Study on the Impact of African Swine Fever Epidemic on Market Value of Listed Companies in Swine Industry

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Abstract: This paper aims to obtain the impact of the current African swine fever epidemic on China's swine industry through the study of the impact on the market value of upstream and downstream enterprises such as breeding, feed, veterinary drugs, and processing. The results show that the epidemic situation of African swine fever has a significant negative impact on the market value of selected listed companies during the sample period, especially on aquaculture enterprises. The period of impact on veterinary drug enterprises is the longest; The impact on meat processing enterprises is second only to that on the veterinary medicine industry, and the impact on feed enterprises is the least.

1. Introduction

African swine fever is a hemorrhagic and acute infectious disease that causes the infection of domestic pigs and wild boars. The mortality rate of infected domestic pigs and wild boars is as high as 100%. The World Organization for Animal Health (OIE) has listed it as a legally reported animal epidemic disease, and China has also listed it as a class of animal epidemic diseases to be guarded against [1]. According to the report of the Ministry of Agriculture and Rural Affairs, from August 3, 2018, when the first African swine fever epidemic was diagnosed in China, to April 22, 2019, the epidemic situation was effectively controlled, a total of 129 outbreaks were reported in 28 provinces (cities) of China, and a total of 1.02 million pigs were killed, which had a great impact on China's swine industry [2]. The academic analysis on the impact of African swine fever epidemic mostly focuses on the analysis of pig enterprises and pork prices [3-10], but the research on the impact of listed companies in swine industry is less involved. Stock market is a barometer of modern economic development, and the impact of epidemic on the market value of listed companies in swine industry can be used as an effective measure of the impact of epidemic on China's swine industry. In this paper, the event research method [11-18], which is commonly used in financial market analysis, is used to select representative listed companies in swine industry. By analysing the comparison before and after the outbreak of the epidemic, the change of stock returns of listed companies in swine industry chain caused by the change of investors' investment behavior is analyzed, and then the impact of the event on swine industry is analyzed.

2. Materials and methods

2.1 Data Sources

The data used in this study mainly come from Shanghai Stock Exchange and Shenzhen Stock Exchange. The closing price and market index data of 40 listed companies in swine industry were collected. According to the requirement of the event analysis method that the estimated window time should not be less than 120 days [19], starting from the reporting time of the first African swine fever on August 3, 2018, the relevant data of 141 trading days from January 19, 2018 to October 19, 2018 were selected, and the discontinuous samples were eliminated. A total of 4512 price samples of 32 listed companies were obtained.

2.2 Research Design

2.2.1 Event Definition

The event date selected in this paper is August 3rd, 2018, the date of first confirmed African swine fever, and the event window is [-10,10]. That is, there are 21 trading days from 10 trading days before the event date to 10 trading days after the event date. The cleaning period selected in this paper is [-130,-11], that is, 120 trading days from 130 trading days before the event to the first 11 trading days.

2.2.2 Samples Selection

In this paper, listed companies involved in swine industry are selected. According to their main business statistics, they can be classified into aquaculture enterprises (WENS, Muyuan, Dakang Agriculture, Yisheng, Shunxin Agriculture, Tech-bank Food and New Wellful), feed enterprises (Da Bei Nong, Aonong Bio, Tecon Bio, Haid Group, New Hope, Wellhope Agriculture, Tangrenshen Group, Tongwei Group, Zhengbang Technology and Zhenghong Technology), veterinary drugs enterprises (Lu Kang Pharmaceutical, Haixiang Pharmaceutical, Hisun Pharmaceutical, Jinhe Bio, Pulike, Lifecome Biochemistry, Apeloa Pharmaceutical, Ringpu Bio, Jinyu Bio-technology, CAHIC, Changchun High-Tech) and pork products processing enterprises (Shuanghui Development, Delisi, Huatong Meat Products, Huangshanghuang), including 32 listed companies of 4 types.

2.2.3 Calculation of Expected Normal Return

The expected return refers to the return generated by the normal price fluctuation of listed companies under no epidemic. The calculation steps are as follows:

(1) Data collection. The data sources of this paper are the daily stock closing prices of 32 listed companies from 130 days before the event to 77 days after the event, and the daily closing indexes of Shanghai Composite Index and Shenzhen Component Index during this period.

(2) Calculation of the normal rate of return of stocks. The calculation method of the normal rate of return of individual stocks is [19]:

$$R_{it} = P_{it} / P_{it-1} - 1 \tag{1}$$

In formula (1), t represents the number of days; P_{it} represents the closing price of listed company i on the tth day; P_{it-1} represents the closing price of listed company i on the of the $t-1^{th}$ day.

(3) Calculation of the normal market rate of return. The calculation method of the normal market rate of return is:

$$R_{mt} = MP_t / MP_{t-1} - 1 \tag{2}$$

In formula (2), t represents the number of days; MP_t represents the closing index of the composite index of the securities market on the tth day; MP_{t-1} represents the closing index of the composite index of the securities market on the $t-1^{th}$ day.

2.2.4 Calculation of Abnormal Return

Abnormal return (AR) refers to the actual income after the event minus the normal income in the whole event window. Generally, the market model is used to calculate the abnormal returns, which assumes that there is a certain linear relationship between the returns of the securities market and the returns of specific listed companies. The formula is as follows:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \tag{3}$$

In formula (3), R_{it} represents the actual rate of return of listed company i on the tth day; R_{mt} indicates the market rate of return of the securities market on the tth day; α_i and β_i are parameters of the market model; $\alpha_i + \beta_i R_{mt}$ represents the expected rate of return of listed company i; ε_{it} represents the abnormal return of listed company i, that is, the difference between the actual rate of return and the expected rate of return of listed company i when the stock market rate of return is R_{mt}. Therefore, during the event period, the formula for calculating the abnormal return of listed company i is:

$$\varepsilon_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt} \tag{4}$$

In formula (4), $\hat{\alpha}_i$ and $\hat{\beta}_i$ are the parameters of the market model of daily stock closing price and stock market index of 32 companies during the clean period. This paper uses the method of data regression to calculate [21]. To further analyze the impact of events on the market value of listed companies in a period of time, this paper also calculates the cumulative abnormal return (CAR), and its calculation formula is:

$$CAR = \sum AR_i \tag{5}$$

2.2.5 Conducting Significance Test

To judge whether the linear relationship between market return rate and individual stock return rate is significant, after calculating the abnormal return (AR) and cumulative abnormal return (CAR) of sample companies, this paper uses "T test: two samples equal variance hypothesis" to test the significance of the data [20-21].

3. Results

3.1 Statistical results

3.1.1 Abstract

In this paper, 32 listed companies are divided into four types according to meat processing, breeding, feed processing and veterinary drug research and development, and the abnormal returns are calculated and accumulated respectively. (Table 1)

Table 1 Statistics of abnormal returns (AR) and cumulative abnormal returns (CAR) of sample companies

Subordinate to	Event day	[0]	[-10，0]	[1，10]	[-10，10]
Category	Shares	AR	CAR	CAR	CAR
Breeding	Dakang Agriculture	0.62%	9.35%	3.83%	13.18%
	Muyuan	5.40%	6.28%	-15.12%	-8.84%
	Shunxin Agriculture	-5.92%	-3.06%	-19.60%	-22.66%
	Tech-bank Food	10.48%	27.82%	-11.53%	16.29%
	WENS	0.94%	1.13%	-8.21%	-7.08%
	New Wellful	0.14%	1.54%	1.40%	2.94%
	Yisheng	-0.24%	-5.60%	-19.06%	-24.66%
Feed	Aonong Biology	2.41%	-12.20%	0.29%	-11.91%
	Haid Group	-2.47%	-5.59%	-2.71%	-8.30%
	Wellhope	0.29%	-0.76%	1.72%	0.96%

	Tangrenshen Group	0.99%	12.80%	-3.93%	8.87%
	Tecon Biology	4.40%	9.60%	0.87%	10.47%
	New Hope	2.71%	2.98%	-2.69%	0.29%
	Zhengbang Technology	5.05%	18.67%	-7.38%	11.29%
	Zhenghong Technology	0.58%	2.05%	-0.38%	1.67%
Animal remedy	Haixiang Pharmaceutical	-2.13%	-2.04%	-1.11%	-3.15%
	Jinhe Biology	3.68%	2.88%	1.60%	4.48%
	Lu Kang Pharmaceutical	3.11%	-1.08%	-19.28%	-20.36%
	Lifecome Biochemistry	0.32%	-1.14%	0.11%	-1.03%
	Pulike	4.41%	0.09%	-0.20%	-0.11%
	Apeloa Pharmacy	-1.85%	-6.24%	-8.31%	-14.55%
	Ringpu Bio	4.83%	1.12%	0.42%	1.54%
	Jinyu Bio-technology	4.40%	5.34%	-0.38%	4.96%
	Changchun High-Tech	-3.59%	-18.93%	-1.47%	-20.40%
	CAHIC	5.15%	1.47%	-0.63%	0.84%
Meat processing	Delisi	1.47%	4.47%	-1.21%	3.26%
	Huatong Meat Products	2.26%	-13.85%	-1.73%	-15.58%
	Huangshanghuang	1.43%	0.49%	-3.97%	-3.48%
	Shuanghui Development	-7.43%	-10.82%	-5.74%	-16.56%

3.2 Statistical Inspection

The abnormal returns and accumulated abnormal returns of 32 companies in the event window period are tested by T (Table 2). The results showed that there were 27 sample companies with good statistical significance, including 5 breeding companies, 8 feed companies, 10 veterinary drugs and 4 meat products processing companies. A total of 5 sample companies failed the statistical significance test, including 2 aquaculture companies, 2 feed companies and 1 veterinary drug company.

Table 2 T test results of sample companies

Shares	T- Stat	Shares	T- Stat	Shares	T- Stat	Shares	T- Stat
Delisi	-12.28 ***	WENS	4.69 ***	Tecon biology	-9.96 ***	Lu Kang Pharmaceutical	-8.41 ***
Huatong Meat Products	-4.08 ***	New Wellful	0.36	Tongwei stock	0.17	Lifecome Biochemistry	-12.3 ***
Huangshanghuang	-7.27 ***	Yisheng stock	-17.7 ***	New Hope	-2.53 **	Pulike	-20.49 ***
Shuanghui Development	-6.5 ***	Aonong Biology	-16.19 ***	Zhengbang Technology	-2.2 **	Apeloa Pharmacy	-8.58 ***
Dakang Agriculture	-17.78 ***	Da Bei Nong	-1.51	Zhenghong Technology	-9.89 ***	Ringpu Bio	-11.02 ***
Muyuan	-0.44	Haid Group	5.34 ***	Haixiang Pharmaceutical	-10.95 ***	Jinyu Bio-technology	10.8 ***
Shunxin Agriculture	-20.21 ***	Wellhope Agriculture	-14.99 ***	Hisun Pharmacy	1.89	Changchun High-Tech	-18.08 ***
Tech-bank Food	7.37 ***	Tangrenshen Group	12.93 ***	Jinhe Biology	-8.15 ***	CAHIC	-3.57 ***

*, * *, * * * indicate 10%, 5% and 1% respectively

4. Conclusion

4.1 Overall analysis

Statistical analysis of abnormal returns and accumulated abnormal returns of listed companies in swine industry on different trading days shows that the abnormal returns and accumulated abnormal returns of meat processing industry are the most negative during the event window period (event day [-10,10]), indicating that the African swine fever event has the longest negative impact on meat processing enterprises. Comparing the extraordinary profits on the event day with the accumulated extraordinary profits within 10 days before the event ([-10,0] on the event day), the African swine fever incident may have spread in the industry before the diagnosis, and the market responded quickly. And the breeding and feed enterprises were not negatively affected before the event date. However, in the 10 days after the event (Event Day [1,10]), the accumulated abnormal returns were all negative. Combining with the abnormal returns on the event day, it can be seen that within 10 days after the event, the events all brought negative impacts on the sample enterprises, with aquaculture enterprises having the greatest impact, followed by veterinary drug enterprises. (Table 3)

Table 3 AV-AR and AV-CAR of various industries on different event days

Event day	[0]	[-10，0]	[1，10]	[-10，10]
AV-AR and AV-CAR	AV-AR	AV-CAR	AV-CAR	AV-CAR
Breeding	1.63%	5.35%	-9.76%	-4.40%
Feed	1.75%	3.44%	-1.78%	1.67%
Animal remedy	1.83%	-1.85%	-2.93%	-4.78%
Meat processing	-0.57%	-4.93%	-3.16%	-8.09%

4.2 Analysis by Industry

Among the aquaculture enterprises, 7 listed companies have been impacted to varying degrees. Among them, Shunxin Agriculture and Yisheng are most seriously affected. Before the event date, the accumulated abnormal returns of Shunxin Agriculture and Yisheng Shares were higher than the abnormal returns, and they were mainly positive numbers. After the event day, the accumulated abnormal returns were all negative and lower than the abnormal returns, so it can be seen that the event has brought a great negative impact on them. The regression results show that within 49 days after the event, the cumulative abnormal return of Shunxin Agriculture and Yisheng shares continuously decreased to -30.22% and -54.26%, indicating that the influence period of time is far more than 49 days.

Among feed enterprises, 5 had significant negative impact, while 3 listed companies gad no significant impact. Among them, Zhengbang Technology had the greatest impact. Its accumulated abnormal return was as high as 18.67% before the event, and then dropped to -7.38% after the event, and it did not increase slowly until 30 days after the event. Then, the daily accumulated abnormal return of Haid Group during the window period were negative for 17 days, and the situation did not improve until 33 days after the incident.

Among veterinary drug enterprises, 9 listed companies had significant negative impact and had a longer impact period. Among them, the impact on Lu Kang Pharmaceutical was the greatest. Its accumulated abnormal return was -1.08% on the event day, and quickly dropped to -19.28% within 10 days after the event. Further analysis found that the impact period exceeded 49 days. Both Apeloa Pharmaceutical and Changchun High-Tech had negative abnormal returns for 8 days within 10 days before the event day, which lasted for a long time after the event day.

Among the meat processing enterprises, 4 listed companies had been significantly impacted,

especially Shuanghui Development and Huatong Meat Products. Among them, Shuanghui Development suffered the greatest impact, and the accumulated abnormal return in the window period had been declining, with the highest decline rate reaching 53%. The decline rate did not decrease until 49 days after the event. The accumulated abnormal return of Huatong Meat Products in the window period also declined sharply, but it increased greatly on the 20th day after the event, which indicated that the impact cycle of Huatong Meat Products was shorter than that of Shuanghui Development.

4.3 Conclusion

The "African Swine Fever" event has a significant impact on the market value of listed companies in swine industry, such as aquaculture, feed, veterinary drugs and meat products processing. The event has the greatest impact on pig breeding enterprises. The veterinary drug industry has the longest impact period. The impact degree and cycle of meat processing industry are second only to those of veterinary medicine industry, and the impact on feed industry is the least.

5. Discussion

In this paper, the following aspects are worth discussing in the process of designing and analyzing by event research method. Firstly, due to shortcomings of data collection, the samples did not cover all listed companies in swine industry. Secondly, market model is a common model in the application of event research method, but it is not the only one. Comparing the research results of this paper with the output results of other models has yet to be realized. Finally, due to the asymmetry of information, it is temporarily impossible to rule out whether there are other factors affecting the securities prices of listed companies in the window period.

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