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# Information Contagion Effects in Nuclear Crisis: Evidence from Chinese Listed Companies

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**Abstract.** This study aims to examine the returns of nuclear power plants companies and other power enterprise around the time of Fukushima nuclear crisis. We utilize event study methodology to test for significant excess performance. Consistent with our predictions, we find that the existence of an information contagion effect in the Chinese securities market. This study contributes to understanding the decision-making behavior of investors in China.

**Keywords:** Nuclear crisis, information contagion effects, decision-making behavior, cumulative abnormal return, CAR

## 1. Introduction

Information contagion effects refer to the spillover of effects of fluctuations from one or more firms to other firms. Most research on information contagion effects limits to how shock affect firms in the same industry [1], [2]. Prior research also provides evidence of information contagion effects in response to earnings related news [3], [4], [5]. The conclusion emerging from this body of work is that earnings-related news events are associated with statistically significant transfers of information from announcing to non-announcing firms, although the magnitude of the market reaction for non-announcers tends to be considerably smaller than that observed for announcers. However, the existing research in information contagion ignored effects of significant events. We focus on inter-industry contagion effects in this paper when the Fukushima nuclear crisis happened; the cumulative abnormal return (CAR) changes in companies which events directly related to, those companies are indirectly related to the power industry companies, and other power plants firms which are not related to nuclear crisis. This paper aims to explore and classify the magnitude of information contagion effects after the nuclear crisis.

The remainder of the paper is organized as follows. Section 2 reviews the nuclear crisis and develops the hypotheses. Section 3 describes the sample selection and research designs. Section 4 presents the empirical results. Section 5 concludes the paper.

## 2. The Nuclear Crisis and Hypothesis Development

### 2.1. The Fukushima Nuclear Crisis Submitting

On May 11, 2011, a huge earthquake and tsunami destroyed a large part of northeastern. Japan's four nuclear power plants along the coast are subject to a different damage, the most serious one is the world's largest nuclear power plant-the first nuclear power plant and the second nuclear power plant in Fukushima. The interruption of operating system power supply caused by the earthquake led failure of the first and second nuclear power plant in Fukushima reactor cooling system, being declared to emergency status later. From March 12 to March 15, the first nuclear power plant in Fukushima 4unit has exploded, and the

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emergence of leakage of radioactive material, causing great repercussions in Japan and the international community of great concern. After the explosion, radioactive substances into the air, and spread by wind to China, the USA, Russia and other countries. By the Fukushima nuclear crisis, countries have expressed care and concern for nuclear power, on the use of nuclear energy, nuclear power equipment manufacturing as well as development of nuclear power had an immeasurable impact.

### 2.2. The Information Contagion Effect

Studies in information contagion effects usually concern about a company's stock price reaction when new information is released by other companies in the industry. Generally speaking, a contagion effect is perceived if the stock price of a company is systematically affected after a peer firm announces corporate information. Since the stock price of the company is decided by investors' expectations of its future cash flows and risks, the source of the contagion effect lies in the adjustment of such expectations according to the information released by peer firms. Therefore, the occurrence of an important event is usually accompanied by a contagion effect. For example, the bankruptcy announcement of a competitor would cause its rival to suffer an abnormal loss of about 1% [6]. Other clients of Arthur Andersen also experienced a significant loss in stock prices after the Enron case [7]. There are also evidences of the contagion effect on companies in the same industry and those companies having business relationships with Enron [8]. The typical information transfer study proceeds in three steps. First, the stock return behavior of announcing firms is examined to isolate any share price movements that accompany the news event of interest (e.g., a bank failure). Next, stock returns coincident to the news announcement are computed for a sample of non-announcing firms (e.g., other banks). Information transfer effects are presumed present when the mean event-period stock return for non-announcing firms is reliably different from zero. Finally, corroborating evidence is sought indicating that cross sectional differences in the stock returns of non-announcing firms can be traced to event related differences in firm characteristics. Undoubtedly, rational investors would anticipate that sales in the food industry would be negatively affected for a considerable time. On the other hand, the nuclear crisis was classified as a major security event by the State Council, and the issue of food safety aroused unprecedented attention from the government and society. To address the public's concerns, a series of nuclear safety inspections have been conducted, and supervision of the power industry is likely to be greatly enhanced. It is predicted that the cost of quality control of the entire power industry will increase significantly. Based on this phenomenon, we propose our first hypothesis:

H1: The Nuclear-suppliers companies will suffer a significantly negative abnormal return during the event period as a result of the nuclear crisis.

H2: Other power plants or power equipment without nuclear will also suffer a negative abnormal return during the event period.

## 3. Research Design

### 3.1. Cumulative Abnormal Return (CAR)

As the methods used in this fields frequently, this study uses the multivariate regression model. Dummy variables are used to allow statistical evaluation of variation in the intercept and slope during the event period when nuclear crisis news declared. To measure α and β, the return generating model was used:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \tag{1}$$

Where, $R_{it}$ = the average of the daily realized returns on securities in portfolio i on day t. $\alpha_i$ = the intercept term for portfolio i , $\beta_i$ = the systematic risk of portfolio i, $R_{mt}$ = the return on the value-weighted market portfolio on day t. $\varepsilon_{it}$ = a random disturbance term.

To measure the effect of the nuclear crisis on share prices, the return generating model used is:

$$R_{it} = \frac{P_{it} - P_{i(t-1)}}{P_{i(t-1)}} \tag{2}$$

$$R_{mt} = \frac{Index_{mt} - Index_{m}}{Index_{m(t-1)}} \tag{3}$$

Where, $P_{it}$ = the price of portfolio i on day t. $P_{i(t-1)}$ = the price of portfolio i on day (t-1). $Index_{mt}$= index on stock market on day t. $Index_{m(t-1)}$ = index on stock market on day (t-1).

In this approach the prediction error is directly estimated as the coefficient of the dummy variable. The expect rate of return (E (Rit)) is then computed as the prediction error divided by the regression standard error:

$$E(\hat{R}_{it}) = \alpha_i + \beta_i R_{mt} \tag{4}$$

The average daily stock excess returns (AAR) and cumulative average excess return(CAR) can be calculated as:

$$AAR_{it} = \frac{1}{N}\sum AR_{it} \tag{5}$$

$$CAR_{it} = \sum_{t=m}^{n} AAR_{it} \tag{6}$$

Where, m and n are portfolio-specific days.

### 3.2. Event day

March 11, 2011, the day when report carried the news of the Fukushima nuclear power plant explosion, is defined as the event day (t=0). Taking the nature of the event into account, it is impossible to forecast the event.

### 3.3. Sample Selection

We include all listed companies in the Chinese market in the event period as our initial samples. Then, we use the industry classification standards of both the China Securities Regulatory Commission (CSRC) and the Global Industry Classification Standard (GICS) to screen listed companies belonging to the power industry, and then combine them to obtain 153 initial samples. The list was examined to identify those firms whose stock was not trading during the study period, and the non-trading firms were dropped from the study. The remaining firms were split into three portfolios: (1) power plants nuclear-related firms, (2) power equipment nuclear-related suppliers firms, and (3) other power plants or power equipment without nuclear. Table 1 details the process of sample selection.

Table 1: Sample Selection

| Sample selection | Sample size |
|---|---|
| CSRC: Power, steam and hot water production and supply of industry | 69 |
| Manufacturing/Electrical machinery and equipment manufacturing | 96 |
| Less: no trading during the event period | (3) |
| Less: repeated companies | (12) |
| Total Number | 150 |
| Divide into groups | |
| power plants nuclear-related firms(Nuclear-plants) | 8 |
| power equipment nuclear-related suppliers firms(Nuclear-suppliers) | 34 |
| other power plants or power equipment without nuclear (Other plants) | 108 |

## 4. Empirical Results

Figure 1 shows the abnormal returns (CAR) for Nuclear-plants, Nuclear-suppliers and other plants firms in different time window. With the expansion of the event window, the Nuclear-plants, and other plants firms were experiencing smooth trends while Nuclear-suppliers sample was experiencing a downward trend.

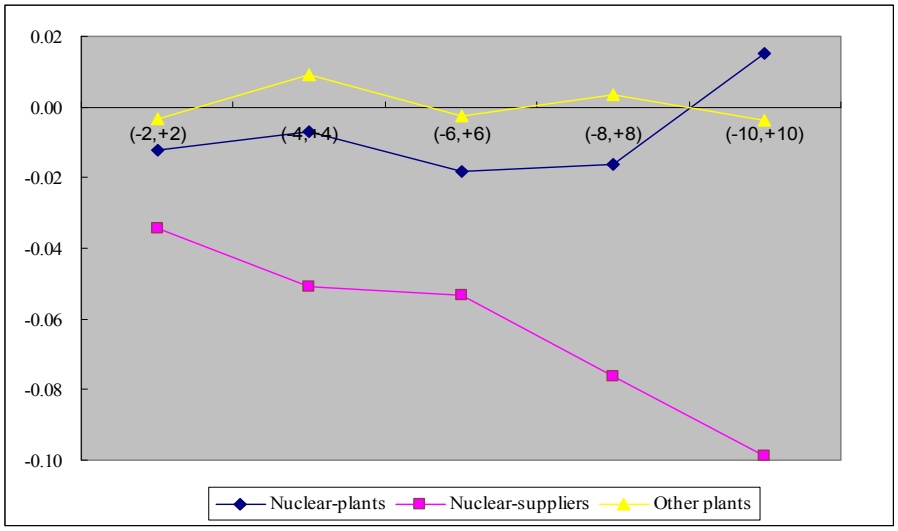


Fig. 1: Cumulative Abnormal Returns (CAR) for three group sample

Table 2: Average Abnormal Returns (AAR) for the three group firms

| Event day | Nuclear-plants | | | Nuclear-suppliers | | | other plants | | |
|---|---|---|---|---|---|---|---|---|---|
| | AAR | T value | sig. | AAR | T value | sig. | AAR | T value | sig. |
| -3 | -0.0062 | -1.9669 | 0.0899 | 0.0031 | 0.7987 | 0.4305 | 0.0001 | 0.0774 | 0.9384 |
| -2 | -0.0063 | -1.6103 | 0.1514 | -0.0058 | -2.1278 | 0.0414 | -0.0024 | -1.2362 | 0.2191 |
| -1 | -0.0019 | -0.3420 | 0.7424 | 0.0022 | 0.4917 | 0.6264 | -0.0020 | -1.2710 | 0.2065 |
| 0 | -0.0036 | -0.8210 | 0.4387 | -0.0121 | -2.0180 | 0.0523 | -0.0021 | -1.0274 | 0.3065 |
| 1 | 0.0035 | 0.4998 | 0.6325 | -0.0081 | -1.1484 | 0.2596 | 0.0049 | 1.9059 | 0.0594 |
| 2 | -0.0040 | -1.2142 | 0.2640 | -0.0106 | -3.9510 | 0.0004 | -0.0019 | -1.3066 | 0.1942 |
| 3 | 0.0075 | 0.9135 | 0.3914 | -0.0183 | -2.1979 | 0.0356 | 0.0100 | 4.7628 | 0.0000 |
| 4 | -0.0087 | -2.1286 | 0.0708 | -0.0045 | -1.0375 | 0.3075 | 0.0006 | 0.3183 | 0.7509 |
| 5 | -0.0007 | -0.0709 | 0.9455 | 0.0056 | 1.2617 | 0.2165 | -0.0015 | -0.7482 | 0.4560 |
| 6 | -0.0017 | -0.4168 | 0.6893 | -0.0048 | -1.7675 | 0.0870 | -0.0063 | -4.3844 | 0.0000 |
| 7 | -0.0086 | -0.8622 | 0.4172 | -0.0017 | -0.6432 | 0.5248 | 0.0013 | 0.9176 | 0.3609 |
| 8 | -0.0003 | -0.0550 | 0.9577 | -0.0093 | -4.9952 | 0.0000 | -0.0001 | -0.0535 | 0.9574 |
| 9 | 0.0129 | 1.0603 | 0.3242 | -0.0059 | -3.0990 | 0.0041 | 0.0023 | 1.2065 | 0.2303 |
| 10 | 0.0167 | 1.2651 | 0.2463 | -0.0126 | -3.7507 | 0.0007 | -0.0024 | -1.0487 | 0.2967 |

The empirical results are described in table 2. We also carry out the T value. As it is shown in table 2, there is still an average abnormal return greater than zero for sample companies in t=-1. As the Nuclear crisis begins to become publicly known, our sample companies suffer an average negative abnormal return on t = 0, statistically significant at the 0.5 percent level. Even so, the sample companies still suffer an average loss in abnormal return over the whole event period. The sample companies also incur a significant abnormal loss. That is to say, it shows that an information contagion effect does exist in the Chinese securities market.

Table 3: Cumulative Abnormal Returns (CAR) for the three group firms

| Event day | Nuclear-plants | | | Nuclear-suppliers | | | other plants | | |
|---|---|---|---|---|---|---|---|---|---|
| | CAR | T value | sig. | CAR | T value | sig. | CAR | T value | sig. |
| (-2,+2) | -0.0122 | -0.8408 | 0.4282 | -0.0344 | -2.7871 | 0.0090 | -0.0035 | -0.8305 | 0.4081 |
| (-4,+4) | -0.0070 | -0.2480 | 0.8113 | -0.0508 | -2.7232 | 0.0105 | 0.0090 | 1.8004 | 0.0746 |
| (-6,+6) | -0.0183 | -0.6441 | 0.5400 | -0.0534 | -3.1394 | 0.0037 | -0.0024 | -0.4309 | 0.6674 |
| (-8,+8) | -0.0162 | -0.6370 | 0.5444 | -0.0762 | -4.2072 | 0.0002 | 0.0035 | 0.5421 | 0.5889 |
| (-10,+10) | 0.0153 | 0.4461 | 0.6690 | -0.0989 | -5.0486 | 0.0000 | -0.0039 | -0.5397 | 0.5905 |

To ensure the reliability of our results, we extend the event window into T (-10,+10); Table 3 shows the empirical results under the new definition. We find that the event of nuclear crisis induces a statistically reliable stock price decline at contagion firms that provide common products as the Nuclear-plants sample. The mean CAR for the pre-crisis period T (-2, +2) is not significantly different from zero. Overall, the results in Table 4-2 provide evidence supporting our first hypothesis of a contagion effect of firms directly related to

crisis. As shown, no fixed pattern exists for abnormal returns of the sample companies in the 21 trading days during T (-10, +10). This shows that our results are relatively reliable.

The above results show that the Nuclear-supplier companies in the industry suffer significantly negative abnormal returns in the event period. However, another likely scenario is that this pattern is not unique to the sample companies but is a miniature of stock price movement for all nuclear related companies. To this end, we calculate and test the abnormal returns of other plants in the manufacturing industry in the event period, as shown in Table 3. We find that only the listed companies in the electronics industry suffer significantly negative abnormal returns, but the abnormal return s do not differ significantly from zero in the T (-1,+1) of the entire event period. We also note that the abnormal returns of companies in the paper and printing industry are significantly negative, but their abnormal returns do not differ significantly from zero on day t. Therefore, the results show that the stock price movement of non-dairy companies in the food industry is unique; it is neither a microcosm of the entire manufacturing industry nor the same as other nuclear related companies.

## 5. Conclusions

This event study examines the returns of Nuclear-plants, Nuclear-suppliers and other plants firms during the period of the Fukushima nuclear crisis. This study can be used to deal with most of the problems that researchers will encounter in carrying out event studies. Further studies could consider expanding the definition of event and if the sample size could be expanded appropriately, it would help not only to promote the conclusions of this study, but also to obtain more extensive information owing to the different nature of the nuclear crisis.

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