

The Impact of Product Recall Announcements on Stock Market Reaction: a Study of Chinese Listed Companies

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Abstract

Product recalls can be viewed as a firm or nation's worst nightmare. Though the magnitude of the loss of brand equity and reputation due to a recall is difficult to directly estimate, the impact of a recall on shareholder wealth is more easily quantified. Based on a sample of 29 product recall announcements by Chinese listed companies during the period 2002 to 2008, the effects of the stock market reaction to them was examined. Consistent with previous research in the United States market, we found a significant negative abnormal return in the Chinese market, but also found that Chinese companies suffered greater financial losses from product recalls. The results also revealed that Chinese companies in the food industry experienced more severe reactions from their recall announcements, while companies in automobile industry experienced a less severe reaction in their stock prices. We briefly describe the case of the melamine tainted milk crisis in China and investigate the stock market reaction, for both affected companies and their competitors. The results show that all of the affected companies suffered from significant negative financial losses, while their competitors benefitted from the recall.

Key words: Product recalls, stock market reaction, event study, melamine-tainted milk crisis

1. Introduction

In recent years, recalls of Chinese-made products due to quality problems have been surging. Of the 152 consumer products recalled by the United States Product Safety Commission since January 2007, 104 were made in China (Roth et al., 2008). In 2008, out of the 86 consumer products recalled in the UK, 72% or 62 of these products were made in China (Rapex, 2009). Governments and consumers alike want such products promptly removed from the marketplace, due to health and safety concerns. The recall of unqualified products is an example of a product-harm crisis, which is defined as a “discrete, well-publicized occurrence wherein products are found to be defective or dangerous (Siomkos & Kurzbard, 1994)”. The increasing complexity of products, more stringent product-safety legislation and higher demands by consumers have combined to make product-harm crises ever more frequent occurrences (Dawar & Pillutla, 2000). Needless to say, product-harm crises are among a firm’s worst nightmares (Heerde, Helsen & Dekimpe, 2007).

Product-harm crises often result in product recalls, which can ruin carefully cultivated brand equity, damage a company’s reputation and lead to revenue and market-share losses (Chen, Ganesan & Liu, 2008). It is very difficult to directly estimate the magnitude of the loss of brand equity and reputation, however, the impact of a recall on shareholder wealth is more readily quantifiable through the use of event study methodology, based on daily stock prices. The underpinnings of event study methodology state that, in an efficient market, the financial impact of an unanticipated event will be immediately reflected in stock prices (Fama, 1970). Since product recalls are potentially important economic events, the study of the stock market reaction to product recalls will lead to a better understanding of the efficiency of stock markets (Pruitt & Peterson, 1986).

Numerous researchers have examined the effects of product recalls on the stock prices of affected companies, based on recall cases in the United States (Pruitt & Peterson, 1986; Hoffer, Pruitt, & Reilly, 1988; Bromiley & Marcus, 1989; Chu, Lin & Prather, 2005). However, little is available in literature about the stock price effects of Chinese product recalls. We collected secondary data and used event study methodology to unravel and empirically

examine the financial impact of product recalls on the shareholder wealth of affected companies in the Chinese market. This is used as the foundation for development of an understanding of different reactions to product recalls in different industries.

This paper has three purposes: (1) to test the impact of product recalls on Chinese companies, (2) to compare the impact of product recalls in the United States and China, and (3) to develop a case example of the impact of the recent melamine-tainted milk crisis on the affected Chinese dairy companies and their competitors. The remainder of the paper is organized as follows. Section 2 presents the literature about the stock market reaction to product recalls. Section 3 describes the history of product recalls and product recall systems in the United States and China. Section 4 describes our empirical study of the stock market reaction to product recalls in Chinese listed companies and compares the results to those in American companies. Section 5 further develops the case of the melamine-tainted milk crisis in Chinese dairy companies to study the effects of product recalls on the affected companies and their competitors. Finally, conclusions and opportunities for further research are discussed in Section 6.

2. Literature review

Jarrell and Peltzman (1985) laid the foundation for using event study methodology to examine the impact of product recalls on shareholders, and since then, many researchers have extended its use to examine market efficiency following product recall announcements (Pruitt & Peterson, 1986; Hoffer, Pruitt & Reilly, 1988; Bromiley & Marcus, 1989; Chu, Lin & Prather, 2005). However, there is debate in the literature about the size of the stock market's reaction to product recall announcements. For example, Jarrell and Peltzman (1985) found that the shareholders of firms producing recalled drugs and automobiles bore greater financial losses than the direct costs of recalling the defective products, and that their competitors also experienced a substantial effect, although not as great as recall company losses. Any favorable effects on competitors' demand from a recall were overwhelmed by negative demand effects on the whole industry. However, Hoffer, Pruitt and Reilly (1988) found "little evidence" of significant effects for either recall firms or their competitors, after correcting some

methodological problems and reclassifying and reanalyzing Jarrell and Peltzman's (1985) data for the 1975-1981 period. Pruitt and Peterson (1986) found a significant negative financial impact of non-automobile product recalls on the equity holders of affected firms. There was no significant relationship between the magnitude of the market reaction and the market value of the direct costs of the recalls. Chu, Lin & Prather (2005) studied the impact of security price reactions to non-automobile recalls in a different time period from that of Pruitt and Peterson (1986). They conducted a cross-industry event study, finding that the drugs and cosmetics industries suffered more, while the rubber and automotive industries were less affected. Bromiley and Marcus (1989) found that the stock market reaction was small and was not a sufficient instrument of social control to provide a significant deterrent to producers of hazardous automobiles, compared to the expected gains from these defective automobiles.

Furthermore, some researchers are of the opinion that the assertion in the above literature that all recalls are homogeneous is unreasonable, and that the stock market reaction may vary considerably with different types of recall information. Therefore, further research on recalls is necessary (Reilly & Hoffer, 1983; Davidson & Worrell, 1992; Thomsen & McDenzie, 2001; Rhee & Haunschild, 2006). For example, Reilly and Hoffer (1983) speculate that market responses to a product recall may be different, depending on the severity of the recall. Davidson and Worrell (1992) examined the impact of different types of non-automobile recall announcements on stock prices. Their results showed that, although the stock market had a significant negative reaction to recall announcements, more significant negative abnormal returns were found in the reaction to announcements for replacing or returning purchases vs. a repair or check of product announcements and products taken off the market vs. recall announcements. While only finding limited support, government-ordered recalls suffered greater losses than voluntary recalls. Thomsen and McKenzie (2001) examined the shareholder losses from the meat and poultry recalls of different hazard levels. They found that the recalls of more serious hazards suffered significant negative losses, while the recalls of less serious hazards had no negative impact. Rhee and Haunschild (2006) found that automobile companies with a strong reputation experienced greater market share downside from product defects and the release of product recall announcements than those with weaker reputations did.

Some researchers argue that different product recall strategies may have differing impacts (Rupp, 2001; Haunschild & Rhee, 2004; Chen, Ganesan & Liu, 2008). For example, Rupp (2001) tested the hypothesis that recalls initiated by the government present a low-quality signal and do more damage in the eyes of shareholders than recalls initiated by manufacturers, using automobile recall data from 1973 to 1998. The results showed that the market reaction to recalls initiated by the government were not associated with greater shareholder losses. Haunschild and Rhee (2004) found that companies which initiate voluntary recalls will obtain greater learning effects and can lower their subsequent recall rates, compared to companies executing involuntary recalls. Chen, Ganesan and Liu (2008) identified proactive and passive recall strategies, based on CPSC recall announcements. Interestingly, they found that proactive recall strategies had more negative share losses than passive strategies, because investors perceive proactive strategies as a signal of larger financial losses to the firm, rather than signaling socially responsible actions.

The literature on using secondary data to study the effect of product recalls on financial wealth is based on recall experiences in the United States, and most of it provides evidence in support of the efficient market hypothesis. In a recent paper, Cheah, Chan and Chieng (2007) investigated the effect and extent of product recalls by pharmaceutical companies, in the United Kingdom and the United States, on shareholder wealth. They examined whether there was a differing impact for recalls with different hazard levels. They found that, although there were negative mean risk-adjusted returns for all hazard level recalls in both in the U.K. and U.S., the U.S. companies suffered greater financial losses for more serious hazard levels, while there was no difference in financial losses for U.K. companies at all product hazard levels.

In recent years, many Chinese-made products have been recalled, due to various kinds of quality problems. Especially after the Mattel toy recall in 2007 and the Sanlu dairy product recall in 2008, product safety issues in China have attracted more and more attention by both practitioners and researchers. For the first time, food and drug safety issues became the topic of a government report in 2009. It indicated that the Chinese government is putting more emphasis on food and drug safety, which will have substantial impact on the enhancement of product quality in the food and drug industries.

In this study, we offer new evidence about Chinese product recalls, investigating several research questions. Are there significant financial losses associated with Chinese product recalls? Comparing this research with research on U.S. recalls, what is the extent of financial loss due to Chinese product recalls? Are there different financial effects in different industries? All of these questions are in need of further study.

3. Recalls and Recall Systems in the U.S. and China

With the increasing consciousness of consumers' expectations about safety and health, many countries, including the United States, Japan, Canada and the United Kingdom, have developed product recall systems. Every year, a large number of various defective products are recalled, in order to prevent consumers from suffering from the possible harmful effects of defective products and protect the legitimate rights and interests of consumers.

3.1 Recalls in the U.S.

The United States was the first country to carry out a product recall, and it is the country employing recalls the most frequently. In the United States, the first product recall occurred in 1966 in the automobile industry. Since then, recall systems for defective products have been introduced into a number of pieces of product safety and public health legislation in the U.S., and recalls for different products are carried out under the supervision of different agencies. For example, National Highway Traffic Safety Administration (NHTSA) orders recalls and repairs for automobiles with defects. The Food Safety and Inspection Service (FSIS) and Food and Drug Administration (FDA) are charged with enforcing food and drug recalls. The Consumer Product Safety Commission (CPSC) is charged with protecting the public from unreasonable risk of serious injury or death from thousands of different consumer products, such as toys, power tools, household chemicals, and so on, under the agency's jurisdiction. At present, product recall systems for defective products have become a common means of quality management in the U.S.

3.2 Recall Systems in China

Compared to recalls in the U.S., recall systems in China started relatively late. The

Defective Automobile Products Recall Regulations in China for the pilot implementation of the first recall system went into effect on October 1, 2004. It mandated that manufacturers should organize and implement the recall of defective automobile products that may cause personal injury or property loss, in accordance with its provisions and procedural requirements. In 2007, other recall systems for food, drug, toy and electronics products were set up.

Product Liability Secured Regulations were promulgated by the General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) in 2007. The specific *Regulations* for consumer electronics products, such as mobile phones, require enterprises with defective products to initiate the recall. The *Provisions on the Administration of Toy Recalls* was delivered by AQSIQ and become effective on August 27, 2007. The *Provisions on the Administration of Food Recalls* was delivered by AQSIQ and became effective on August 31, 2007. The *Administrative Measures for Drug Recalls* was delivered by the State Food and Drug Administration (SFDA) and become effective on December 10, 2007. New *Food Safety Legislation* was approved on February 28, 2009 and will be come into force on June 1, 2009. The passing of these new laws is meant to tighten the supervision of manufacturers and impose tougher penalties on those which make bad products, as the government seeks to restore public confidence, after a spate of problems with tainted food. The new laws set up a system for monitoring and assessing food safety risks, initiate a recall problem products system, and more importantly, set up mandatory food safety standards and authorizes the enforcement of uniform nationwide standards for everything from allowable additives to nutritional labeling, rather than the previous non-uniform standards.

Clearly, the Chinese government is placing increasing emphasis on food and drug safety issues. The following is an excerpt from a 2009 government report, which indicates that it is the first time that food and drug safety were included in a government report, which will have a significant impact on the enhancement of product quality in the food and drug industries.

“We will comprehensively improve product quality and enhance workplace safety... We will make intensive efforts to improve food and drug safety, and improve and strictly enforce standards for product quality and safety. We will implement strict market access rules and

product traceability and recall systems so that the people buy food and drugs with confidence and consume them with satisfaction.” “Report On the Work of the Government.” Wen Jiabao, Chinese Premier of the State Council, March 5, 2009

4. Methodology

4.1 Data

We selected product recall announcements from companies whose common stock was listed on either the Shenzhen A Share Stock Exchange or the Shanghai A Share Stock Exchange. We searched for product recall announcements from several sources, using “recall,” “return,” “replace” and “take off the shelf” as key words. The sources included four Chinese major security newspapers, including *China Security Journal*, *Shanghai Securities News*, *Securities Daily* and *Secutimes*, which have been appointed by the China securities regulatory commission (CSRC) to release news about Chinese listed companies. We also collected product recall announcements from the China Infobank database (<http://www.infobank.cn/>), which collects basic materials, important decisions, announcements and reports of Chinese listed companies in the Shenzhen Stock Exchange and Shanghai Stock Exchange from 1993 to the present, and the website www.cninfo.com.cn, which is the official website nominated by the CSRC to release news of Chinese listed companies. A third source was the Chinese automobile recall website (<http://www.qiche365.org.cn/>). The Chinese government set up the automobile recall system in 2004, and all automobile recall news is released on the Chinese automobile recall website. We eliminated recall announcements released by companies not registered in the Shenzhen and Shanghai stock exchanges. We collected a total of 29 product recall announcements covering a nine year period from 2002 to 2008, among which 13 announcements were related to the automobile industry, seven were related to the pharmaceutical industry, four were related to the food industry and five were related to electronics industry. The distribution of announcement by industry is shown in Figure 1.

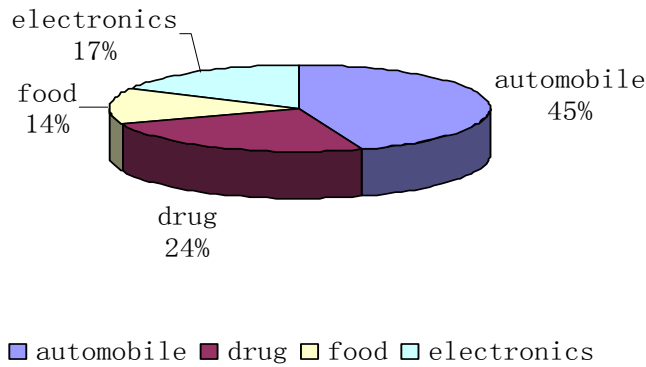


Fig. 1 The industry distribution of product recall announcements

Descriptive statistics for the 29 listed companies which released product recall announcements are contained in Table 1. We used the data for the most recent fiscal year completed before the release of the product recall announcements.

Table 1 Basic information about the 29 product recall companies

	Sales (million RMB)	Total assets (million RMB)	Net profit (million RMB)	Employees
Mean	6405.59	6026.03	175.74	5101
Median	4077.48	4161.50	58.45	4244
Std. Dev.	6975.83	5736.47	362.48	3957
Maximum	25675.34	23232.14	1450.68	16688
Minimum	178.79	569.42	-587.60	563

4.2 Analysis

We used event study methodology, based on daily security prices, to estimate the impact of product recall announcements on shareholder wealth. This methodology is well established and has been used in numerous academic papers to measure the financial impact of a change in corporate events, such as CEO turnover, supply chain glitches, quality award winners, investment in ERP, etc. Event study methodology is based on the notion that, in an efficient market, the financial impact of any unanticipated event will be immediately reflected in

security prices. Using this method, we can determine whether there was an abnormal security price associated with an unanticipated event. We employed the following steps:

Step 1: Obtain the estimated parameters for computing the expected normal return of stock i on day t .

There are three ways to estimate normal returns, including mean-adjusted, market-adjusted and market model measures. We used the market model to estimate the normal return of Chinese product recall announcements on shareholder wealth, since the market model is the best model for controlling systematic risk. The Chinese stock market has experienced unusual ups and downs during the targeted period 2002-2008, especially during the period 2006-2008. The Shanghai Composite Index on the first trading day of 2002 was 1611, then reached its lowest point during the targeted period on June 6, 2005, at a level of 998. It then went up to its highest historical point of 6124 on Oct.16, 2007, then dropped back to 1821 on the last trading day of 2008. The Shenzhen Composite Index had a similar experience. On the first trading day of 2002, it was 3266, then reached its lowest point of 2593 on November 16, 2005. It then rose to its highest historical point of 19,600 on October 10, 2007, then dropped back to 6486 on the last trading day of 2008. Hence, we chose the market model to control market systematic risk.

The market model is derived from the Capital Asset Pricing Model (CAPM), which posits a linear relation between a firm's stock return and the market return as the following equation:

$$R_{it^*} = \alpha_i + \beta_i \cdot R_{mt^*} + \varepsilon_{it^*} \quad (1)$$

Where R_{it^*} is the actual return of stock i on each day t^* of estimation period $[t_0, t_1]$ ¹, R_{mt^*} is the return of market portfolio (such as Shanghai Composite Index) on each day t^* of estimation period $[t_0, t_1]$, α_i is the intercept of the relationship for stock i , β_i is the

¹ If there were any excluded dividends (XD) or excluded rights (XR) for the company on the date, we used the ex-right price adjustment to measure the rate of return for the company.

slope of the relationship of stock i with the market return, and ε_{it} is the error item with $E(\varepsilon_{it})=0, V(\varepsilon_{it})=S_i^2$. We estimated $\hat{\alpha}_i, \hat{\beta}_i$ and \hat{S}_i^2 through the use of ordinary least squares (OLS), over an estimation period of 120 trading days. We set the day of product recall announcements to be day 0 and used a 5-day event period, which included day 0 and the four days following the recall announcement. To prevent any potential bias, we made the estimation period end 10 trading days before the announcement, that is, the estimation period was day (-130,-11).

Step 2: Compute the normal return of stock i on each day t of the event period.

We used the parameters estimated in the first step to compute the normal return of stock i on each day t of event the period.

$$E(R_{it}) = \hat{\alpha}_i + \hat{\beta}_i \cdot R_{mt} \quad (2)$$

Step 3: Compute the abnormal return (AR) of stock i on each day t of the event period.

In event study methodology, the abnormal return is an important index for measuring the impact of the unanticipated information release on the security price. We derived estimates of daily abnormal return (AR) for the i th company as the difference between the actual return of stock i on day t and the estimated normal return of stock i on day t , which is expressed as:

$$AR_{it} = R_{it} - \alpha_i - \beta_i \cdot R_{mt} \quad (3)$$

The daily average abnormal return for all the sample companies on day t is:

$$AAR_t = \sum_{i=1}^N AR_{it} / N \quad (4)$$

where N is the number of sample companies on day t . We used a t -test to test the statistical significance of the average abnormal return:

$$t = \sum_{i=1}^N \frac{AR_{it} / S_i}{\sqrt{N}} \quad (4)$$

Step 4: Compute the cumulative abnormal return (CAR) of stock i in the event period $[t_1, t_2]$.

The abnormal returns can then be cumulated over the number of event days to get a measure of the cumulative abnormal return for each company.

$$CAR_i(t_1, t_2) = \sum_{t=t_1}^{t_2} AR_{it} \quad (5)$$

Step 5: Compute the average cumulative abnormal return (ACAR) of the sample firms in the event period $[t_1, t_2]$.

$$ACAR_i(t_1, t_2) = \frac{1}{N} \sum_{i=1}^N CAR_i(t_1, t_2) \quad (6)$$

We also used a t -test to test the statistical significance of the average cumulative abnormal return:

$$t = \frac{\sum_{i=1}^N \frac{\sum_{t=t_1}^{t_2} AR_{it}}{\sqrt{\sum_{t=t_1}^{t_2} \hat{S}_i^2}}}{\sqrt{N}} \quad (7)$$

5. Results

Table 2 gives the event study results of Chinese product recall announcements. From Table 2 we can see that, on the announcement day (Day 0), there was a mean abnormal return of -0.22%, which was not statistically significant. There were no statistically significant results for the median abnormal return and percentage of negative abnormal returns on Day 0. However, a significant impact was found on the day following the announcement day (Day 1). The mean abnormal return on Day 1 was -2.81%, the median abnormal return on Day 1 was -2.58% and the percentage of negative abnormal return on Day 1 was 89.66%. All of the statistics indicate that the probability of obtaining a negative abnormal return by chance on Day 1 is less than 1%. The reason for the effect to be seen on Day 1 may be because recall announcements are often released near, or after the market closes, so financial market investors are unable to place a trade based on the information released on Day 0, and they must wait until the next trading day to act on the new information. When we traced back to

the recall examples, this was the case for most of them. On the days before the announcement day (Day -5 to Day -1), the abnormal returns varied without statistical significance, thus they were driven more by chance rather than by economic factors. This suggests that the negative abnormal returns on Day 1 were related to the recall announcement, and that the events were unanticipated prior to announcement. For the remaining days following Day 1, the abnormal returns also varied randomly. These results indicate that product recall announcements are associated with significant and negative stock price changes, which indicates that investors perceive product recalls as a signal of product hazard and financial losses to the firm.

Table 2 Event study results for 29 Chinese product recall announcements

Day	Abnormal return			Cumulative Abnormal Return		
	mean	median	% negative	mean	median	% negative
-5	-0.15% (0.08)	-0.76% (-1.160)	58.62% (0.928)	–	–	–
-4	0.81% (1.00)	0.73% (-1.290)	34.48% (-1.671)	–	–	–
-3	0.50% (1.05)	-0.24% (-0.550)	55.17% (0.557)	–	–	–
-2	0.79% (1.32)	0.50% (-1.690*)	37.93% (-1.300)	–	–	–
-1	-0.39% (-0.83)	-1.00% (-0.465)	51.72% (0.186)	–	–	–
0	-0.22% (-0.73)	0.02% (-0.390)	46.15% (-0.392)	-0.22% (-0.076)	0.02% (-0.39)	46.15% (-0.392)
1	-2.81% (-5.20***)	-2.58% (-4.020***)	89.66% (4.271***)	-3.01% (-4.256***)	-2.60% (-3.644***)	82.76% (3.528***)
2	-0.03% (-0.11)	-0.25% (-0.370)	62.07% (1.300)	-3.04% (-3.714***)	-1.86% (-2.927***)	68.97% (2.043*)
3	0.55% (1.17)	-0.42% (-0.550)	55.17% (0.557)	-2.48% (-2.728**)	-1.62% (-1.6)	68.97% (2.043*)
4	-0.94% (-2.46**)	-0.80% (-1.690*)	68.97% (2.043*)	-3.42% (-3.283***)	-2.92% (-1.763*)	65.52% (1.671)

*p<.10, **p<.05, ***p<.01

Table 3 summarizes the existing literature about event study results of stock market reaction to product recalls in the United States market.

Table 3 Event study results for U.S. product recall announcements

Author	Analysis period	Sample size	Industry	Abnormal return on Day -1	Abnormal return on Day 0
Jarrell & Peltzman (1985)	1967-1981	116	automobile recall	-0.81% ^{***} (-1,1)	-
Pruitt & Peterson (1986)	1968-1983	156	non automobile recall	-0.4% ^{***}	-0.363% ^{***}
Hoffer, et al. (1987)	1970-1984	46	Severe automobile recall	-0.565% ^{***}	-0.093%
Bromiley & Marcus(1989)	1967-1983	119	automobile recall	-0.32% [*]	-0.32% [*]
Davidson & Worrell (1992)	1968-1987	133	non automobile recall	-0.36% ^{***}	-0.12%
Thomsen & McKenzie (2001)	1992-1998	252(class 1) 189(class 2)	Meat and poultry recall	-	-0.4% ^{**} (class 1) 0.2%(class 2)
Chu, Lin & Prather (2005)	1984-2003	269	non automobile recall	-1.1% ^{***}	-0.6% [*]

*p<.10, **p<.05, ***p<.01

Comparing Table 3 and Table 4, we can see that most studies of product recalls in the United States found that there were significant negative abnormal returns on Day -1, and some found significant negative abnormal returns on Day 0. The reason for this is that announcements in the United States were made public on the day prior to their publication in *Wall Street Journal*. Therefore, the United States market would be expected to react on event Day -1. However, the United States market can only react on Day 0 if the announcements are made late in the afternoon of Day -1. Hence, some researchers found significant negative abnormal returns on both Day -1 and Day 0.

Compared to recall announcements in the United States, recall announcements in China are related to greater financial losses in stock price. One possible explanation is that in the United States, the first recalls occurred much earlier than in China and recall systems are therefore more mature. People are more accepting of product recall announcements and may not perceive them as serious and potentially leading to huge financial losses to companies. Since many product recall announcements in the United States are released even though there have been no accidents or injuries, people may perceive them as a signal of socially

responsible action. Therefore, they do not have such a negative impact on investors as product recalls in China do.

During 2007 and 2008, it seemed like there were new stories about defective products and recalls every day in the United States, all leading back to Chinese facilities (Lyles, Flynn & Frohlich, 2008). However, there was very little news about product recalls in China. For example, in March 12, 2009, the U.S. Department of Agriculture’s FSIS released a CLASS II recall announcement for chicken drink products manufactured by Khong Guan Corporation for products that did not meet poultry products inspection or poultry exemption requirements, even though no reports of illness had been received. However, in China, the products of Khong Guan Corporation were not taken off the shelves. Hence, when there is a product recall announcement released in China, people assume that there must be a severe product hazard and that there will be great financial losses to the company. Thus, the stock market reacts more negatively to recalls in China.

Another important issue in product recalls is examination of whether there is a differential impact of product recalls in different industries. Table 4 lists the mean standardized abnormal returns (SAR) on Day 1 for different industries.

Table 4 The mean SAR on Day 1 for different industries

Industry	Mean of SAR on Day 1
Automobile (N=13)	-0.685
Drugs (N=7)	-0.992
Electronics (N=5)	-1.091
Food (N=4)	-1.677

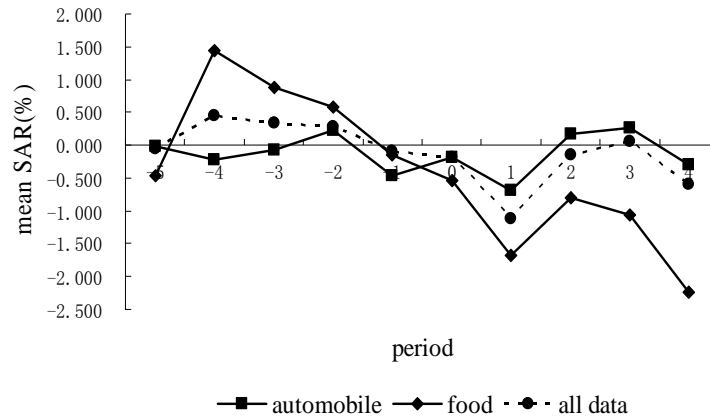


Fig 2. Mean Standardized Abnormal Return (SAR) by industry

As shown in Table 4, the food industry suffered more severe effects of product recalls, while the automobile industry suffered less. This may be because defective food products can lead to serious and immediate health issues, while defective automotive parts seldom do. Furthermore, food is a necessity, so everybody is affected by unqualified food products. Hence, recalls in the food industry will have a great negative impact on the public. For example, after the 2008 melamine-tainted milk crisis, many Chinese people stopped purchasing Chinese dairy products. In contrast, automobiles are still a luxury good in China, where only 30 of every 1000 people own automobiles, compared with 600 of every 1000 in the US. Hence, the impact of automobile recalls China may not be as large as that of food recalls. Because the automobile recall system in China was set up in 2004, most are proactive recalls. Thus, consumers may perceive a recall as a signal of an automaker's diligence in attending to quality issues. However, food product recalls are always accompanied by health-related incidents. Hence, investors will perceive a food recall as a serious signal of impending financial loss. From Figure 2, we can more clearly see the different impact of product recalls in the food and automobile industries.

Moreover, companies will take different actions in terms of when to announce a recall and how to handle a recall. Siomkos and Kurzbard (1994) divided company responses into four types: denial, involuntary recall, voluntary recall and super-effort, comprising the so-called "company response continuum." Jolly and Mowen (1984) indicated that a company is perceived to be more responsible if it acts before a government agency steps in and orders it

to take action. Rupp (2001) divided recall strategies into government-initiated and manufacturer-initiated recalls and found that different product recall strategies will have differing impacts. Chen, Ganesan and Liu (2008) identified proactive and passive recall strategies, based on CPSC recall announcements, and identified antecedents that may influence firms' choice of recall strategy, including firm size, reputation and the volume of recalled product.

Based on this research, we define a proactive recall to be a recall initiated by the firm which initially finds the potential defective problem itself and takes recall action without receiving any complaint or incident from consumers or order from a related government agency. This kind of proactive recall is a signal of a firm's diligence in attending to quality issues. Otherwise, the recall strategy is passive. When we traced back product recall announcements in China, we found that most recalls in the automobile industry followed a proactive recall strategy, while the food industry was more likely to follow a passive recall strategy. Table 5 and Figure 3 show that companies following a passive recall strategy suffer greater negative abnormal returns from the recall.

Table 5 Mean SAR on Day 1 for different recall strategies

Recall strategy	Mean SAR on Day 1
Proactive (N=11)	-0.569
Passive (N=18)	-1.208

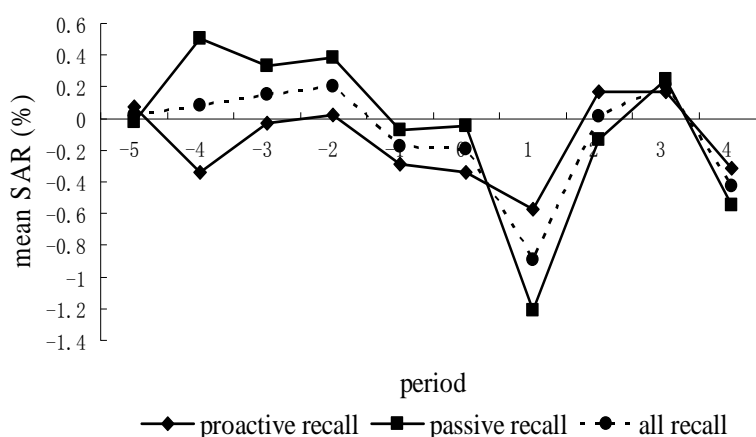


Fig 3. Mean Standardized Abnormal Return (SAR) for different recall strategies

There are several potential explanations for the differences between the automotive and food industries.

(1) Immature product recall systems in China. More and more researchers have recognized the importance of institutional theory in explaining firm behavior. Government regulation is one of the most important driving forces for companies' coercive isomorphism (DiMaggio & Powell 1983; Ketokivi & Schroeder, 2004; Rogers, et al, 2007; McFarland, Bloodgood & Payan, 2008). As discussed in Section 3, Chinese automobile recall systems were set up in 2004, while other recall systems were set up in 2007. Since the product recall system for automobile industry had been set up for several years and was more mature than other recall systems, government legislation and promotions caused more automobile companies follow a proactive recall strategy.

(2) Learning from foreign companies. The entire network of organizations within which firms and individuals are embedded is a social network (McFarland, Bloodgood & Payan, 2008). Firms in these networks are inclined to imitate the behaviors of other network members (Henisz & Delios 2001). Galaskiewicz & Wasserman (1989) state that firms may not only imitate those organizations they perceive as successful in their industry, but are also more likely imitate those organizations with which they have social ties, which is called mimetic isomorphism in institutional theory. In China, many automobile companies cooperate with foreign companies. For example, First Automotive Group Corporation cooperated with international leaders such as Volkswagen AG, Toyota and Mazda to establish strategic and long-term cooperative relationships. Chana Auto Co. Ltd. cooperated with Ford, Mazda and Suzuki and established several joint ventures in China. As a result of such cooperative activities, Chinese companies learn a lot from leading international companies, including corporate social responsibility for adopting a proactive recall strategy.

(3) Different supply chain structures. Most automobile companies are large companies, with stable suppliers and good relationships. Because each automobile has a unique identity, it is potentially easier to recall particular automobiles and the recall cost may be lower. Hence, automobile companies are more willing to employ proactive recall strategies. However, the food industry is more complicated. There are many tiers "from farm to fork." Many suppliers

in the food industry are small companies, and it is very difficult to use top-down quality control to trace and follow food, feed and ingredients through all stages of production, processing and distribution. In the food industry, raw material batches from different suppliers with different quality attributes are often mixed together, increasing the complexity of tracing back. For example, in the 2008 melamine tainted milk crisis, more than 80% of the raw milk from Yili and Mengniu, the largest dairy companies in China, was provided by small-scale farmers scattered across the country and gathered through independent milk collection stations. Hence, it is much more difficult to control quality and build traceability systems for the food industry. That is why the Chinese government developed regulations for restructuring the dairy industry after the crisis. By October 2011, 30% of the cows are to be raised on large farms, and dairies are to obtain 70% of their raw milk from farms owned by the dairy itself. This is supposed to rationalize the current system of small, struggling farmers whose milk reaches dairies via a web of unaccountable middlemen. Hence, if there is no legislation to force recalls, the food industry will not employ proactive recalls.

6. Recent melamine-tainted milk recall case in China

On the night of September 11, 2008, China's Ministry of Health released a preliminary investigation confirming the contaminated Sanlu baby milk powder as the cause of kidney stones in infants, after a first-phase probe by experts. At the same time, the Sanlu group, one of the leading dairy producers in China, admitted that some of its baby milk formula was contaminated with melamine and released an announcement recalling all the tainted batches of baby milk powder produced before August 6, 2008. On September 16, 2008, Chinese inspectors found melamine in 69 batches of baby milk powder produced by 22 companies nationwide, and authorities ordered a halt to the sale of the tainted products, which included such well-known brands as Sanlu, Mengniu, Yili and Yashili, among others. On October 14, 2008, six Chinese central agents jointly issued an urgent notice demanding thorough checks on all milk powder and liquid milk products made before Sept. 14.

Melamine-tainted baby milk powder produced by Sanlu was found to have caused the deaths of at least six children and sickened some 300,000 children. China's top legislature

approved the Food Safety Law on February 28, providing a legal basis for the government to strengthen food safety control "from the production line to the dining table." The law, which goes into effect on June 1, 2009, will enhance monitoring and supervision, toughen safety standards, recall substandard products and severely punish offenders.

It is clear that market performance of the companies producing tainted milk products will be negatively affected, for example, Mengniu Dairy's stock price plummeted from HK\$20.00 to HK\$7.95 (60.25%) in a single day on September 23, 2008, after trade suspension for several days after the tainted milk powder testing results were reported. Synutra International Inc.'s (SYUT) stock price plummeted from \$33.61 to \$15.29 (54.51%) in a single day on September 16, 2008. The expected market reaction to the stock prices of competitors not involved in the melamine-tainted milk scandal, however, is more difficult to predict. On the one hand, there could be a positive effect on the stock prices of competitors, which could reap the benefit of consumers' switching to their products. On the other hand, the public could lose confidence in the entire industry, and the government could put more stringent regulations on the entire dairy products industry, hence, there could be a negative spillover effect on the shareholder wealth of competitors (Jarrell & Peltzman, 1985).

Although the Sanlu group is at the heart of the tainted milk scandal and its products were found to contain the highest level of melamine contamination, it is not a listed company and its stock price is not available. Hence, we can not measure the impact of the scandal on its stock price. There are six Chinese listed dairy product companies altogether, including Yili, Bright Dairy Group and Sanyuan listed in China A Share, Mengniu listed in Hong Kong, and Synutra International Inc. (SYUT) and American Dairy, Inc. (ADY) listed in the United States. Yili, Bright Dairy Group, Mengniu and SYUT were involved in the tainted melamine milk scandal, while Sanyuan and ADY are competitors that were not involved in the scandal. We examined the stock market reactions of both the involved companies and their competitors. Since the Chinese government released investigation results that found melamine in 69 batches of baby milk powder produced by 22 companies nationwide on September 16, 2008, we set it to be Day 0. Since SYUT and ADY are listed in the United States, we set September 15, 2008 to be Day 0 for SYUT and ADY due to the time difference between

Chinese and the U.S. The results of the analysis of abnormal returns and the post-announcement stock price performance of 60 days cumulative abnormal return for these six companies are provided in Table 6 and Table 7.

Table 6 Abnormal returns of Chinese dairy companies

Day	Abnormal returns					
	Affected companies				Competitors	
	Yili	Mengniu	Bright Dairy	SYUT	Sanyuan	ADY
-5	2.12%	-1.60%	-2.61%	1.72%	-5.49%	1.08%
-4	2.12%	0.10%	2.66%	-4.73%	2.16%	3.19%
-3	-0.47%	2.97%	1.47%	0.46%	0.59%	-2.48%
-2	2.22%	-3.87%*	3.22%	-1.99%	0.63%	-4.12%
-1	-1.24%	-3.64%*	-2.86%	-1.84%	0.09%	-12.31%***
0	-1.79%	5.11%**	-2.04%	-23.21%***	-6.03%	-6.52%
1	-7.36%***	-56.28%***	-6.23%**	-56.51%***	5.50%	28.02%***
2	-8.55%***	2.06%	-1.29%	-1.02%	11.44%***	1.41%
3	-6.50%***	3.06%	0.07%	-8.49%**	5.69%	6.56%
4	-8.67%***	-0.53%	-7.99%***	10.12%***	6.40%	0.94%
5	-9.98%***	-2.52%	9.07%***	32.62%***	11.20%***	4.10%

*p<.10, **p<.05,

***p<.01

(1) Effects on the melamine-tainted milk companies

Table 6 shows that on Day 1, all of the melamine-tainted milk companies experienced highly significant negative abnormal returns, especially the negative abnormal returns for Mengniu and SYUT, which were more than 50%. We also report the abnormal returns before the announcement day (Day -5 to Day -1), where they varied randomly, without statistical significance, driven more by chance rather than economic factors. Thus, the melamine tainted milk incident was completely unanticipated before the announcement.

Due to the 10% raise and down price limit policy in the Chinese stock market², we did not capture as great a negative abnormal return for Yili and Bright dairies, which are listed in

² Since Dec. 16, 1996, the stock price fluctuations of all the stocks traded in Shenzhen and Shanghai stock exchanges are limited into $\pm 10\%$ per day.

China A share, as we did for Mengniu, which is listed in the Hong Kong market and SYTU, which is listed in the United States market. However, from the cumulative abnormal return results in Table 7 we can see that, in a 60 day event window, Yili suffered a more negative abnormal return than Mengniu, which indicates that the limited stock price fluctuations in one day will be reflected in the following trading days.

Table 7 The 60 days cumulative abnormal return of Chinese Dairy companies

Day	Cumulative abnormal return					
	Affected companies				Competitors	
	Yili	Mengniu	Bright Dairy	SYUT	Sanyuan ³	ADY
0	-1.79%	5.11%**	-2.04%	-23.21%***	-6.03%	-6.52%
1	-9.15%***	-51.17%***	-8.27%**	-79.72%***	-0.53%	21.50%***
2	-17.70%***	-49.11%***	-9.56%**	-80.73%***	10.92%	22.92%***
3	-24.21%***	-46.05%***	-9.49%*	-89.23%***	16.60%*	29.48%***
4	-32.88%***	-46.58%***	-17.48%***	-79.11%***	23.00%**	30.42%***
5	-42.87%***	-49.10%***	-8.41%	-46.49%***	34.21%***	34.52%***
6	-40.18%***	-46.85%***	-3.14%	-31.39%***	44.22%***	34.84%***
7	-29.56%***	-45.26%***	-3.30%	-40.61%***	52.81%***	29.00%**
8	-34.98%***	-37.85%***	3.09%	-47.61%***	-	26.90%**
9	-38.08%***	-27.55%***	-0.68%	-47.17%***	-	23.22%*
10	-45.43%***	-28.50%***	-4.10%	-37.41%***	-	33.21%**
11	-52.16%***	-26.17%***	-5.55%	-44.00%***	-	34.87%**
12	-39.73%***	-27.37%***	-5.24%	-38.68%***	-	52.44%***
13	-45.55%***	-34.11%***	8.38%	-28.66%**	-	56.18%***
14	-46.21%***	-36.59%***	4.15%	-26.44%**	-	56.65%***
15	-43.68%***	-33.44%***	4.59%	-21.94%	-	57.80%***
	
51	-34.73%**	-29.17%*	21.30%	-47.48%*	-	99.47%***
52	-36.46%**	-28.37%*	22.30%	-48.29%*	-	102.15%***
53	-29.81%*	-27.98%*	22.68%	-47.47%*	-	105.17%***
54	-32.66%*	-20.52%	26.35%	-57.24%**	-	103.03%***
55	-34.57%**	-23.95%	25.36%	-55.35%**	-	102.97%***
56	-34.86%**	-29.79%*	24.40%	-60.09%**	-	105.95%***
57	-33.80%*	-27.24%*	22.51%	-61.57%**	-	103.82%***
58	-34.13%*	-27.48%*	25.04%	-59.50%**	-	101.93%***
59	-36.30%**	-25.36%	26.82%	-54.85%**	-	94.40%***

³ Sanyuan suffered from a trading halt on Sep 26, 2008 after getting six raising limit continuously to consider merger and acquisition issue with Sanlu group.

*p<.10, **p<.05, ***p<.01

(2) Effects on the competitors

Tables 6 and 7 also show the results for the competitors. The stock prices of ADY and Sanyuan, which were not involved in the melamine scandal, experienced significant positive abnormal returns on Day 1 and Day 2. The positive cumulative abnormal return of the Sanyuan group on Day 7 was more than 50%, after which a trade halt was imposed, due to its consideration of merger and acquisition with the Sanlu group. The 60 days cumulative abnormal return of ADY doubled, providing strong evidence that competitor firms benefitted from the recall and that dairy products perceived as substitutable and replaceable by the products of competitors.

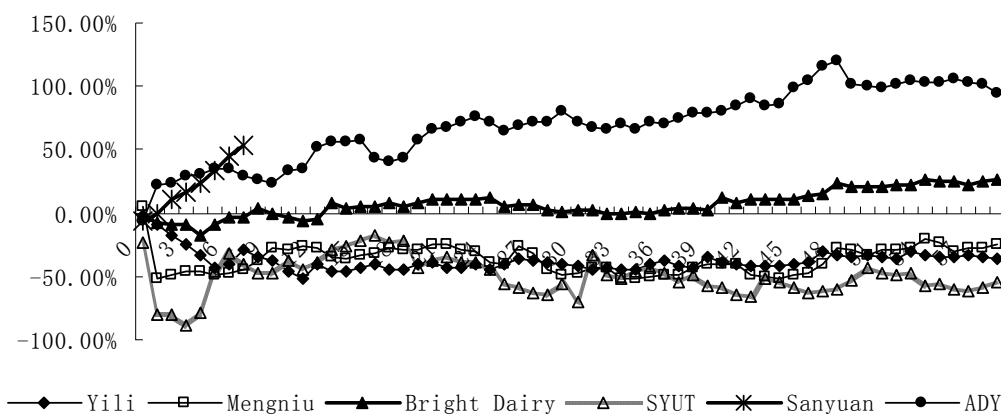


Fig.4 T 60 days cumulative abnormal return of Chinese dairy companies

Figure 4 shows the 60 days cumulative abnormal returns of Chinese dairy companies. From Table 7 and Figure 4 we can see that, in a 60 day event window, companies other than Bright Dairy suffered from significant negative cumulative abnormal returns. While the stock price of Bright Dairy recovered from Day 5 until Day 59, the cumulative abnormal return was 26.82%, although it was not statistically significant. This shows that Bright Dairy recovered from the melamine-tainted milk crisis, to some extent. However, the 60 day cumulative abnormal returns of the competitors that were not involved in the melamine tainted milk scandal experienced significant positive results. There are a number of possible reasons for these findings.

The dairy industry is broad in China, encompassing agriculture, manufacturing and service areas. As a dairy company, it must take all aspects into consideration, from dairy farming to processing and sales. A problem in any aspect will cause failure to the dairy company. The longer the supply chain is, the more difficult it is for manufacturers to keep track of who did what, when and the final quality of the products (Lyles, et al., 2008). After the dairy crisis, the Chinese government reformed the production, purchase, processing and sales sectors of the dairy industry and helped them “come back to normal”.

Because of the geographic distribution differences between the raw milk supply base and dairy product consumption market, Chinese dairy companies can be divided into two categories: resource-based companies, represented by Mengniu Dairy and Yili Dairy, and urban-based companies, represented by Bright Dairy and Sanyuan Dairy. The core competency of resource-based enterprises is the control of complex nation-wide distribution channels. In contrast, the competitive advantage of urban-based companies lies in control of milk sources of the core market and direct distribution networks (cold-chain logistics system), but they only rely on limited milk sources around the city. Different types of dairy companies have different milk supply modes. For example, more than 80% of the raw milk used by Yili and Mengniu is provided by small-scale farmers scattered across the country and gathered through independent milk collection stations. In contrast, 95% of the raw milk used by Bright dairy is provided by self-owned large dairy farms and small dairy farm complexes; only 5% of the raw milk is provided by small-scale farmers. Among the companies involved in the melamine-tainted milk crisis, Bright had the fewest detected problem dairy products, and most were concentrated among the three largest dairy products makers, which may be one of the reasons that Bright Dairy recovered quickly from the crisis. In the case of the Sanyuan group, 80% of the raw milk was provided by its large, self-owned dairy base. The other 20% of the raw milk was provided by large dairy farms, with none supplied by small-scale farmers. Thus, Sanyuan has more controllability of its milk sources, which reduces supply risk, which is the reason that none of its dairy products were found to be tainted.

Table 8 Raw milk sources of Chinese dairy companies

Dairy	Small-scaled	Cooperative large dairy	Self-owned large dairy
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company	farmers	farms	farms
Yili	80%	20%	
Mengniu	90%		10%
Bright Dairy	5%		95%
Sanyuan	0%	20%	80%

Data source: organized by the study.

7. Conclusions

This study investigated stock market reactions to product recall announcements in China. Based on a sample of 29 Chinese product recall announcements made during the period from 2002 to 2008, we found significant negative abnormal returns on the day following a product recall announcement. This indicates that the stock market reacts quickly and efficiently to recall announcements. Although the results in China were somewhat consistent with the findings in the literature about the stock market reactions to product recall announcements in the United States, we found that the significant negative abnormal returns in China market were larger than in the United States market. The different recall systems between the United States and China provide a possible explanation for the results.

The results also reveal that companies in the food industry experience a more severe reaction from their recall announcements and that food recalls in China are always associated with illness. This means that companies in the food industry are more likely to employ a passive recall strategy. In contrast, companies in the automobile industry experience a lower reaction by stock prices to product recall announcements. Automobiles are frequently recalled, even when there have been no accidents, which means that companies in the automobile industry are more likely to follow a proactive recall strategy. Possible explanations for this phenomenon are given in the study.

This study delves into the case of the melamine-tainted milk recall situation in China in 2008 to examine the stock market reaction for both the affected companies and their competitors. We found that all of the affected companies suffered from significant negative financial losses, while competitors benefitted from the recall.

A limitation of our study is the relatively small sample size of 29 recall announcements, which is necessary because of the relatively recent onset of product recalls in China. There are a number of directions worthy of further research. For example, how will Chinese companies react when they are faced with product recalls? What is the best reaction? Coombs (1995) identified four aspects of a crisis situation: crisis type, veracity of evidence, damage and performance history. Firms should develop a suitable crisis communication strategy, through the evaluation of the crisis situation (Coombs, 1998). Hence, there is a great need for investigation of effective product recall strategies to handle different product harm crises. We can further investigate which factors will affect the selection of different product recall strategies. Last, but not least, is to study how to develop an effective supply chain quality management strategy, in order to prevent or lower the frequency of product recalls.

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