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Decision Support

Mitigating contagion risk by investing in the safety of rivals

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ABSTRACT

Firms often benefit when an unfavorable event befalls a rival, usually through a shift in demand. But sometimes negative, especially catastrophic, events adversely affect an entire industry. We refer to such phenomena as contagion, and note that each firm faces not only its own direct risks but also the contagion risks imposed by rivals who, for example, avoid strong safety measures because investment cost exceeds expected loss. The conclusion of this paper is that, in the extreme case, low-risk firms may benefit from investing in safety improvements for their higher-risk rivals. For example, a firm that over-complies with safety requirements may benefit from investing in safety improvements in a rival that complies with regulations at a minimal level. This research explores conditions under which such a contagion risk mitigation strategy is profitable. Our findings indicate that, for a low-risk firm, there is a threshold above which such an investment would be profitable. In a market where price sensitivity to a rival's safety is close to zero, a low-risk firm can decrease this threshold by extending the investment horizon. The investment is less likely to pay off when firms compete on quantity, as opposed to price. We also show that, below a threshold market price, a third firm that is neutral (neither needs investment nor invests) may be put at a cost disadvantage when this contagion risk mitigation strategy is implemented.

1. Introduction

Rivals generally benefit from each other's failures because of demand shift, which is a *competitive effect*. But some events may adversely affect an entire industry, causing all firms to suffer, which we call a *contagion effect*. Grafton, Hoffer, and Reilly (1981) and Reilly and Hoffer (1983) showed that industry rivals producing similar lines of cars experienced substantial declines in sales following automobile recalls related to safety risks. Similarly, Dowdell, Govindaraj, and Jain (1992) found that the 28 major firms in the pharmaceutical industry lost a total of $8.68 billion after the Tylenol recall in 1982. Following the BP Gulf spill in 2010, the US government tightened regulatory mechanisms, causing cost overruns and project delays across the petroleum industry (KPMG Report, 2013).

Research on Supply Chain Risk Management (SCRM) has mostly addressed threats associated with customers (e.g., Breiter & Huchzermeier, 2015; Gümüs, 2014; Sodhi, 2005; Treville, Schürhoff, Trigeorgis, & Avanzi, 2014) or suppliers (e.g., Chaturvedi & Martínez-de-Albéniz, 2011; Gurnani, Ramachandran, Ray, & Xia, 2014; Wang et al., 2010). But very little Supply Chain (SC) research focuses on risks posed by rivals. In this paper we address this gap by making use of *contagion risk* and examining whether, and when, investment in rivals' safety measures can mitigate it.

The term contagion is commonly used in the social sciences to refer to the spread of various effects through networks of entities. Contagion effect spreads through behavioral or social mechanisms and as such is different from *spillover effect*, which spreads through fundamental links. In a competitive environment, contagion risk emerges when contagion effect exceeds competitive effect. In the context of SCRM, we define as a measure of contagion risk the probability that a firm is adversely affected by the negative externalities of the operational failures of its rivals. Contagion risk is well recognized in many industries and firms adopt various strategies to address it. Pharmaceuticals, for example, lobby regulators to tighten restrictions on the import and sale of potentially unsafe drugs which could negatively affect the reputation of the industry. Some industries, such as the nuclear power industry, practice self-regulation to ensure compliance with minimum regulations and help prevent actual regulations from becoming more restrictive and thus costly.

Contagion risk can be classified as *interdependent risk*, which depends not only on a firm's choices but also on the choices of others (Heal & Kunreuther, 2007). Contagion is triggered by an adverse event occurring at a rival or its SC (Fig. 1). A triggering event is caused by an *initiating event* which is either *active* (evident) or *dormant* (hidden) and out of the rival's control. For instance, the

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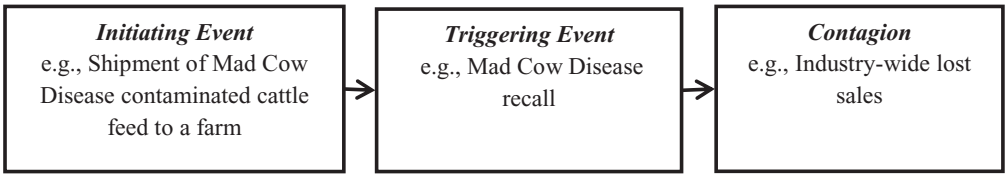

Fig. 1. Contagion Risk.

Fukushima nuclear meltdown in 2011 was caused by a tsunami, an active incident, whereas the Toyota Sticky Gas Pedal Recall in 2009 was initiated when defective pedals were sent to Toyota to be used in the assembly line, a dormant event. The probability of a triggering event for a single industry may be low, but its frequency across industries is significant. In addition to the two cases noted above, the European horse meat scandal of 2013, the disaster of the Rana Plaza collapse in Bangladesh in 2013, the Tazreen factory fire in Bangladesh in 2012, the 2003 cases of Mad Cow Disease in Canada and the US are all examples of triggering events.

Contagion may affect an entire industry or just a few firms. For example, a survey conducted on Toyota's gas pedal problems in 2009 showed that the public connected only Asian automakers with the problem (Automotive News, 2010). Contagion can adversely affect non-liable firms and their SCs by disrupting demand (e.g., the Mad Cow Disease outbreaks in North America, 2003), suspending supply (e.g., Australia's suspension of live-cattle export to Indonesia, 2011), or increasing operating costs (e.g., the Tylenol recall, 1982). Contagion effect could be drastic even when the size of the triggering event or liable firm is small. For instance, in 2003, upon report of a single case of Mad Cow Disease on a remote northern Alberta farm, all major importing countries closed their borders to Canadian beef. According to Slovic (1987), the severity of contagion (ripple effect) depends on multiple, often correlated, characteristics of a triggering event. Using factor analysis, Slovic shows that the characteristics of a hazard (controllability, dread, catastrophic potential, fatal consequences, benefits, observability, popularity, and time to harm manifestation) can be distilled down to two factors: "dread risk" and "unknown risk". He argues that the informativeness of an event, and thus its potential social impact, is systematically related to its location in the two dimensional space defined by these two factors.

A triggering event occurs because a rival does not comply with minimum regulations or because compliance with minimum regulations is insufficient to avoid the event. In the latter case, one approach to address the issue is to increase the minimum requirements. However, given that triggering events are rare, further restriction may be seen as over-regulation and opposed by government or industry. An alternative approach is to encourage complying firms to over-comply voluntarily. However, if firms perceive over-compliance as unnecessary or threatening to their competitiveness, or if they believe that the investment costs exceed the expected profit from the investment, they will not over-comply. This applies especially to Small and Medium Enterprises (SMEs) that lack the operational scale to absorb an increase in cost or cannot afford the capital investment whose return may be long term. In this context, low-risk firms, which over-comply with safety regulations, may consider investing in safety improvements for high-risk rivals that choose to comply only with regulations at the minimum level.

A valuable illustration comes from the meat industry, where we show that a firm might voluntarily help a high-risk competitor to purchase kits to test for Mad Cow Disease. Testing every animal over 21 months significantly reduces the probability that contaminated meat can enter the food chain. In 2003, a small slaughterhouse in the state of Washington issued a recall for about 10,000 pounds of raw beef that was suspected to be contaminated with Mad Cow Disease. Following the recall, 53 countries banned imports of U.S. beef, costing the American beef industry between $3.2bn and $4.7bn (Coffey, Mintert, Fox, Schroeder, & Valentin, 2005). At the time of the event, US had an active Mad Cow Disease screening program in place. The Department of Agriculture records show that 35,000 animals were tested between 2001 and 2003, but none were tested at the slaughterhouse where the mad cow case was detected (UPI, 2015). This is despite the fact that the slaughterhouse specialized in older and/or injured dairy cattle, which are considered most at risk for Mad Cow Disease.

Since many forms of direct contribution to a rival may be considered "collusion" and possibly illegal, an intermediary association is needed to collect and invest contributions. This association can also verify if a candidate rival requires such financial contribution to improve its safety measures, and ensure that the rival follows the requirements of the investing firm. Investment in a rival's safety provides a non-regulatory mechanism for the governance of contagion risk which can be combined with self-regulation. The culture of collaboration embedded in self-regulation promotes such investments, and self-regulatory organizations (SROs) can play the role of intermediary association. SROs are non-governmental organizations formed by the private sector to set standards, monitor compliance, and enforce rules. An example of a SRO is the Children's Food and Beverage Advertising Initiative (CFBAI) which is designed to influence the advertising of foods targeting children under 12, to encourage healthier dietary choices and healthy lifestyles. The CFBAI is a voluntary self-regulation programme and involves 18 of the United States' largest food and beverage companies (as of September 2013), covering approximately 80 percent of the child-directed food advertising market (OECD.org, 2015).

While all firms are at risk of contagion, over-complying firms should be more concerned as they can be penalized for risks that they have already addressed internally. Furthermore, since contagion risk is a high-consequence but low-probability risk it may not be a priority for firms that struggle to comply with minimum regulatory requirements. Our research asks what factors can affect the investment decisions of a low-risk firm and answers how variation in the contributing factors may lead to different decisions. We apply a mathematical approach to explore the conditions under which it would be beneficial for a low-risk firm to improve the product safety measures of a high-risk rival in a market where firms compete on price and demand depend on both, price and safety.

This paper contributes to the SC literature by introducing the notion of contagion risk, providing a detailed model of perceived safety, bringing forward a new coopetitive approach to risk mitigation, and addressing the variables contributing to contagion risk. On the practical side, the research underscores the need for low-risk firms to address contagion risk and helps them decide when to consider industry-level safety investments as an effective strategy to manage contagion risk.

In the remainder of the paper we briefly review the most relevant literature (Section 2), provide a preliminary analysis to set the stage for the formulation of the problem (Section 3),