

# NEGATIVE SPILLOVER OF EXTERNAL WOM IN SUPPLY CHAIN PARTNERSHIP

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## Abstract

*In this study, we explore how customers' WOMs in firms' crisis events spread across organizational boundaries to affect their supply chain partners. Based on guilt-by-association theory, we propose that both the external WOM effect and internal demand-supply effect have a mediator influence on the relationship between news report of crisis and firm performance of its supply chain partners. In other words, the damage of a crisis event will spread through two intermediaries, and finally be reflected in the stock market performance. We collected second-hand longitudinal data from financial databases, search engines, and social media to verify our hypotheses. Our results support both the direct and mediating role of News volume, WOM volume, and crisis-stricken firm's abnormal returns on its supply chain partner's abnormal returns. These findings not only help enrich the understanding of crisis spillover effect to supply chain partners, but also provide some guidance for investors and managers.*

*Keywords: Organizational Crisis, Spillover Effect, Supply Chain Partners, Word-of-Mouth.*

# 1 INTRODUCTION

Organizational crisis, triggered by low-probability, high-impact events such as accidents, scandals, or product safety incidents, exacerbates firms' reputation and credibility, weakens consumers' satisfaction and purchase intention, thus eventually harming firms' market value (e.g., Dawar & Lei 2009; Huber et al. 2010; Pearson & Clair 1998; Pullig et al. 2006; Zhao et al. 2011). With the prosperity of social media in current information age, organizational crises become increasingly publicized and widely discussed (Dutta & Pullig 2011), aggravating their detrimental effects (e.g., Jubbega 2012; Kim 2014).

In the modern era wherein firms operate in an increasingly transparent environment (Manuj & Mentzer 2008), more extensive influences of organizational crises – the spillover effect - have been identified for both academicians and practitioners. Yu et al. (2008) defined it as “negative impacts resulting from a crisis that strikes one organization can spread to other organizations”. Previous literatures have confirmed the existence of crisis-spillover to other products within a single brand (e.g., Balachander & Ghose 2003), related brands (e.g., Dahlén & Lange 2006), competing brands (e.g., Roehm & Tybout 2006), or even the whole industry (e.g., Yu & Lester 2008). While prior studies investigate the spillover effect spreading among organizations horizontally in the market, little attention has been put on vertical spillover effect among organizations. Such as supply chains, a typical example of firms forming close vertical inter-organization relationships, have become important strategy for firms' competitive advantage (Li et al. 2006). Therefore, how a firm's crisis and its WOM will affect the supply chain partners' performance is critical to both academic research and industrial practice.

Although lacking in theoretical and empirical support, a recent crisis event lends us a hand. On July 20<sup>th</sup>, 2014, Shanghai Media Group reported the widespread use of meat sources that have expired and gone bad in Shanghai Hushi Food Products Limited Company, the meat supplier for well-known international fast food chains like McDonald's, KFC, and Pizza Hut (Fauna 2014). The astonishing news quickly hit the headlines in mainstream social medias of China (e.g., Sina Microblog), triggering a heated discussion and condemnation among ordinary consumers. Not surprisingly, McDonald's and KFC stood in the breach, and were blamed for concealing and conniving Hushi's wrongdoings. Swift apologies and breakup with Hushi Food do not help much, according to Hotnews (2014), “Yum shares fell 4.2 percent to close at \$74.13 and McDonald's shares lost 1.5 percent to \$97.55”, intuitively demonstrating the crisis spillover effect to supply chain partners. Nevertheless, due to the non-generalizability of a single case, longitudinal and quantitative analysis in a large scale is in urge.

There are two possible parts of intermediary effect worth noting across the spillover process. From the internal aspect, the supply chain continuum is more fragile and vulnerable due to “bullwhip effect” (Forrester 1961), needless to say a crisis event. Hendricks and Singhal (2003, 2005) showed how supply chain disruptions affect the observable share price and shareholder value of a focal firm. From the external perspective, social media plays a vital role in the crisis dissemination, especially the corresponding news report from publicity and word-of-mouth (WOM) from individuals. Publicity is a relatively credible source of information which can exert a tremendous influence (Bond & Kirshenbaum 1998), especially for the negative ones. Thereafter, those news reports quickly result in subsequent WOM frenzy in SNSs, through which consumers express outrage and attribute blame (Gao et al. 2012). In 2014, Kim compared the impact of crisis on firm performance pre and post SNS media appearance, emphasizing the diffusion nature of WOM. However, research about the spillover effect of WOM in supply chain context is rare for now.

Against the above research gaps, this study tackles the following notable questions: **(1) Will customers' WOM in firms' crisis events spread across organizational boundaries to affect their supply chain partners? (2) How does the spillover mechanism work?** Our research framework is grounded in guilt-by-association theory (GBA). To verify our hypotheses, we collected second-hand data from financial databases (Capital IQ, WIND), search engines (Google, Baidu), and social media (Sina Microblog). Our results support the mediating role of both WOM volume, and crisis-stricken firm's performance in the spillover effect from crisis news reports to supply chain partners'

performance. These findings not only help to enrich the understanding of spillover effect to supply chain partners under a crisis event, but also alert practitioners to face and attenuate the damage through effective WOM observation and supply chain management.

The article is organized as follows: we first review theories on organizational crisis, spillover effect, and relevant WOM research. Then we propose our research model and hypotheses. Next, we report on research methodology and data analysis. Finally, we discuss the implications and limitations of this study.

## **2 LITERATURE REVIEW**

### **2.1 Negative Impacts of Organizational Crisis**

As soon as a high-impact organizational crisis happens, it will soon become the front-page news in all of China's major daily newspapers (Gao et al. 2012). Then, just as a Chinese saying goes, "Ill news flies apace", these information can quickly spread in today's blogosphere and Internet forums, where unsatisfied individuals can unleash a flood of complaints and grievances (Einhorn 2006). In other words, negative WOMs about the crisis and relevant organizations pour in, which further harm a brand's reputation and confidence, leading to reduced likelihood of brand consideration (Dutta & Pullig 2011). Overall, the bad news and WOM can be regarded as the reputational negative effect of organizational crisis, which has long been an important source of firm's competitive advantage (Barney 1991).

Secondly, the relational negative effect is reflected in the disruption of social ties among different organizations (e.g., breakup of strategic alliances between organizations, or supply chain partnership). Once a focal firm encountered a crisis, others in the industry may undertake a preferential detachment process (e.g., press releases, newsletters to shareholders) whereby they reduce their linkages to the initially stricken organization to reduce possible impact (Yu et al. 2008). Not surprisingly, as a deserted and isolated firm, the following inevitable business discontinuity and supply chain breakups might destroy the firm in crisis effortlessly.

Last but not least, the most realistic influence is the fiscal negative effect of organizational crisis. Ahluwalia et al. (2000) pointed out that the negative publicity is devastating in affecting consumers' buying decisions, resulting in major losses of revenue and market share of the firm. In addition, an organizational crisis may precipitously lower stakeholders' valuation of the stricken organization, thus withdraw their investments (Yu et al. 2008). A few recent researches have proved the harmful impact of negative events on firms' stock returns (e.g., Chen et al. 2013; Kim 2014).

Overall, previous literature has laid a valuable foundation for us to understand the reputational, relational, and fiscal damage of organizational crisis, but the possible causality and interplay relationship between the three kinds of negative effect still need our close attention.

### **2.2 Spillover Effect of Organizational Crisis**

Drawing upon the psychology literature, a new perspective – "guilt-by-association" (GBA) – is offered for understanding spillover effect of organizational crisis (Gao et al. 2013; Kahuni et al. 2009). According to the dictionary definition, GBA means "guilt ascribed to a person, not because of any evidence, but because of his or her association with an offender" (New Shorter Oxford Dictionary 1993). Therefore, people's judgments of perceived risk and trust regarding a particular brand, may depend not only on the brand itself, but also on its associated contaminated brands (Gao et al. 2013). Just as Klein and Dawar (2004) pointed out, individuals intend to attribute responsibility to scapegoats who have a direct association with the crisis organization, thus increasing their likelihood of spillover effect.

Previous studies have already examined different associations in a variety of contexts, such as between attributes, between products, and between brands. The first stream of research focused on the spillover effect on the firm's "family" members, that is, the crisis spills over across different products within a brand, co-brand or brand portfolio (Balachander & Ghose 2003; Erdem & Sun 2002; Kahuni

et al. 2009). Spillovers have also been found to occur across attributes of one single product (Ahluwalia et al. 2001). Another interesting topic is the spillover effect on its competitors. When the competing brands are sufficiently similar with the firm in crisis (Janakiraman et al. 2009; Roehm & Tybout 2006), or have a relatively junior status (Dahlen & Lange 2006; Yu & Lester 2008), spillovers can easily occur across directly competing products. Otherwise, competitors might benefit a lot during the crisis (Janakiraman et al. 2009).

However, there's hardly any research about spillover effects across industry boundaries, especially within vertical organizations. Except for Yu and Lester (2008), who have noticed the crisis spillover effect on supply chain partners, but they only put forward simple propositions about partner attributes without any data support. Thus, it still remains unclear how, and why these negative impacts might spread to, as well as the mechanisms that govern the spillover process across the entire supply chains.

### **2.3 Concepts and Predictive Power of WOM**

Advances of information technology and the emergence of online social media have profoundly changed the way information is transmitted, thus accelerate the development of word-of-mouth (WOM) (Laroche et al. 2005). People like to express their opinions and join discussions in popular social media, generating amounts of WOMs every day. Especially after a high-impact crisis, millions of WOM will pour in, often with a strong negative emotion (Gao et al. 2012). Unfortunately, negative WOMs are more memorable and diagnostic in forming or changing consumer attitudes, which will lead to a worse social influence (Ahluwalia et al. 2000; Chevalier & Mayzlin 2006; Fiske 1980; Mittal et al. 1999).

Accordingly, since WOM reflects the attitude of consumers, it can be also served as a perfect indicator of the firm's ROA, market sales, and even stock prices. The underlying mechanism may be mined from behavioural economic theories, that is, investors' decision is influenced by all publicly available information (Brealey et al. 2004). Although public investing information such as company press releases, earning announcements and analyst recommendations do exist, it is often sporadic and infrequent (Oh & Sheng 2011). In this case, WOM provides an alternative source of information to investors (Duan et al. 2008), which is real-time, high-volume and discloses more hidden stories to the investors that is otherwise unavailable. Just as Bollen et al. (2011), Zhang et al. (2010) investigated, sentiment expressed through Twitter can predict fluctuations of Dow Jones Industrial Average (DJIA). Luo (2007), Luo (2009) also linked WOM with stock price changes, regarding negative WOM as an influential resource that damages customer equity as well as brand equity, whose predictive power on firm performance is considerably important.

## **3 RESEARCH MODEL AND HYPOTHESES DEVELOPMENT**

Our research model, as illustrated in Figure 1, focuses on how an organizational crisis spills over to its supply chain partners. We consider both the external mediator (WOM effect) and internal mediator (demand-supply effect) that influence the performance of stricken firms' supply chain partners, whereby external mediator reflects the reputational negative effect, internal mediator mirrors the relational negative effect, both of which result in the ultimate fiscal negative effect of organizational crisis.

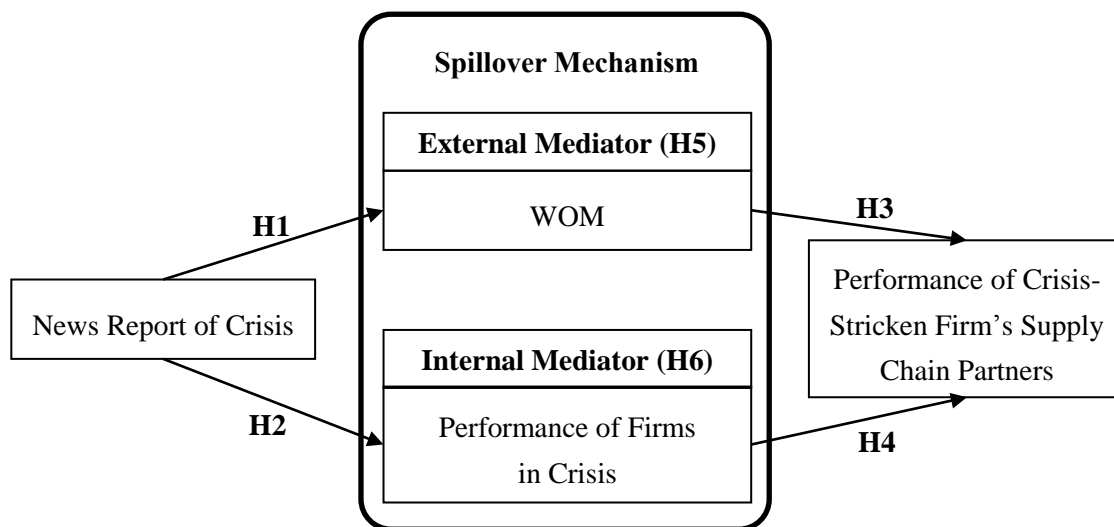


Figure 1. Research Model

### 3.1 News and WOM

According to Coombs and Holladay (2004), a crisis is “an event for which people seek causes and make attributions”. As soon as an organizational crisis happens, it will soon become front-page news in all of China’s major daily newspapers (Gao et al. 2012). Then, based on the media report of crisis, people begin to seek key information and evaluate event causes (An & Gower 2009), thereafter outlet their outrage and attribute blame in popular social media (Gao et al. 2012).

During the process, a crisis covered by more government agencies and journalists, would raise the credibility of the information (Siomkos & Shrivastava 1993), accelerate the dissemination speed, reach more audiences, and eventually generate more WOM about the crisis. To the contrary, news report from a single media can only reach a minority of people with a small impact, less likely to trigger a heated discussion in social media. Therefore, we put forward hypothesis 1:

*H1: News report volume of a crisis event has a positive impact on relevant WOM volume.*

### 3.2 News and Performance of Firms in Crisis

The destructive effects of negative publicity have drawn a lot of researchers’ attention, especially the shrink in market sales and brand equity (Pullig et al. 2006; Xie & Peng 2009). Just as Jubbega (2012) pointed out, stock price is driven by all publicly available news. Investors look back to all events happened in recent periods and then evaluate future value of an organization (Brealey et al. 2004). In addition, consumers tend to overweight negative information in comparison to positive ones (Ahluwalia et al. 2001), resulting in a more serious impact of negative news on firm performance (Bollen et al. 2011; Luo 2007). Schumaker and Chen (2009) also demonstrated the significant relationship between breaking financial news and stock price changes.

Although the impact of one stakeholder might be small, when more negative news is reported, the investment decisions of the entire stakeholder set will be changed, whose aggregated damage might be considerably significant (Rowley 1997). Therefore, we hypothesize:

*H2: News report volume of a crisis event has a negative impact on performance of the firm in crisis.*

### 3.3 WOM and Performance of the Crisis-Stricken Firms’ Supply Chain Partners

In the age of Web 2.0 (Ullrich et al. 2008), social media gradually becomes an important source of public available information, where investors can collect WOM of consumers, firms as well as other

investors (Jubbega 2012), thus aggregate information for their investment decision (Brealey et al. 2004; Oh & Sheng 2011). A few recent researches have verified the significantly negative contemporaneous correlation between personal postings and stock returns (e.g., Antweiler & Frank 2004; Luo 2007; Luo 2009).

However, different from credible news report (Siomkos & Shrivastava 1993), WOM may easily spread across the inter-organizational ties, derogate the reputation of all its associated partners (e.g., Ferguson et al. 2000), and even evolve into universal condemn as a whole. Especially for supply chain partners of these firms in crisis, scapegoating is common due to the ambiguity of crisis cause (Klein & Dawar 2004; Payne & Davidson 2008). Therefore, we propose:

*H3: WOM volume of a crisis event has a negative impact on performance of the crisis-stricken firm's supply chain partners.*

### **3.4 Performance of Firms in Crisis and Its Supply Chain Partners**

With the advent of globalization, the uncertainties and vulnerability of the supply value chains have become greater (Christopher & Lee 2004). A few researches have investigated the significantly positive relationship between supply chain risks and firm performance (Hendricks & Singhal 2005; Wagner & Bode 2008), which can be explained by the famous "bullwhip effect" (Forrester 1961). In other words, even a small change in goods inventory will lead to an enormous fluctuation in the entire supply chain continuum, needless to say a high-impact crisis event of their business partner.

In addition, based on GBA theory, the crisis spillover effect is positively related to the proximity of firms in crisis and its associates. According to Yu and Lester (2008), to a certain degree, direct contacts (i.e., supply chain partners) with the initially crisis-stricken organization may breed strategic, managerial, and economic interdependency between organizations. Hence, the more direct their contacts, the more likely that the damage of the focal organization will spill over to the other participants (Wasserman & Faust 1994; Yu & Lester 2008). Therefore, we hypothesize:

*H4: Performance of firms in crisis has a positive impact on performance of its supply chain partners.*

### **3.5 Mediating Role of WOM**

Based on three characteristics of WOM: multi-source, broad influence, and low quality, we attempt to explore why the deteriorating effect of WOM will spread to performances of supply chain partners. A key reason for this mediation lies on the comprehensiveness and multi-source of WOM compared to news report. In a typical news, for fairness and reliability concern, journalists seldom refer to other organizations except the focus firm (Kang 2010). But WOM could be almost freely written by anyone from anywhere, including who have uncertain inside information, such as exposing the associated organizations (e.g., supply chain partners) of those crisis-stricken firms.

The second reason for mediation effect is the high volume and rapid dissemination of WOM (Oh & Sheng 2011). With a relatively broad influence, investors can be promptly informed of the crisis, the stricken organization, and other related stakeholders, thus changing their investment decision immediately (Janakiraman et al. 2009).

Last but not least, WOM is widely known as an unreliable and chaotic source of information (Cheung et al. 2009). It is difficult for individuals to discern between true and false. Even if the associated organizations (e.g., supply chain partners) are innocent, inveracious WOM can easily deteriorate their reputation (Ferguson et al. 2000).

Therefore, the mediating role of WOM can be also explained as the spillover effect of WOM to crisis-stricken firms' supply chain partners, just as Hypothesis 5 postulated:

*H5: WOM volume partially mediates the impact of news report volume of a crisis event on performance of the crisis-stricken firms' supply chain partners.*

### 3.6 Mediating Role of Performance of Firms in Crisis

According to Yu et al. (2008), the disadvantage of detachment with the initially crisis-stricken organization might outweigh the benefits. In the case of a negative event, the supply chain partners often strive to avoid being linked with. However, during the preferential detachment process, the supply chain partners have to make fundamental changes internally. For instance, they may stop purchasing products from these firms in crisis, withdraw their investments in these firms, and find a new business partner. Hence, the detachment process is often very costly to execute, we propose Hypothesis 6:

*H6: Performance of firms in crisis partially mediates the impact of news report volume on performance of its supply chain partners.*

## 4 RESEARCH METHODOLOGY

### 4.1 Sample Selection

“Business”, a widely recognized magazine in China, provides a ranking list for negative events per month, which contains almost all the high-impact crises happened in China. Based on these top lists ranked by the number of postings, reposts, and time range, we firstly selected a sample of 82 representative crisis events from 2011 to 2012, such as Sinopec’s poor-quality gasoline, detection of carcinogens in Mengniu milk, with plenty of distinguished Chinese companies involved in. It’s worth noting that these crisis events in “Business” do draw extensive attention from both individuals, news media, and even the market.

Then, due to the limitation of database, we have to discard some samples except those whose firms are listed in the stock market of Chinese Mainland, HongKong or Taiwan. Thirty-nine crisis events are left, with varieties of industries involved (e.g., energy, food, manufacture, construction and telecom). Thus, we guarantee the generality of this research, and exclude the effect of industrial attributes on firm performances.

After obtaining the prime firms that encountered with the crisis events, we then retrieved those firms’ supply chain information (e.g., upstream firms and downstream firms) from Standard & Poor’s Capital IQ database. In average, each firm in crisis has about four supply chain partners, but the partners which are not listed in China were also excluded in lack of data. Thereafter, we have a total sample of 37 crisis events with 148 supply chain dyads.

In addition, we rely on a variety of sources to collect longitudinal data (for 15 days) on news report and WOM about each crisis event. Stock prices of both the firms in crisis and their supply chain partners were also collected. Finally, after dropping out the observations with missing data, we gained totally 997 observations for our study.

### 4.2 Data

#### 4.2.1 Data on News Report

We searched the keywords about each crisis events in the largest search engine in China (Baidu) and the world (Google). Among millions of search results, we only pick out the news reports in public online media, within 15 days after the occurrence of crisis events. After deleting repeated news articles over the observation period, we obtain a final dataset of 1463 news. Fang and Peress (2009) have used the number of newspaper articles mentioning a focal firm in a certain time period as the proxy for the firm’s media coverage and attention. We apply this method, and sum up the number of news reports of each crisis event per day. In other words, for each supply chain dyads, we have 15 observations for *News Volume*.

#### 4.2.2 Data on WOM

We collected the WOM data from Sina Microblog, one of the most influential online social networking sites in China. Just like a Chinese-version Twitter, millions of microbloggers communicate with daily activities in this public platform, seek and share information (Java et al. 2007) through short updates or postings up to 140 characters (Oh & Sheng 2011). Thus, Sina Microblog is a great source of WOM, where individuals can express, discuss, and collect various information freely. Normally, a typical microblog contains the user's nickname, date of the post, the content of post and the message text forwarded if any. In this paper, we crawled all the posts containing the keywords of our sample crisis events within 15 days after the occurrence of crisis. A total of 428555 postings were collected in our final dataset. Then, we counted the number of posts in Sina Microblog about a crisis in each day, so as to measure *WOM Volume*.

#### 4.2.3 Data on Firm Performance

The data of stock price for each firm in crisis, its supply chain partners and the corresponding industry index were downloaded from WIND Database, a professional financial database in China. As for the market reaction to a crisis event, we used the methods developed by Brown and Warner (1980, 1985) to estimate the impact of unanticipated events on stock price changes. Prior studies have assessed the extent to which stock price performance around the time of an unanticipated event is abnormal (Marcus & Goodman 1991; Xu & Zhang 2013). Just as Marcus and Goodman (1991) defined, abnormal return is the deviation of the actual stock price from the economic model's prediction which represents the market-adjusted return for a crisis.

Thus, we defined an anticipated or normal return for each firm in crisis and its supply chain partners at time  $t$  as  $ER_{it} = \alpha + \beta R_{mt} + e_{it}$ , where  $ER_{it}$  is the expected return of the firm  $i$  (including firms in crisis and their supply chain partners) at time  $t$ ,  $\alpha$  is the regression intercept,  $\beta$  is the beta coefficient of the regression,  $R_{mt}$  is the returns of an industry  $m$ 's standard index at time  $t$ , and  $e_{it}$  is the disturbance term or residual, for firm  $i$  at time  $t$  (Marcus & Goodman 1991). Since a crisis event does not affect returns prior to its occurrence, those returns can be considered normal relative to the crisis. Then, it is necessary to confirm an estimation period for the prior-to-event conditions. In our study, we used the estimation period from 65 days before each crisis under analysis to 5 days before it. After we obtained the expected returns of each firm within 15 days after occurrence of each crisis, we calculated the abnormal returns as  $AR_{it} = R_{it} - ER_{it}$ , where  $AR_{it}$  is the abnormal return for firm  $i$  at time  $t$ , with the actual return  $R_{it}$  for firm  $i$  at time  $t$  derived from its stock price, and  $ER_{it}$  being the expected return. Therefore, we measured the performance of crisis-stricken firm by using its abnormal return (*C-Firm's Abnormal Return*), as well as evaluating the performance of its supply chain partners through the same proxy (*S-Firm's Abnormal Return*).

#### 4.2.4 Control Variables

Following the widely recognized firm valuation models in IS and finance literature (Ferreira & Laux 2007; Luo et al. 2013; Trueman et al. 2000), we included two sets of control variables that may influence the relationships among news report, WOM, crisis-stricken firm's performance and supply chain partner's performance. One set of the control variables is about the firms in crisis, including firm size and listing experience. The other set is just the same measurements about the corresponding supply chain partners. Among them, *Firm size* is measured by total assets of the firm. *Listing Experience* is measured by the difference between the occurrence year of the crisis and the listing year of the firm. Table 1 reports the summary of all the variables described above. Table 2 and Table 3 report the descriptive statistics and variable correlation, respectively.

Variables	Definitions
News Volume	The total number of news report of a crisis event in one day
WOM Volume	The total number of social media postings of a crisis event in one day



C-Firm's Abnormal Return	The abnormal return of a crisis-stricken firm in one day
S-Firm's Abnormal Return	The abnormal return of a supply chain partner in one day
C-Firm's Firm Size	The total assets of a firm in crisis
C-Firm's Listing Experience	The occurrence year of a crisis event minus the listing year of the crisis-stricken firm.
S-Firm's Firm Size	The total assets of a supply chain partner
S-Firm's Listing Experience	The occurrence year of a crisis event minus the listing year of the supply chain partner

*Table 1. Summary of Variables*

	<b>N</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Mean</b>	<b>Standard deviation</b>
News Volume	997	0	64	2.18	6.14
WOM Volume	997	0	116802	666.82	4002.76
C-Firm's Abnormal Return	997	-6.69	4.26	-0.19	1.17
S-Firm's Abnormal Return	997	-1.24	2.89	0.08	0.52
C-Firm's Firm Size	997	50000	$1.83 \times 10^{11}$	$4.60 \times 10^{10}$	$4.92 \times 10^{10}$
C-Firm's Listing Experience	997	3	28	12.08	4.30
S-Firm's Firm Size	997	$1.00 \times 10^7$	$3.52 \times 10^{11}$	$2.62 \times 10^{10}$	$7.4 \times 10^{10}$
S-Firm's Listing Experience	997	1	27	9.98	5.69
Valid N	997				

*Table 2. Descriptive Statistics*

<b>Variables</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
1.News Volume							
2.WOM Volume	0.18***						
3.C-Firm's Abnormal Return	-	-0.02					
4.S-Firm's Abnormal Return	-0.08**	-0.07**	0.11***				
5.C-Firm's Firm Size	-0.06*	0.00	0.06**	-0.19***			
6.C-Firm's Listing Experience	0.15***	-0.07**	0.05*	0.14***	-0.28***		

7.S-Firm's Firm Size	0.02	-0.05*	0.09***	-0.04	-0.01	0.12***	
8.S-Firm's Listing Experience	-0.06*	-0.06*	0.08***	0.15***	-0.08**	0.05*	0.36***

\*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

Table 3. Correlation Matrix

### 4.3 Analysis and Results

To test H1, H2, H3, and H4, we run four OLS regression models among *News Volume*, *WOM Volume*, *C-Firm's Abnormal Return* and *S-Firm's Abnormal Return* (see Model 1 to Model 4 in Table 4). As Model 1 indicates, *News Volume* has a significant positive effect on *WOM Volume*, which reveals that the more coverage of news reports helps generate more WOM, supporting H1. We also find a significant negative effect of *News Volume* on *C-Firm's Abnormal Return* in model 2, in accordance with H2. Since the reports of crisis events are always bad news, which negatively impact the decision of investors, the market reaction should also be in the same direction. In model 3, just as expected, *WOM Volume* has a significant negative effect, and *C-Firm's Abnormal Return* has a significant positive on *S-Firm's Abnormal Return*. Therefore, H3 and H4 were supported, confirming the direct effect of crisis-stricken firm's performance and relevant WOM on its corresponding supply chain partners.

Additionally, to test the mediating effect of WOM and performance of firms in crisis, we follow the multiple-step Sobel test suggested by Baron and Kenny (1986). In the first step, we test the relationships between predictors (*News Volume*) and mediators (*WOM Volume* and *C-Firm's Abnormal Return*). In the second step, we test the relationships between mediators and outcomes (*S-Firm's Abnormal Return*), with the effects of predictors on outcomes controlled. In the last, we calculate the statistic z-score to test whether the mediating effect is significant. Table 5 reported the results of mediator analysis. The results indicated that both *WOM Volume* (z-score = 1.34 > 1.28, sig. = 0.1) and *C-Firm's Abnormal Return* (z-score = 2.7 > 1.96, sig. = 0.01) significantly mediated the effect of *News Volume* on *S-Firm's Abnormal Return*. These results suggest that the crisis spillover effect is transmitted through external WOM as well as internal crisis-stricken firms' performance, supporting H5 and H6.

As for the control variables, both of *C-Firm's Firm Size* and *S-Firm's Firm Size* has a significantly negative effect on firm's performance (see Model 3 and Model 4). Because large firms are usually well-known and close to individuals, and would certainly draw more attention owing to an eye-catching effect, especially for the negative WOM of either themselves or their associated firms (Chevalier & Mayzlin 2006). The *Listing Experience* variables have a significantly positive effect on firm's performance. This implies that firms survived in stock market for a longer time are less impacted by the occurrence of crisis events. There is another explanation that they have enough experience to cope with and attenuate the negative impact of crisis, which might be our next study to focus on.

	Model 1	Model 2	Model 3	Model 4
<b>Dependent Variable</b>	WOM Volume	C-Firm's Abnormal Return	S-Firm's Abnormal Return	S-Firm's Abnormal Return
<b>Theoretical Variables</b>				
News Volume	81.31*** (12.91)	-0.036*** (0.006)		-0.005** (0.003)
WOM Volume			-1.14×10 <sup>-5</sup> * (6.32×10 <sup>-6</sup> )	-8.92×10 <sup>-6</sup> (6.43×10 <sup>-6</sup> )

C-Firm's Abnormal Return			0.048*** (0.014)	0.043*** (0.014)
<b>Control Variables</b>				
C-Firm's Firm Size	-1.19×10 <sup>-9</sup> (1.66×10 <sup>-9</sup> )	1.95×10 <sup>-12**</sup> (7.70×10 <sup>-13</sup> )	-1.70×10 <sup>-12***</sup> (3.39×10 <sup>-13</sup> )	-1.71×10 <sup>-12***</sup> (3.38×10 <sup>-13</sup> )
C-Firm's Listing Experience	-64.19*** (19.17)	0.029*** (0.009)	0.01*** (0.004)	0.012*** (0.004)
S-Firm's Firm Size			-8.61×10 <sup>-13***</sup> (2.32×10 <sup>-13</sup> )	-8.38×10 <sup>-13***</sup> (2.32×10 <sup>-13</sup> )
S-Firm's Listing Experience			0.015*** (0.003)	0.015*** (0.003)
Number of Observations	997	997	997	997
R-Square	4.41%	4.38%	8.67%	9.02%
F value	15.29***	15.15***	15.66***	14.01***

Standard errors are in parentheses.

\* p<0.1; \*\* p<0.05; \*\*\* p<0.01.

Table 4. Regression Analysis

Antecedent	Test Procedure	Path	Unstandardized B	SE B	Mediator Effect (Sobel Test)
<b>C-Firm's Abnormal Return</b>	S-Firm's AR=f(News Volume)	(c)	-0.008	0.003	<b>Supported</b>
	C-Firm's AR=f(News Volume)	(a)	-0.036	0.006	
	S-Firm's AR=f(News Volume, C-Firm's AR)	(c')	-0.005	0.003	
		(b)	0.043	0.014	
<b>WOM</b>	S-Firm's AR=f(News Volume)	(c)	-0.008	0.003	<b>Supported</b>
	WOM=f(News Volume)	(a)	81.31	12.91	
	S-Firm's AR=f(News Volume, WOM)	(c')	-0.005	0.003	
		(b)	-8.92×10 <sup>-6</sup>	6.43×10 <sup>-6</sup>	

Table 5. Mediator Effect

## 5 DISCUSSION AND IMPLICATIONS

### 5.1 Discussion of Findings

In this study, we explore the question of whether the crisis spillover effect exists in a supply chain relationship, and if so, how the spillover mechanism works. Based on a multisource second-hand dataset collected from financial databases (Capital IQ, WIND), search engines (Google, Baidu), and social media (Sina Microblog), we statistically test both the direct effect and mediator effect. Our findings support all the hypotheses we proposed.

First of all, we confirm that the occurrence of a crisis will have a negative effect on its supply chain partners' performance. This finding suggests that when a crisis is publicly reported, the market will immediately reach this signal and reflect the damage on the stock prices. In addition to the firms

stricken by the crisis, their supply chain partners are passively affected, like scapegoats incriminated innocently.

Second, this study finds that there are two mechanisms operated during the spillover process of crisis events to supply chain partners, that is, the mediating role of both external WOM effect and internal demand-supply effect. If WOM reflects the attitude of individuals on the crisis, demand-supply risks mirror the actual behaviour of associated organizations. So, the whole market delivers a negative signal to all the investors, thus driving the stock market fluctuation in relevant firms.

## **5.2 Theoretical and Practical Implications**

Our findings offer several theoretical implications for academics. Extant literature has repeatedly called for more research on spillover effect of crisis event. However, most researches are limited by horizontal organizational positions in the market, while we extend the spillover effect to its vertical influence along the entire supply chain. Besides confirming the existence of spillover effect in this study, we dig into its intrinsic influencing mechanisms. The classification of external WOM effect and internal demand-supply effect do offer a deeper and more comprehensive perspective for spillover theory development.

Second, this research contributes to the theory of the information-finance interface. Few studies have linked marketing variables (e.g., WOM) to shareholder value (e.g., stock price) (Luo 2009), let alone the spillover effect among them. Even if the negative WOM hasn't mentioned a firm, its fiscal damage might still spread to it, which we call the spillover effect of WOM. Employing a variety of second-hand financial, media, and marketing data sources, we are among the first to investigate the spillover effect through market data analysis.

This study also has implications for investors and managers. Our results suggest that investors can benefit greatly from the value of WOM formed in social media and the identification of supply chain relationship. In other words, investors may sensibly sell stocks if the firm or its supply chain partners are burdened with a crisis and negative WOM. For managers, if their firms' supply chain partner is confronted with a crisis, they should pay close attention to the subsequent triggered WOM which may spill over to themselves. What they should do is to face and reduce the damage through effective WOM observation and supply chain risk management.

## **5.3 Limitations and Future Research**

Although our study provides useful insights, it still has some limitations inherent in our research data and design. Firstly, due to the unavailability of foreign stock prices, our research sample is restricted to only firms listed in China. However, listing location does not mean its business area (e.g., Chinese firm may issue its IPO elsewhere, and foreign firm may conduct its main business in China). We need to supplement the missing data and provide a more robust analysis. Secondly, the crisis events extracted from "Business" differ considerably in their crisis type. Future research can distinguish crisis spillover effect across different types.

There are also plenty of other opportunities for future research. Firstly, the spillover effect of crisis may be more significant in a stronger supply chain partnership (e.g., strategic alliance). It is necessary to differentiate the strength of partner relationship, in order to excavate the essence of spillover effect. Secondly, since the spillover effect does exist, supply chain partners' strategy becomes an interesting topic. There are plenty of crisis management researches on firms in crisis, but studies on the response of its supply chain partners are still in its infancy. Last, volume is only a simple indicator for WOM, we intend to investigate WOM valence (Duan et al. 2008) or sentiment in the future, and might provide more evidence for the spillover effect of WOM.

## **6 CONCLUSION**

Will the negative impacts of crisis events spread across organizational boundaries to affect their supply chain partners? How does the spillover mechanism work? Based on guilt-by-association theory,

this study suggests that both the external customers' WOM effect and internal demand-supply effect serve as key mediators during the crisis spillover process to supply chain partners. With a multisource, second-hand and longitudinal dataset collected from financial databases, search engines, and social media, we empirically confirm both the direct effects and mediator effects of News report volume, WOM volume and stricken firm's performance on supply chain partners' performance. These findings not only help enrich the understanding of crisis and WOM spillover effect within vertical organizations, but also provide some guidance for investors and managers.

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