, while the t-test statistic is -48.0974, which is much smaller than the critical value, indicating that the series of logarithmic returns of the electronics industry is smooth.

2.2.3. ARCH effect test

The ARCH effect test is also known as the heteroskedasticity test. In this section, the data is mainly processed and not modeled accordingly. Therefore we use the squared autocorrelation test of the residuals.

In the serial autocorrelation and partial autocorrelation tests of the logarithmic yield series, in which the lag order is uniformly chosen as 12, it is found that the AC and PAC of the series corresponding to the above samples fluctuate above and below 0, which is very close to 0, and the p-values corresponding to the Q-statistics are all less than 0.05. Therefore, it can be argued that there is a significant autocorrelation between the squares of their residuals at the 5% significance level, suggesting that the regression model is heteroskedastic, i.e., ARCH effect. At the same time, in order to make the model more simple, we can consider using the GARCH model family for modeling.

2.3. Theoretical model

The variance of a normal model is considered to be "mean squared", whereas in time series data it is time-varying, so that abnormal values of volatility make the returns not follow a normal distribution. a GARCH model describes the thick-tailedness of the distributional pattern through the non-normal variance, but the variance equation with $u_t^2 = (-u_t)^2 = (u_t)^2$ cannot distinguish between a positive and a negative shock. Therefore EGARCH models are often used to test for asymmetry.

In order to fully reflect the influence of the variable of risk on the model in the article, and to fully reflect the leverage effect of external factors such as policy on the market and the behavior of investors' risk preferences and so on, the standard deviation term σ, of the conditional variance is added to the article, and it is used to represent the risk. At the same time, the financial time series data disturbance variance is less stable and often depends on the size of the subsequent disturbance term, so we add a 1st order lag variable to the mean equation. In the following section, we will compare the degree of fit of the conditional variance of the EGARCH model based on the t-distribution with that based on the GED distribution, and then select a suitable research model for this paper.[3]

EGARCH-M model for:

$$r_t = \lambda r_{t-1} + k\sigma + c + u_t \tag{1}$$

$$\ln \sigma_t^2 = w_1 + \alpha \frac{|u_{t-1}|}{\sigma_{t-1}} + \theta \frac{u_{t-1}}{\sigma_{t-1}} + \beta_1 \ln \sigma_{t-1}^2 \tag{2}$$

3. Analysis of results

3.1. Descriptive analysis

In this paper, we analyze and study the week effect, month effect and holiday effect in terms of mean return, standard deviation (i.e., volatility), lag, skewness, kurtosis, expected risk, and asymmetric shocks. The JB statistic is also included to further test the validity of the assumption of non-normality of the data. The effectiveness of the model fit was also tested by ARCH-LM.

Table 1 shows the descriptive statistics of the weekly effect: in terms of mean value, Monday (-0.0659), Wednesday (-0.0731) and Thursday (-0.0946) have significant negative returns; Tuesday (0.0119) and Friday (0.0708) are significant positive returns. Therefore, for investors, it is more likely to buy on Thursday and sell on Friday to obtain positive returns, which is consistent with the conclusion of Zhang Bin. In addition, intra-week return volatility is not significant, no longer high volatility on Monday, but Thursday replaces Monday as the trading day with the highest volatility, which is contrary to the conclusions of past scholars' studies; the samples are all left-biased, which is consistent with the overall sample. In addition, the electronics industry sector returns are all left-skewed to varying degrees, which indicates a greater probability of extreme low return situations in the market than a normal distribution.

According to the JB test, their asymptotically significant values are all 0, much smaller than 0.05, so it can be assumed that in the weekly effect, their return distributions are non-normal and belong to the spiked thick-tailed distribution, which also further proves the correctness of the article's modeling based on the t-distribution.

Table 1: Results of descriptive statistics

	Mon.	Tues.	Wed.	Thur.	Fri.
Average value	-0.0659	0.0119	-0.0731	-0.0946	0.0708
Standard deviation	0.0201	0.0200	0.0209	0.0209	0.0208
N	957	979	983	978	971

3.2. Empirical analyses

The conditional variance model established by the ARCH model imposes strict restrictions on the conditional distribution of the research series, arguing that market fluctuations are symmetric, i.e., the impact of equally good and bad news on the market is the same, and many studies have been conducted based on this, and the use of models such as the GARCH (1,1) model also leads to the conclusion that the financial data has a "sharp peaks and thick tails" nature. Using models such as GARCH (1, 1), it can also be concluded that financial data has the nature of "sharp peaks and thick tails". However, a lot of empirical evidence shows that the results fitted by EGARCH and TGARCH tend to reject the normal distribution, and it has been shown that China's stock market is greatly affected by policy and other factors, and the phenomenon of volatility caused by it has been found in the empirical test of their conditional variance does not obey the normal distribution. Nowadays, the models used to measure the volatility phenomenon are TGARCH and EGARCH to simulate the leverage effect in the stock market. Comparing the two models, we find that the TGARCH model requires the GARCH term coefficient to be greater than 0. This is more demanding for a market with a small sample of data such as Chinese market, especially since this paper focuses on a specific industry.As for the EGARCH model, its parameters are not required, and it can better reflect the leverage effect, which is excellent in nature and effective. In addition, this paper also preliminarily compares the two models for the leverage effect of the degree of response, the results show that the TGARCH-M model in the test for the leverage effect of the P-value is much larger than 0.1, while the same conditions EGARCH-M passed the test. Therefore, the EGARCH-M model is selected for fitting in this paper.

Therefore, under the consideration that China's stock market is vulnerable to the impact of information asymmetry, this article will be based on the EGARCH-M model under t-distribution. The results after fitting are as follows:

$$r_t = 0.168790\sigma + 0.050353r_{t-1} - 0.002113 \tag{3}$$

$$ln\,\sigma_t^2 = -0.256028 + 0.169603\frac{|u_{t-1}|}{\sigma_{t-1}} - 0.023660\frac{u_{t-1}}{\sigma_{t-1}} + 0.984084\ln\sigma_{t-1}^2 \tag{4}$$

Based on the mean equation above, it is known that when the market risk increases by one percentage point, the return for the electronics industry increases by 0.168790 percentage points. According to the above variance equation, for the electronics industry, when the market is favorable news($u_t > 0$), the shock is 0.145943, while for the negative news($u_t < 0$), the shock is 0.193263.

According to Table 2, the following results can be obtained: for the variance equation, the coefficients of the theta term are all negative, indicating that the impact of negative news on the stock market is greater than that of good news, but only the accompanying probability of the t-test statistic of Monday and Tuesday is less than 0.01, which indicates that there is a significant leverage effect on these two days. Therefore, in the study of the weekly effect, it can be assumed that the information shocks to the stock market on Monday and Tuesday exhibit asymmetry. For the coefficients β_1 of the first-order lag, their p-values are much less than 0.01, which are all significant, indicating that the effects of the former period on the latter period are all significant. In particular, return volatility on Thursday is most affected by the lag, with a 1 percentage point swing in the previous period also increasing the latter period by 0.965479 percentage points. Monday is less affected. It fluctuates by 1 percentage point in the previous period and 0.915874 percentage points in the latter period. This reflects the weekly effect that can occur with volatility clustering.

Table 2: Empirical regression results

	Mon.	Tues.	Wed.	Thur.	Fri.
σ	-0.23298	-0.0893 (0.4204)	0.1943 (0.6006)	-0.0426 (0.6803)	0.0388 (0.7960)
c	0.0089	0.0091	0.0024	-0.0058	-0.0008
α	0.2594**	0.2817*	0.2597*	0.2233***	0.2465**
θ	-0.1270*	-0.0962*	-0.0505 (0.1280)	-0.0293 (0.2734)	-0.0315 (0.2986)

Meanwhile, we can further test that the residual skewness after using the model fitting are relatively reduced, but the concomitant probability of the JB statistic is still very significant, so it can be assumed that the data fitted by the EGARCH-M model is still non-normal, which further affirms the correctness of the modeling idea.

Meanwhile, in order to test the ARCH effect after fitting, the ARCH-LM test is used again, and the results show that the concomitant probability of the F-statistic values of the trading days are all greater than 0.05, thus basically indicating that the EGARCH-M eliminates the existence of heteroskedasticity. For the mean equation, their residuals Q(5) and Q(10) are not significant, which indicates a better setup of the equation, and the remaining serial correlation is almost non-existent. For the variance equation, their residual squares of Q(5), Q(10), and Q(20) are not significant, indicating that the remaining ARCH effect is almost eliminated and the equation is better set up.

3.3. Further analysis

This paper is based on the EGARCH-M model under the t-distribution, which well reflects the time-varying characteristics of the electronics industry sector index in China's main board market over the past two decades, while the robustness performance is good. This section summarizes the previous paper to obtain the above summary table. From the table, the following conclusions can be drawn: 1) The return performance of the electronics sector index is lowest on Thursday and highest on Friday. This is different from the past research findings: the SSE market return is significantly negative for the Tuesday effect, and significantly positive for the Friday effect. In the test, the Tuesday effect, which was often seen in the past, is no longer significant, while the Friday effect still exists. 2) The phenomenon of large fluctuations in returns on Monday, which was often seen in the past, has disappeared, replaced by sharp fluctuations on Thursday. 3) In terms of risk measures, there is a significant weekly effect on the expected risk, with the Monday effect in particular being representative, and at the same time there is a leverage effect on Mondays and Tuesdays in the market. 4) In terms of risk, the expected risk has a significant weekly effect, with the Monday effect being representative. The leverage effect also exists in the market on Mondays and Tuesdays.[4]

Because in a stock market with transparent policies, full competition, sound laws and good functioning, all valuable information will be accurately, timely and fully reflected in the stock market price, at which time it is not possible for investors to analyze the past stock trends to obtain excess profits above the market return

Since the A-share market since the implementation of the new clearing system, scholars on the

calendar effect of repeated experiments, often can be derived from the Friday effect, that is, Friday's return is significantly positive, to obtain higher than the average return of the week's excess returns. The explanation is also more reasonable: Monday through Thursday are T +1 trading rules; and Friday by the rules, can not sell on the day to get the funds, you must wait until the opening of the market on Monday in order to transfer the funds sold last week, which looks like the investor equivalent to comply with the T + 3 rules. And because our government and enterprises like to release policies or news on the weekend, which makes investors bear more risks. Based on the value-at-risk perspective, people have the right to demand high returns on Fridays, otherwise investors will avoid trading on Fridays, thus reducing the cost of capital. This is a plausible explanation for the emergence of the Friday effect. Moreover, following the perspective of the trading system, the Thursday effect can also be effectively explained. It is because of the higher cost of capital on Fridays that many risk averse individuals tend to choose Thursdays to sell their holding positions and wait for the weekend news release. Such risk averse individuals are more likely to be large institutional or fund positions, and they tend to prefer sound investments in order to keep their money safe. And they hold a huge amount of money, is the main market trading, the market impact is very significant. This large amount, exodus type of trading, will make the stock price volatile, and in the herd effect, often more likely to lead to a market crash, so that the return is significantly lower than the average return during the week, the Thursday effect. This is also consistent with the conclusion that Thursday returns are the most volatile.

For the risk variable, risk and return show a positive correlation on Mondays. This is mainly due to the high chance of policy or news releases over the weekend, which makes Monday's risk greater relative to other trading days, accumulating weekend uncertainty.

As for the leverage effect, this paper both shows a significantly negative leverage effect on Mondays and Tuesdays, i.e., the shock from positive news is larger than the shock from negative news. This is mainly affected by two factors: First, the history of Monday often appear large yield fluctuations, and more retail investors in China, the stock market access threshold is low, with incomplete financial knowledge, will make the judgment of the policy bias, so that people in the empirical judgment, more sensitive to good news. Secondly, in the herd effect, good news effect period longer than negative news, good news will accelerate people into the field, making Monday, Tuesday's leverage effect significantly negative.

4. Suggestion

It has been found through research that the calendar effect is changing. The returns of different industries have different characteristics, which depend not only on factors such as the size of the industry and geography, but also on the general environment of the stock market, i.e. investors, government and enterprises. In the short term, a complete, efficient and effective securities and financial market not only facilitates listed entities to focus on their main business, but also reduces speculative behavior and financial bubbles in the market. In the long run, a sound and perfect financial system is a measure of whether a country's economy is developed or not, and it is also an indispensable economic foundation for the long-term stability of the society.

The existence of the calendar effect indicates that there are still certain arbitrage opportunities in China's securities market, and the standardization and effectiveness of the stock market still need to be further improved and perfected. In response to the phenomenon of asymmetric returns, the phenomenon of leverage effect and the phenomenon of volatility aggregation analyzed in the previous section, the following three suggestions are put forward:

We need to rationalize the timing of policy announcements. The announcement of a large number of policy information at the same time is likely to make investors overreact, resulting in low market performance. Such as the frequent weekend shortcomings, often making the lowest returns on Monday and Tuesday. The centralized release of annual reports can also lead to a crazy February market. In addition, the two sessions are concentrated in March, when the policy is almost always the hot spot of market speculation. Big data analysis shows that the probability of the stock market before and after the two sessions is much higher than the probability of falling, and is prone to the phenomenon of institutions and other large bankers who are informed in advance of the news into the layout. Therefore, it can be appropriate to increase the information forecast and other official briefing to avoid the market by the policy impact of the ups and downs.

We need to standardize the policy disclosure system. Once the market appears new hotspot, there is no lack of some enterprises appear to rub hot behavior. Or in the stock price plummeted when released

some false positive news to restore the stock price. Therefore, the government should improve the penalty system, strict management, improve the cost of violation of the law.

We need to raise the bar for investors. China's stock market, the majority of retail investors, almost all with the psychological overnight wealth, not well recognized the risk of the stock market, prone to herd effect. Therefore, society should popularize financial knowledge. At the same time, management agencies should regulate and supervise investors' leverage behavior such as financing and securities financing, control market bubbles as much as possible, put an end to gamblers' behavior, and let the market return to rationality for investors

5. Conclusions

We can find that the return of the electronics sector index is the lowest on Thursday and the highest on Friday. Compared to the past, the large fluctuations in returns on Mondays have disappeared, replaced by sharp fluctuations on Thursdays. Meanwhile, in terms of risk measures, there is also a significant weekly effect of expected risk, especially representative of the Monday effect; at the same time, there is also a leverage effect in the market on Monday and Tuesday. At the same time, we can find that the electronics industry's returns show a non-normal distribution, the phenomenon of "sharp peaks and thick tails". At the same time in the electronics industry shows a certain leverage effect, in the Monday and Tuesday performance is significant. In addition, the electronics industry yield fluctuations are subject to the previous period of varying degrees of significant impact, especially on Thursdays, the most obvious. For investors: First of all, they should have enough financial knowledge to make clear that the "calendar effect" is a kind of anomaly and a law that can be utilized in a complementary way. Investors should be clear about their own risk appetite, adjust investment strategies in a timely manner according to market changes, and determine the timing of buying and selling by referring to the time-varying characteristics of the calendar effect, guided by rational judgment.

For the government: there are a large number of retail traders in China's stock market, the market access threshold is low, and China has always had a "policy market", which is accustomed to releasing policies or news on weekends. Therefore, the government should build a perfect disclosure system, randomize the time of policy disclosure, and release the news in the middle of the week, so as to avoid the intensive short or good news over the weekend, which will lead to big ups and downs in the market. At the same time, the regulator should also strengthen the assessment of investors, improve the market access threshold, regular investment knowledge assessment, popularization, etc., so as to effectively attenuate the adverse impact of the herd effect in the market. In addition, the government should also actively improve the trading system, such as promoting the improvement of the financing and securities system, and exploring the feasibility of the T+0 policy.

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