

Hazard Severity and Time to Recall: Evidence from the Toy Industry

Etayankara Muralidharan, Manpreet Hora, Hari Bapuji

NOTICE: This is the peer reviewed version of the following article: Muralidharan, E., Hora, M., Bapuji, H. (2022). Hazard severity and time to recall-Evidence from the toy industry. *Journal of Business Research*, 139:954-963, which has been published in final form at <http://dx.doi.org/10.1016/j.jbusres.2021.10.035>.

Permanent link to this version <https://hdl.handle.net/20.500.14078/2784>

License © 2017 Elsevier. Licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 user license <http://creativecommons.org/licenses/by-nc-nd/4.0/>

Hazard Severity and Time to Recall: Evidence from the Toy Industry

Etayankara Muralidharan

Associate Professor
School of Business
MacEwan University
5-252J, 10700-104 Avenue
Edmonton, Alberta, Canada T5J4S2
Tel: 780-6333533
Fax: 780-497-4666
Email: muralidharane@macewan.ca

Manpreet Hora

Associate Professor- Operations Management
Scheller College of Business,
Georgia Institute of Technology
800 West Peachtree St. NW,
Atlanta,
GA 30308, USA
Tel.: 404-385-3465
E-mail: manpreet.hora@scheller.gatech.edu

Hari Bapuji

Professor-Strategy & International Business
Department of Management and Marketing
10.060, Level 10, 198 Berkeley Street
The University of Melbourne
Victoria 3010 Australia
Phone: +61-3-8344-9867
Email: hari.bapuji@unimelb.edu.au

Acknowledgement

This project has been funded by MacEwan University, School of Business.

Hazard Severity and Time to Recall: Evidence from the Toy Industry

Abstract

The time a firm takes to recall products that pose severe hazards has serious implications for the firm and its stakeholders. We examine the role of hazard severity and investigate how it influences the impact of recall experience, type of product defect, and product price on time to recall. Operationalizing time-to-recall as the number of days that elapsed from the time a product was first sold in the market to the date it was recalled, we test our hypotheses using data on 833 toy recalls issued by 445 firms in the U.S. during 1988-2018. We find that, under conditions of high hazard severity, time to recall is longer for (i) firms with past recall experience, (ii) recalls of products involving design defects, and (iii) recalls of high-priced products. We discuss the implications of our findings for research and practice.

Keywords: Organizational crisis; Product recall; Time-to-recall; Hazard severity; Design defects; Recall experience

1. Introduction

In the event of a product-harm crisis, firms take actions to eliminate or reduce the harm to consumers by promptly recalling products from the market (Dutta & Pullig, 2011; Muralidharan, Bapuji, & Hora, 2019). Crisis characteristics such as hazard severity can significantly influence the time a firm takes to issue recalls. For example, although Johnson & Johnson recalled Tylenol (which caused deaths) within a week in 1982, it took two years to recall products with less severe problems (due to odor emanating from the products) in 2010 (Kavilanj, 2010). Recognizing the importance of considering hazard severity, researchers have recently begun to divert attention to its relationship with time to recall.

Prior research examined the effect of hazard severity on time to recall and its interaction with brand characteristics (Eilert et al., 2017) and the effect of board gender diversity on the time taken to issue high severity recalls (Wowak et al., 2021). This emerging research evidence highlights the need to examine hazard severity in a more focused manner to shed light on its relationship with time to recall and recall decisions in general. Such focused examinations can bring nuance to research on product recalls that has typically considered all recalls as similar or uniform in their antecedents and consequences. Further, it can help generate a better understanding of the role of hazard severity in recall decisions.

In this study, we draw on the crisis management literature (Bundy et al., 2017; Christensen & Kohls, 2003) to identify crisis event-related factors and examine their relationship with hazard severity. Building on insights from the behavioral theory of the firm (Cyert & March, 1992), we argue that crisis event-related factors (specifically, past recall experience, product defect type, and product price) influence a firm's ability and motivation to issue a quick recall, depending on whether the recall posed a severe hazard or not. Our findings from an

analysis of 833 toy recalls issued by 445 firms during 1988–2018 in the United States (U.S.) reveal that under conditions of high hazard severity, compared to conditions of low hazard severity, time to recall is longer for (i) firms with high past recall experience than it is for firms with low past recall experience, (ii) recalls due to design defects than due to manufacturing defects, and (iii) high priced products than it is for low priced products.

Our empirical examination in the toy industry is particularly salient to study the hypothesized relations for the following reasons. First, the toy industry is unique in that the end consumer is a child, while customers are parents or other adults and therefore safety issues are particularly salient. Ni, Flynn, and Jacobs (2016) suggest that perceptions related to harm and hazard get heightened as they involve customers (i.e., parents and other adults) who may deem themselves as responsible for endangering the vulnerable and helpless individuals (i.e., children who are the end users) by giving them the product. Even if children are exposed to potential harm, particularly severe harm, the adults responsible would like to act quickly, and thus see any delays in issuing recalls as a double failure of the companies. Hazard severity therefore would play an important role in recall timing decisions for firms to avoid this perception. Second, although firms in the toy industry generally outsource their manufacturing to contract suppliers, their design activities are internalized (Bapuji & Beamish, 2019; Wong, Arlbjørn, & Johansen, 2005). Hence, the role of design defects (versus manufacturing defects) in recall timing decisions helps to understand the long-term and universal implications for recalls due to product designs, compared to those due to manufacturing defects, which tend to be localized and may have more short-term and limited/localized implications for firms.

Third, the toy industry exhibits several unique characteristics, including high seasonality (i.e., most toys are sold in the last quarter of the calendar year), short product life cycles, intense

competition on both innovation and pricing, high supply and demand uncertainty due to changing consumer preferences, high impulse purchasing, and high competition between toy retailers and manufacturers (Wong et al., 2005). These increase the competitive nature of the industry which in turn places prices and profit margins in the toy industry under pressure (Wong et al., 2005). Further, purchasing adults might see the recall of a high-priced item as another violation of expectancy (i.e., higher price indicates higher quality and thus, provide better safety). Hence, the importance of the role of price in recall timing decisions is particularly salient in the toy industry. Finally, previous research indicated that firms that experienced recalls in the recent period (e.g., previous year) tend to quickly recall products with severe problems (Eilert et al., 2017). However, research also indicates that firms that experienced failures tend to avoid them in the future and thus delay product recalls (Baumard & Starbuck, 2005). Therefore, examining the effect of recall experience on time to recall by capturing cumulative experience in line with previous research (e.g., Hanuschild & Rhee, 2014) would help advance our understanding on time to recall.

The study makes the following contributions to the nascent yet growing literature on product harm crisis and time-to-recall from theoretical and empirical standpoints. From a theoretical standpoint, our study underscores the need to examine hazard severity as a key boundary condition in crisis management where it acts as a modifier of recall management decisions in that antecedents of such decisions may vary contingent on the levels of hazard severity. We specifically examined the antecedents of past recall experience, type of product defect, and product price drawn from crisis management literature. Together, these are among the most notable relationship studied by previous scholars. Therefore, our examination of these

relationships by introducing hazard severity as a boundary condition opens new avenues to revisit recall management research and practice.

From an empirical standpoint, our study adds insights from a different industry and points to the need to examine potential industry variations in recall crisis management decisions. While extant studies have shown that time to recall in the auto (Ni & Huang, 2017) and toy (Hora, Bapuji, & Roth, 2011) industries is higher for products with design defects (compared to manufacturing) and for products with high price, our study on the toy industry shows that the increase in the time to recall is observed more in high hazard severity conditions compared to low hazard severity conditions. Further, earlier work has shown that “problem severity is less likely to lead to a recall delay when the firm has faced recalls in its recent past” (Eilert et al., 2017:125). The measures used by these scholars are specific to the auto industry, which prompted them to recommend that future studies “investigate firms’ recall timing decisions in other industries to help in generating empirical generalizations” (Eilert et al., 2017:127). Our study set in the toy industry addresses this call and adds additional nuance and analytical rigor to this stream of research.

2. Recall Behavior of the Firm and Time to Recall

The successful management of a product recall crisis involves appropriately timing the recall (Siomkos, 1989), strategically handling recall communications (Claeyes & Cauberghe, 2014), and offering appropriate remedial solutions to customers (Davidson & Worrell, 1992). Among these, swiftly issuing a recall – or shorter time to recall – has recently attracted increasing research attention. This is because a quick recall of hazardous products minimizes consumer harm, while the other aspects of handling communications and offering remedial solutions minimize damage to the company.

Past research examining time to recall has generated interesting insights. Specifically, this research has examined a range of antecedents to time to recall, including firm characteristics (e.g., firm size, experience, firm type, firm specialization, location of headquarters, and female representation on firm's board) and product characteristics (e.g., type of defect causing the product harm, component sourcing, and number of models) (Eilert et al., 2017; Hora et al., 2011; Majid & Bapuji, 2018; Ni & Huang, 2017; Wowak et al., 2021). Recently, researchers have begun to consider that the relationships related to recalls (i.e., recall management as well as antecedents and consequences of recalls) might depend on the severity of the hazard posed by the recalled product. For example, in a study focused on examining the stock market reactions to early recalls (i.e., recalls in which time to recall is shorter), Eilert et al., (2017) found that time to recall is higher for severe recalls, but this effect is weaker for brands perceived as highly reliable and stronger for diversified brands. In another study, Wowak et al., (2021) found that firms with high female representation on boards issue greater number of less severe recalls (which other firms may not issue as they are not severe) and also swiftly issue more severe recalls, relative to firms in which female representation on boards is lower. Together, in line with research on organizational crises (Bundy et al., 2017), these two studies point to the need to consider hazard severity as a major factor influencing the issue of recalls, their management, and their consequences. However, research that foregrounds hazard severity and makes it a central focus in understanding recalls – and, more broadly, organizational crises, has yet to surface.

In view of the above, we specifically focus on hazard severity to examine how the effect of firm recall experience, product defect type, and product price on time to recall varies based the level of hazard severity. To do so, we build on the insights from behavioral theory of the firm and research on crisis management.

3. Hypotheses

According to the behavioral theory of the firm (BTOF), firms selectively respond to market information and find satisficing solutions to meet multiple goals such as revenue, market share, and profit considerations (Cyert & March, 1992; Eilert et al., 2017). The extent to which a firm can balance these pressures and develop a response to a product-harm crisis, according to BTOF, depends on the firm's motivation and ability (Chen & Hambrick, 1995) to do so. In a product recall, a firm is faced with both direct and indirect costs for firms (Dawar & Lei, 2009).

Direct costs of a recall include those costs that the firm incurs to execute the recall, such as expenses for remedial solutions (repair, refund/replacement) and for reverse logistics (Jayaraman, Patterson, & Rolland, 2003). Since these direct costs could be higher due to the quantity to be recalled, price of the product, etc., firms could be motivated to delay recalls and incur these costs in future time periods to avoid potential loss of sales and portray profits in the short term (Eilert et al., 2017). Indirect costs of a product recall include loss of reputation and reduced market performance, due to recalls adversely affecting stakeholders' perceptions about the product's safety and reliability (Rhee & Haunschild, 2006). Further, indirect costs also include the cost of litigation, which might increase if larger number of people are harmed, or if the harm faced by some is severe. So, if the indirect costs exceed direct costs, a swift recall may be an economical option (Eilert et al., 2017).

The discussion above points to factors such as recall costs and hazard severity that influence the motivation and ability of a firm to issue a quick recall. Crisis scholars suggest that crisis decision making starts with the consideration of factors related to the crisis event. These factors include whether the crisis event is a one-time event or an ongoing one, the technical origins of the crisis, economic concerns related to the crisis, and magnitude of the consequences

of the crisis event (e.g., extent of harm to the victims) (Christensen & Kohls, 2003). These factors influence the motivation and ability of the firm to make crisis related decisions that require balancing multiple organizational goals during a crisis (Bundy et al., 2017; Christensen & Kohls, 2003). We contextualize these factors to recall management and suggest that the magnitude of the consequences (i.e., hazard severity of the crisis) moderates the effect of (i) one time versus on-going event (as reflected in past recall experience), (ii) technical origins of the crisis i.e., whether the origin was internal to the organization or external (as reflected in whether the recall was a result of defects in in-house designs or outsourced manufacturing), and (iii) economic concerns of the crisis event (as reflected in the price of the product) – on time to recall decisions.

In summary, bringing together insights from crisis management literature and the behavioral theory of the firm, we hypothesize that hazard severity moderates the effect of recall experience, type of product defect (design versus manufacturing), and product price on time to recall.

3.1 Recall Experience, Hazard Severity, and Time to Recall

As a source of knowledge on organizational routines, past experience, both success- and failure-related, constitutes a useful tool for organizational learning (Cyert & March, 1992). Product recalls represent a failure-related experience for a firm (Haunschild & Rhee, 2004), and the influence of recall experience on time to recall will be different under conditions of high and low hazard severity. The exact direction of the influence of hazard severity is difficult to hypothesize a priori because prior research on recall experience is ambivalent (Bundy et al., 2017; Eilert et al., 2017). Specifically, two different lines of thinking can be drawn from the literature on how hazard severity will moderate the relationship between recall experience and

time to recall.

The first line of thinking draws from the argument that the influence of recall experience on time to recall is unlikely to be positive because with increasing recalls, firms with past recall experience would have incurred costs to implement the past recalls (costs for reverse logistics and remedial solutions). Such historical costs would have directly affected the cash flow and earnings of the firm, thus leading to resource constraints, which may reduce their ability to issue quick recalls for subsequent product hazards (Eilert et al., 2017). Further, recurring recalls also signal inherent quality process problems to stakeholders (Hartman, 1987), which lead to indirect costs such as loss of reputation. Therefore, firms may have a higher motivation to delay subsequent recalls. The delay may also be a result of defensive behavior that arises as a result of failure experience (Baumard & Starbuck, 2005). Such behavior, and thus, the effect of recall experience on time to recall, could be different at different levels of hazard severity.

High hazard severity increases the culpability of the firm, as harm and injury to consumers are higher compared to when the severity is low. Consequences of the severity of hazard can negatively affect firm operations (as compared to less severe hazards), as verified by previous research: decreased sales of the recalled model(s) in the automobile industry (Reilly & Hoffer, 1983); negative effects on consumer perceptions and behavior (Vasikolopolou et al., 2009); increased blame attribution to the firm by consumers (Laufer et al., 2005); higher expenses to provide remedial solutions, and in the case of public limited companies, a decrease in shareholder wealth (Thomsen & McKenzie, 2001). In short, recalls of products that pose a severe hazard to consumers involve higher direct and indirect costs for the recalling firms.

Firms with past experience in recalls of high hazard severity tend to form an understanding of the negative consequences of issuing a rapid recall, besides expending resources for reverse

logistics and remedial solutions resulting from the recalls. Therefore, with increased experience, firms will tend to react defensively to failures (Baumard & Starbuck, 2005), and will be less motivated to quickly recall such products from the market. Further, firms with past experience of recalling products of high hazard severity, given the costs incurred in executing previous recalls, are likely to be resource-constrained and will have a lower ability to expedite a recall (Eilert et al., 2017). In the event of low hazard severity, however, experience may not exert a similar influence because stakeholders remain relatively unaffected when the severity of the hazard is low, and the direct costs involved in executing the recall may not be high (Thomsen & McKenzie, 2001).

In sum, given the first line of thinking, recall experience of a firm plays a significant role in situations where the severity of the hazard is higher, as firms draw on past experiences in executing the recall to inform their current recall timing decisions. Firms may, therefore, be less motivated and are likely to be resource-constrained to quickly execute a recall when the severity of the hazard is high compared to when the severity of the hazard is low. Hence:

H1a: Hazard severity moderates the relationship between firm recall experience and time to recall, such that time to recall will be longer for firms with high recall experience for both high hazard severity and low hazard severity conditions, but the effect will be weaker when the hazard severity is low.

The second line of thinking draws from the argument that firms learn from past recall experience (e.g., Haunschild & Rhee, 2004; Thirumalai & Sinha, 2011) and, therefore, will recall defective products more quickly under conditions of high hazard severity (Eilert et al., 2017). Past recall experience would help firms to develop the competence to handle product failures, such that they can tap into existing knowledge and routines to manage subsequent recalls efficiently and effectively. Such knowledge, especially in the case of high hazard severity, would enable providing appropriate remedial solutions, making effective stakeholder communications

to allay stakeholder concerns, and handling reverse logistics in a cost-effective manner. Firms would, therefore, be motivated to use such knowledge to quickly recall the product and prevent further damage due to high hazard severity. Further, early recalls of high hazard severity would not place constraints on resources to execute the recall in view of fewer products that need to be recalled.

In the event of low-severity hazards, as mentioned earlier, experience may not exert a similar influence because stakeholders remain relatively unaffected, and the direct costs involved in executing the recall may not be high due to the absence of high remedial costs. Thus, past experience is particularly important when the hazard severity is high, where existing knowledge on managing recalls accumulated through previous experience would help firms implement the recall quicker and in a more cost-effective manner (Eilert et al., 2017). Hence, we propose a competing hypothesis:

H1b: Hazard severity moderates the relationship between firm recall experience and time to recall, such that time to recall will be shorter for firms with high recall experience for both high hazard severity and low hazard severity conditions, but the effect will be weaker when the hazard severity is low.

3.2 Product Defect, Hazard Severity, and Time to Recall

Product defects that result in recalls can be classified into two categories: design defects and manufacturing defects. Design defects refer to those defects that arise due to quality issues integral to a product's design. On the other hand, manufacturing defects are those that arise due to deviation or lack of conformance to the design specifications (e.g., missing parts, use of unspecified raw materials) (Beamish & Bapuji, 2008).

In a globalized value chain like the U.S. toy industry, in which our study is set, firms generally outsource their manufacturing to contract suppliers and specialized manufacturers but internalize their design activities (Hora et al., 2011). The product design process is an internal

activity of the firm and, therefore, remains under the firm's control (Ulrich & Ellison, 2005). For this reason, design-related recalls are classified as "internal-normal" crises that originate from within the organization (Snyder et al., 2006). A quick recall of products with design defects may serve as a signal that the firm's design processes are not robust, and, hence, such recalls directly implicate the firm for the product-harm crisis. In contrast, recalls due to manufacturing defects can be attributed to overseas suppliers (as many firms in the U.S. toy industry did during 2007, "The Year of the Recall") (Beamish & Bapuji, 2008). As such, Hora et al. (2011) show that for firms in the toy industry time to recall is longer for design defects than it is for manufacturing defects. We, however, argue that such responses could vary depending on hazard severity.

Given that the toy industry is unique when compared to other industries, as the end consumer is a child and customers (parents or other adults) consider the safety features of toys particularly salient to minimize potential hazards to their children (Ni et al., 2016). Further, since toys are high in credence qualities (Darby & Karni, 1973), parents experience uncertainty in the safety attributes of the products (Ni et al., 2016). Firms would, therefore, be motivated to reduce the incidence of this safety concern among the customers by recalling the defective products quickly from the market.

The higher the number of incidents related to hazard severity concerns of a product, the higher the remedial payouts would be, not to mention costs of public backlash through lawsuits, etc., which could reduce the ability to provide remedial solutions if the defective products remained in the market. Such increased costs would lead to resource constraints for the firm. Further, in the case of high hazard severity design-related recalls, internal systemic issues like design processes of the firm and its safety testing processes come under greater scrutiny (Hartman, 1987), and stakeholder backlash could be high. In such situations, the firm may be

less motivated and also resource-constrained to issue a quick recall, as they would want to investigate the matter in more depth and be sure about the locus of the problem and its accountability before issuing an expensive recall. Delaying such recalls would ensure sufficient flexibility of resources to buffer the direct costs associated with managing the recall, including providing remedial solutions (Wood et al., 2017). This may not be the case for manufacturing-related recalls. In the case of manufacturing-related recalls of high hazard severity, firms are likely to issue a quick recall as they can attribute the blame to the manufacturing unit (Carvalho, Muralidharan, & Bapuji, 2015). Additionally, firms can also potentially pass on the recall-related cost to the manufacturer of the product when such products are sourced from contract manufacturers (Noggle & Palmer, 2005).

Low hazard severity conditions may not signal systemic internal problems in the design processes (Hartman, 1987). Also, expenses for recalling products of low hazard severity may not be high enough to put pressure on the resources of the firm. Therefore, in a low hazard severity situation, time to recall may not differ as much between recalls due to design defects and those due to manufacturing defects.

In sum, high-hazard-severity-related recalls due to design defects are likely to invite greater scrutiny of the firm and its core operations, given the direct and indirect costs associated with such recalls when compared to low-hazard-severity-related recalls due to design defects. In the case of manufacturing defects, firms can attribute blame to overseas contract manufacturers (use of contract manufacturing being unique in global toy supply chains) and can also pass on the expenses of executing the recall to such contract manufacturers. Therefore, firms may be less motivated and are likely to be resource-constrained to implement a quick recall in the event of high hazard severity due to design defects. Hence:

H2: Hazard severity moderates the relationship between product defect type and time to recall, such that time to recall will be longer for products with design defects for both high hazard severity and low hazard severity conditions, but the effect will be weaker when the hazard severity is low.

3.3 Product Price, Hazard Severity, and Time to Recall

The price of a recalled product influences the direct costs that firms incur in executing the recall. These costs relate to expenditures that firms incur for providing remedial solutions and for retrieving the defective products (Jayaraman et al., 2003). Such expenses would be higher in the case of recalls of high hazard severity for two reasons. First, firms would need to provide more attractive remedial solutions to consumers when the hazard severity is high. Since the basic purpose of a recall is to protect consumers and to compensate them for the supply of defective products, remedial solutions should be commensurate with the hazard severity and, therefore, potential harm to consumers (Roschk & Gelbrich, 2014). For example, customers and regulators would expect a refund rather than a repair or replacement of the recalled products as a remedial solution when the hazard severity is high (Liu, Liu, & Luo, 2016). Higher-order remedial solutions would, therefore, lead to higher costs to the firm when the product price is high. Thus, firms would be cautious to take a decision to quickly recall high-priced products of high hazard severity. In contrast, in the case of low hazard severity, the pressure on firms to issue higher-order remedial solutions may not be high and, hence, the effect of price differences on time to recall decisions may not be high.

Second, recalls of high hazard severity can evoke negative reactions from a firm's stakeholders such as business associates and suppliers. They may signal internal systemic issues that could amplify stakeholder doubts about the firms' quality processes (Hartman, 1987). Such reactions can lead to business associates taking actions to protect their interests; for example, suppliers could tighten payment terms to the firm, thereby imposing additional financial

pressures on the firm (Liu et al., 2016). Issuing quick recalls can be interpreted by stakeholders as the harm crisis being severe and the firm having no choice but to recall quickly to reduce future financial losses (Chen et al., 2009). Moreover, issuing such quick recalls under conditions where products that posed high hazard severity are also high-priced may signal even higher financial losses to stakeholders (Liu et al., 2016). Therefore, firms may be less motivated to quickly recall high-priced products of high hazard severity, whereas, in the case of low hazard severity, price levels may be a lesser concern. Hence:

H3: Hazard severity moderates the relationship between product price and time to recall, such that time to recall will be longer for high-priced products for both high hazard severity and low hazard severity conditions, but the effect will be weaker when the hazard severity is low.

4. Methodology

4.1. Study Setting, Sample, and Data

Our sample included firms from the U.S. toy industry that issued at least one product recall during the past three decades (1988 to 2018). The data from before 1988 could not be used as it was not as complete and detailed for the required variables. During the study period, the usable data comprised a total of 833 recalls issued by 445 firms. The source of the relevant recall notices was the website of the Consumer Products Safety Commission (CPSC), the regulatory agency responsible for ensuring the safety of consumer products. Information from the CPSC website recall notices was used to construct the study variables, as described below.

4.2. Operationalization of Variables

4.2.1. Dependent Variable

Following previous research set in multiple industries (e.g., Hora et al., 2011; Majid & Bapuji, 2019), we operationalized *time to recall* as the number of days that elapsed from the time a product was first sold in the market to the date it was recalled. This operationalization does not

capture *when* the product defect was first noticed by the firm because recall notices do not provide this information. Therefore, we used information on the date of sale and date of recall to calculate the time taken by the firm to recall the product. Fewer days before a recall indicate that a firm either quickly identified or became aware of the problem and promptly issued a recall notice. Conversely, a greater number of days before a recall indicates that a firm may have failed to identify the problem quickly or may have delayed contacting the CPSC to issue a recall or both. The number of days was log-transformed to eliminate skewness in the data.

4.2.2. *Independent Variables*

Hazard Severity: The toy recall notices do not categorize recalls based on the extent of hazard severity as do the food recall notices (Wowak et al., 2021). Further, they do not provide details on hazard levels as auto recall notices do (Haunschild & Rhee, 2004). Therefore, we developed a measure of hazard severity from toy recall notices, based on previous research as well as the classification methods used for auto and food recalls. To capture *hazard severity*, we use the information on the incidents, injuries, and deaths that were reported separately in the recall notices. An “incident” involves a case of product failure, whereas an “injury” involves a case where that failure injured a consumer, and a “death” is a case where such failure resulted in a fatality. Previous research indicates that the severity of a product-harm crisis can be determined by the extent of incidents, injuries, or deaths due to the recalled product (Vassilikopoulou et al., 2009). The toy recall notices only provide a number for incidents of product failure or injuries, but do not always provide the nature and details of the reported failure incidents and injuries. In the absence of such detailed data, we classified all recalls with either an incident, injury, death, or a combination as high hazard severity recalls (a dummy variable coded as 1) and all recalls with no incident, injury, or death as low hazard severity recalls (dummy variable coded as 0).

So, in our dataset, there were 334 high hazard severity recalls and 499 low hazard severity recalls.

Recall Experience: Recall experience was estimated based on past cumulative recalls issued by a firm, with each recall being assigned one point. If a firm issued multiple recalls in a year, that value was assigned to reflect the number of recalls. We estimated recall experience by adopting the discounting techniques used in past research as recent experience offers a more useful learning tool than does distant experience (Haunschild & Rhee, 2004). Specifically, we used a rolling window of past 10 years' recalls. For example, a firm issuing 10 recalls in a given year received a value of 10 for recall experience in that year. Thereafter we discounted the recall experience value by 10 percent each year and assigned it as the recall experience for subsequent years. This straight-line discounting method, operationalized experience for year t as follows: The number of recalls issued in year $t - 1$ was weighted by 10/10, and those from year $t - 2$ were weighted by 9/10, and so on. After applying these weights, the products of the previous years were aggregated to estimate firm recall experience. As followed by previous scholars (Haunschild & Rhee, 2004), we considered in our analysis recalls dating back to the beginning of our sample. As our sample is from 1988, observations for 1989, 1990, and so on, were based on a one-year, two-year, and, so on, rolling windows.

Defect Type: We followed Beamish and Bapuji (2008) and Hora et al. (2011) in using information describing the product parts that posed the hazard to code each recall for *defect type*. We coded design defects as 1 and manufacturing defects as 0. Design defects included the presence of small, detachable parts, like button-eyes and beads, as well as the presence of strings and awkward spaces that could lead to strangulation or entrapment. Manufacturing defects included the presence of banned or unapproved materials (e.g., excess lead content in the surface

paint of the recalled product), faulty assembly (e.g., missing screws) or substandard parts (e.g., breaking/cracking of parts). Two undergraduate students, both blind to our hypotheses, independently coded each recall for defect type. The agreement level obtained was 92 % (Kappa = 0.814; $p < 0.001$).

Product Price: We used the average selling price for the product as specified in the recall notices (Hora et al., 2011). To reduce skewness, we transformed this variable using its natural log.

4.2.3. Control Variables

We used past research to identify five control variables that might influence time to recall: number of units recalled, supply-chain position of the firm, firm type (publicly traded firms versus privately held firms), China as a country of manufacture, and time variations. *Number of units* was the natural log of the total number of product units recalled. We control for this variable because a recall involving more units poses much higher logistical problems and requires additional resources for coordination (Hora et al., 2011). As a result, firms are likely to take a longer time to issue such recalls.

Hora et al. (2011) showed that the *supply-chain position* of the firm affects time-to-recall decisions, in that firms located farther away from the consumer (i.e., toy companies involved in design and/or manufacturing) are slower to recall a faulty product, compared to firms located closer to the consumers (i.e., distributors and retailers who source products). Accordingly, we measured supply-chain position as a categorical variable, capturing whether the firm issuing the recall was a toy company, a distributor, or a retailer.

Publicly traded firms (versus privately held firms) are expected to recall faster in an effort to avoid the negative publicity and potential lawsuits that would affect their reputation (Tiwari, 2019). *Public companies* listed on stock exchanges were captured by a dummy, which was coded

as 1 if the recalling company was public and 0, otherwise. Our sample of recalls had 74 % of the products manufactured in China. We, therefore, controlled for country-of-manufacture effects on time to recall (Muralidharan, Bapuji, & Laplume, 2015; Bapuji & Majid, 2018). We created a dummy that was coded 1 if it was manufactured in China and 0 otherwise.

The data spanned 30 years during which many changes occurred in the consumer product safety laws as well as information and communication technologies, which together can potentially affect the time to recall. Therefore, we controlled for time variations by including year dummies.

4.3. Data Analysis and Results

To study the hypothesized multivariate relationships, we analyzed the data using the ordinary least squares (OLS) regression with the following specification.

$$\begin{aligned} Time_i = & \beta_0 + \beta_1 Recall\ Experience_i + \beta_2 Hazard\ Severity_i + \beta_3 Defect\ Type-Design_i + \beta_4 Average \\ & Price_i + \beta_5 Severity_i \times Experience_i + \beta_6 Severity_i \times Design_i + \beta_7 Severity_i \times Price_i + \beta_8 No\ of \\ & Units_i + \beta_9 Public\ Company_i + \beta_{10} Dummy\ China_i + \beta_{11} SC\ Player_i + \sum_{T=1}^T \beta_{12} Year + \varepsilon_i \end{aligned}$$

$Time_i$ is the natural log of the number of days to recall the defective product from the market. $Experience_i$ is the discounted value of the past number of recalls by the firm i ; $Hazard\ Severity_i$ is a dummy variable to indicate whether the recalled product i was of high hazard severity (or low hazard severity). $Defect\ Type-Design_i$ is a dummy variable to indicate whether the recalled product i was due to a design defect (versus a manufacturing defect). $Average\ Price_i$ is the natural log of the average price of the recalled product i . $Severity_i \times Experience_i$, $Severity_i \times Design_i$, and $Severity_i \times Price_i$ are the interaction terms of severity with experience, defect type, and product price, respectively. $No\ of\ Units_i$ is the natural log of the number of units recalled. $Public\ Company_i$ is a dummy variable to indicate whether firm i was listed in the stock

exchange. *DummyChina_i* is a dummy variable to indicate whether the recalled product *i* was manufactured in China. *SC Player_i* is a categorical variable to indicate the supply-chain position of the firm recalling the product. *Year* represented the year dummies that were introduced to control for time effects and ε_i is the residual error. Table 1 reports the means, standard deviations, and correlations for all variables.

----Please insert Table 1 about here----

Table 2 presents the three regression models used in this study. The base model (Model 1) included the control variables. We added the independent variables “recall experience” and “defect type-design”, “hazard severity”, and “average price of product” in the second model (Model 2). In Model 3, we added the interaction terms “hazard severity $\times$ recall experience”, “hazard severity $\times$ defect type-design”, and “hazard severity $\times$ average price of product.” Overall, all three models were statistically significant.

---- Please insert Table 2 about here ----

Model 1, which included only the control variables, explained 17.1% of the variance in time to recall. The results suggest that as quantity increases, firms tend to take longer to issue a recall ($\beta=0.12$, $p<0.001$). The products sourced from China are recalled faster ($\beta= -0.29$, $p<0.001$). The result for the supply-chain position of the firm was significant: when compared to retailers, distributors ($\beta=0.16$, $p<0.10$) and companies ($\beta=0.16$, $p<0.10$) took longer to recall. Publicly traded firms were also found to recall faster ($\beta= -0.17$, $p<0.05$). In short, the effects of control variables were in the expected direction.

In model 3, the interaction term between hazard severity and recall experience is positive and significant ($\beta= 0.10$, $p<0.01$). This interaction is plotted in Figure 1. The figure illustrates that for firms with high recall experience, time to recall is longer for recalls of high hazard

severity and therefore supports hypothesis H1a. The interaction term between hazard severity and design defects is positive and significant ($\beta = 0.51$, $p < 0.01$). This finding supports Hypothesis 2. Figure 2 depicts this result and illustrates that time to recall is longer for recalls of high hazard severity if the products contained design defects. Finally, with reference to Hypothesis 3, the interaction term between hazard severity and product price is positive but is of marginal statistical significance ($\beta = 0.11$, $p = 0.057$). Figure 3 depicts this result.

-----Please insert Figures 1, 2, and 3 about here-----

4.4. Supplementary Analysis

Given our main focus is on hazard severity, we pursued supplementary analyses by partitioning our sample based on this variable. Here, the intent is to verify the effects of recall experience, defect type, and product price on time to recall (Wowak et al., 2021; Thirumalai & Sinha, 2011) under different categories of hazard severity. Thus, we do not include hazard severity as a variable in the analyses but use it to partition our sample based on hazard severity into low hazard severity (i.e., 499 recalls with no reported incidents, injuries or deaths) and high hazard severity (i.e., 334 recalls with reported incidents, injuries, or deaths). We ran separate analyses on these partitioned samples. Table 3 presents the results of these analyses. Model 1 (Table 3) shows the results of recall experience, defect type, and product price on time to recall for all recalls in our sample. Models 2 and 3 show the results of recall experience, defect type, and product price on time to recall for low and high hazard severity categories, respectively.

----- Please insert Table 3 about here -----

We further partitioned the 334 observations under high hazard severity into two sub-categories: only incidents, but no deaths and injuries (212 observations) and deaths and injuries

(122 observations). Models 4 and 5 of Table 3 show the results of recall experience, defect type, and product price on time to recall based on these two sub-categories of high hazard severity.

Recall experience significantly reduces time to recall when the hazard severity is low (Model 2 of Table 3) i.e., $\beta = -0.05$ ($p < 0.05$), whereas it marginally increases time to recall when hazard severity is high (Model 3 of Table 3) i.e., $\beta = 0.04$ ($p = 0.062$). We also conducted a post-hoc test to verify whether the regression coefficients of experience in models 2 and 3 are significantly different from each other. The results show a significant difference (chi-square = 7.53 $p < 0.01$) confirming that the effect of experience on time to recall when hazard severity is high is significantly higher than the effect when hazard severity is low. Further analysis of the high hazard severity condition shows that it is the deaths and injuries in the sample that have significantly increased the time to recall ($\beta = 0.09$, $p < 0.05$ in Model 5 of Table 3). The post-hoc test comparing the regression coefficients of experience in models 4 and 5 also shows a marginally significant difference (chi-square = 2.73 $p < 0.10$). Together, these results provide additional support for H1 and our theorization that hazard severity, particularly when it involves injuries and deaths, increases time to recall.

In the case of design recalls, while time to recall was longer (although marginally significant) for design recalls in low hazard severity conditions ($\beta = 0.17$ $p = 0.08$) as in Model 2 of Table 3, it was significantly longer for design recalls in all high hazard severity conditions (i.e., minor incidents, injuries, and deaths) in our sample ($\beta = 0.61$, $p < 0.01$, Model 3 of Table 3), with only incidents and no injuries and deaths ($\beta = 0.60$, $p < 0.01$, Model 4 of Table 3), and only injuries and deaths ($\beta = 0.55$, $p < 0.05$, Model 5 of Table 3). The post-hoc test confirms that the regression coefficients of design in models 2 and 3 are significantly different from each other (chi-square = 8.47 $p < 0.01$). This result also confirms that products with design defects (versus

manufacturing defects) take longer to recall under high hazard severity when compared to low hazard severity. These results, once again, provide support for H2 and our theorization that firms take longer to issue recalls of high hazard severity arising from design defects.

While product price did not influence time to recall in the low hazard severity condition (as shown in Model 2) it increased time to recall (although with marginal statistical significance) in the high hazard severity condition ($\beta=0.08$ $p=0.08$) as shown in Model 3. However, while time to recall was longer and statistically significant in the sub-category of recalls with only incidents i.e., $\beta=0.13$ ($p<0.05$), it was not statistically significant for the sub-category of recalls with reported injuries and deaths as shown in models 4 and 5 of Table 3. These results, while offering marginal statistical support for H3, show that the effect of hazard severity on the relationship between price and time to recall maybe more nuanced, i.e., time to recall increases for incidents but not for injuries and deaths.

4.5. Additional Robustness Tests

Besides the supplementary analyses discussed above, we conducted additional analyses to verify the robustness of our empirical results. We examined whether our results were sensitive to the operationalization of recall experience and hazard severity. Following Liu et al. (2016), we operationalized recall experience as the cumulative number of recalls, i.e., without any discounting. Using cumulative experience, our main effects and interaction effects were similar to our main results in Models 2 and 3 of Table 2. Moreover, repeating the supplementary analyses using cumulative experience, the results were similar to the ones obtained in Table 3. Muralidharan et al. (2019) had created a composite score of hazard severity by assigning weights to incidents, injuries, and deaths, based on the Abbreviated Injury Scale (AIS). The AIS represents the most widely used anatomic scale for rating the severity of injuries (MacKenzie,

Shapiro, & Eastham, 1985). Higher scores indicate higher hazard severity. Results obtained using the above composite variable of hazard severity were similar to what are shown in Table 2 (Model 3). The interaction between past recall experience and hazard severity was positive and significant ($\beta=0.04$, $p<0.001$); that between design defects and hazard severity was again positive and significant ($\beta=0.16$, $p<0.01$); that between average price and hazard severity although was in the suggested direction, was not statistically significant ($\beta=0.02$, $p=0.40$).

Further, we conducted the following tests to confirm that our data did not violate the assumptions related to homoscedasticity and multicollinearity. The Breusch-Pagan test was conducted to confirm that the variance of residual error was constant for all values of an independent variable. The null hypothesis of no heteroscedasticity could not be rejected ($p = 0.72$), indicating that the data was not affected by homoscedasticity. The variance inflation factors (VIFs) of all the independent variables were well within the acceptable limit of less than 10 (Neter et al., 1996). Therefore, multicollinearity was not a problem in our data.

As per Liu et al. (2016), higher value of recalled products could be due to a greater volume or quantity recalled, higher unit price, or both. For robustness, we tested whether hazard severity moderated the effects of the quantity recalled and the value (quantity times unit price) of the recalled products on time to recall. While a higher quantity of recall increases time to recall ($\beta=0.12$, $p<0.001$), hazard severity did not have a moderating effect on this relationship. Further, while a higher value of the products recalled (quantity times unit price) increased time to recall ($\beta=0.09$, $p<0.001$), hazard severity did not have a moderating effect on this relationship also. Therefore, our earlier result on the moderating effect of hazard severity on the influence of price on time to recall may need to be inferred in conjunction with the above findings.

5. Discussion and Implications

In this paper, we examined the interplay of firm recall experience, type of product defect, and product price with hazard severity on time to recall in the toy industry. Our findings suggest that past recall experience increases time to recall under conditions of high hazard severity. In high hazard severity situations, although experienced firms would have developed routines to manage such recalls, the costs (both direct and indirect) that they incurred previously could be a deterrent to issuing yet another recall of high hazard severity. This is particularly so in the toy industry where volatile industry characteristics put pressure on price and profit margins. This, we infer, would be more so when hazard consequences lead to injuries and deaths as observed in the significant increase in time to recall for the sample with deaths and injuries. This finding could imply that high hazard severity conditions (of injuries and deaths) influence the customers' perceptions about the quality of the recalled product (e.g., fearing that the product could cause injury or death to their wards), prompting them to move away from the toy company (Ni et al., 2016). Further, the recurrence of such high hazard severity recalls could strengthen negative perceptions and lead to a public backlash and litigation from stakeholders. Therefore, firms with past recall experience would be less motivated to issue more recalls of high hazard severity, especially those associated with injuries and deaths for fear of losing customers, resulting in longer time to recall. In the case of low hazard severity where there are no incidents, deaths, and/or injuries, direct and indirect costs may not be high as compared to the costs in case of high hazard severity recalls and, hence, there exists a lower pressure on firm resources to execute new recalls. Besides, this context is also suitable for firms to present themselves in a positive light to their customers since toys are high in credence qualities (Darby & Karni, 1973). Firms may, therefore, be more motivated and be able to issue a new recall quicker when the hazard severity is low.

Our findings also suggest that time to recall is longer for recalls of high hazard severity caused by design defects compared to those caused by manufacturing defects. When the defect causing the recall is attributable to the firm's own internal processes, such as design defects, firms may delay recalls to avoid admitting responsibility for the defect. In the event of high hazard severity design-related recalls, internal systemic issues like design processes of the firm and the firm's control over safety testing processes come under greater scrutiny (Hartman, 1987). In such cases where design defects lead to severe hazards, firms may be less motivated to issue a quick recall because they would prefer a detailed investigation and assessment of accountability to communicate the remedial steps before issuing the recall. Our supplementary results for design recalls imply that irrespective of the nature of the high hazard severity (minor incident, injury, or death), time to recall is longer for design-related recalls. These results also find support in blame attribution literature, which suggests that recalls occur more swiftly when the blame for the defect may be attributable to external processes such as manufacturing (which typically is outsourced and offshored in the toy industry), thereby attempting to reduce the reputational damage by riding on consumer impressions that overseas manufacturers are mainly responsible for product defects (Carvalho et al., 2015).

Finally, our findings on the effect of product price and hazard severity in time to recall decisions may need to be viewed with caution, since our overall finding on this relationship is only of marginal statistical significance. Supplementary results, however, reveal an interesting insight that shows the effect of product price on time to recall is statistically significant only when the recalled product is associated with incidents of product failures with potential harm, and not with injuries or deaths. This insight suggests that under high hazard severity conditions, firms might deliberate the timing of recall contingent on whether the product defect posed (or

poses) a safety hazard that can be associated with only incidents that do not involve death and injuries. In the case of such relatively minor incidents, to avoid high direct costs, firms may like to investigate the cause of recall of high-priced products before issuing one. This is perhaps because minor incidents could be due to defects in the product or misuse by the consumer, and the uncertainty in the cause may make firms less motivated to execute a quick recall but investigate more carefully before issuing a recall. Since our finding on deaths and injuries was not significant, future research may need to examine in more detail the nuanced effects of product price on time to recall under hazard severity conditions of injuries and deaths.

Further, although product price has a direct bearing on costs of recall and subsequent profitability, this may also need to be examined in conjunction with the quantity of the products recalled. Our robustness tests, as mentioned earlier, suggest that while a higher value (quantity recalled times unit price) for the recall increased time to recall significantly, hazard severity did not moderate this relationship. We believe this insight provides an opportunity for future research to study this effect in more depth to further develop and analyze this finding. Overall, our findings suggest that recall timing decisions by firms are nuanced, and that firm recall experience, type of defect, and product price influence time to recall decisions differently for varying levels of hazard severity in the toy industry.

It may also be noted that our findings on the effect of hazard severity on time to recall extend the work of Eilert et al. (2017) and point to potential industry effects. In the case of recall experience, while in the auto industry it was found that time to recall is shorter when recall experience is high for high hazard severity recalls, our finding from the toy industry was the opposite. This may be due to the differences between the toy and auto industries. The toy industry consists of small private firms where resource constraints in the event of a severe recall

may be a major deterrent in effecting a quick recall. Besides, since toys are high in credence qualities (Darby & Karni, 1973), firms may be less motivated to issue a quick recall in the case of high hazard severity for fear of quickly losing customers (parents) in the toy market, which is highly seasonal. The nature of branding in the industry may also be a potential reason why results differ. While the auto industry is driven by flagship brands, the toy industry is driven by house-of-brands approach where the latter comprises multiple lines of toys under one umbrella brand. Extant research on branding suggests that flagship brands are less vulnerable to brand dilution than parent brands in general (John, Loken, & Joiner, 1998). With increasing hazard severity, the potential damage to umbrella brands could be larger compared to flagship brands, and hence could lead to a longer time to recall for firms with high recall experience in the toy industry. Future research may examine brand implications through comparative studies between the auto and the toy industries to generate new insights on this phenomenon. Finally, our result may also be different from Eilert et al. (2017) because they operationalized time to recall and experience differently. For example, they operationalized time to recall as the time elapsed between the opening of an investigation and time of recall announcement, data for which is available in auto recalls but not for toy recalls. Further, they operationalized recall experience (which they termed as past recall intensity) as the total number of vehicles recalled by the brand in the previous year. In contrast, our operationalization of recall experience variable takes a longer time period into account and is in line with the operationalization of experience in other studies of recalls (e.g., Haunschild & Rhee, 2004).

Our findings have important implications for practice and policy. The type of hazards and the related factors for which firms act promptly to recall can inform product-safety regulators charged with consumer safety. Specifically, regulators can help by developing appropriate

guidelines to identify whether a product hazard occurred due to a design defect or a manufacturing defect and asking firms to self-report the same, and by requiring firms to report their past recalls when reporting issues with a product. Imposing stricter fines on experienced firms that take longer to issue a recall may also be an option to ensure swifter recalls by these firms.

5.1.Limitations and Future Research

The contributions of our findings should be understood within the context of the following limitations. First, this study dealt specifically with consumer products in the toy industry; thus, its generalizability must be ascertained in comparison with research in other industries. Since business models, product complexity, and safety standards vary across industries, firm behavior in crisis situations may need to be studied in the context of industry and more specifically with reference to its value chain. Second, external agencies such as regulators and media can influence time to recall (Siomkos, 1989). Future research could examine the role of external agencies by differentiating between voluntary and involuntary recalls (Hanschild & Rhee, 2004). Third, we operationalized time to recall as the number of days that the product has been on the market, as a proxy for the time to recall (Hora et al., 2011). While it would have been more appropriate to use the date when the firm learned of the defect in its product, this information is not publicly available for the toy industry. Exploratory and in-depth case studies to address this limitation might complement our current study. Fourth, from an operational point of view, recalls of high hazard severity may need to be properly investigated and reasons/responsibilities assigned before a formal recall is issued (Wowak et al., 2021). This would call for optimal response times that may need to be developed for firm recall responses. Future research may need to, through exploratory studies, develop an understanding of this optimal response time that

would help both scholars and practitioners alike. Finally, research has shown that firms with managers as shareholders (in S&P 500 companies) are less likely to experience a product-harm crisis (Kashmiri & Brower, 2016); the presence of female board directors (in the food industry) influences time to recall decisions (Wowak et al., 2021). Future research may consider the role of hazard severity and the effects of ownership structure on time to recall in the toy industry.

References

- Bapuji, H., & Beamish, P. W. (2019). Impacting practice through IB scholarship: Toy recalls and the product safety crisis. *Journal of International Business Studies*, 1-8.
- Baumard, P., & Starbuck, W. H. (2005). Learning from failures: Why it may not happen. *Long Range Planning*, 38(3), 281-298.
- Beamish, P., & Bapuji, H. (2008). Toy recalls and China: Emotion vs. evidence. *Management and Organization Review*, 4(2), 197-209.
- Bundy, J., Pfarrer, M. D., Short, C. E., & Coombs, W. T. (2017). Crises and crisis management: Integration, interpretation, and research development. *Journal of management*, 43(6), 1661-1692.
- Carvalho, S., Muralidharan, E., & Bapuji, H. (2015). Corporate Social ‘Irresponsibility’: Are Consumers’ Biases in Attribution of Blame Helping Companies in Product-Harm Crises Involving Hybrid Products? *Journal of Business Ethics*, 130(3), 651-663.
- Chen, Y., Ganesan, S., & Liu, Y. (2009). Does a firm's product-recall strategy affect its financial value? An examination of strategic alternatives during product-harm crises. *Journal of Marketing*, 73(6), 214-226.
- Chen, M-J., & Hambrick, D.C. (1995). Speed, Stealth, and Selective Attack: How Small Firms Differ from Large Firms in Competitive Behavior. *Academy of Management Journal*, 38(2), 453-82.
- Christensen, S. L., & Kohls, J. (2003). Ethical decision making in times of organizational crisis: A framework for analysis. *Business & Society*, 42(3), 328-358.
- Claeys, A. S., & Cauberghe, V. (2014). What makes crisis response strategies work? The impact of crisis involvement and message framing. *Journal of Business Research*, 67(2), 182-189.
- Cyert, R.M., & March, J.G. (1992). *A Behavioral Theory of the Firm*, 2nd ed. Englewood Cliffs, NJ: Wiley-Blackwell.
- Darby, M. R., & Karni, E. (1973). Free competition and the optimal amount of fraud. *The Journal of law and economics*, 16(1), 67-88.
- Davidson, W.N., & Worrell, D.L. (1992). The Effect of Product Recall Announcements on Shareholder Wealth. *Strategic Management Journal*, 13(6), 467-473.
- Dawar, N., & Lei, J. (2009). Brand crises: The roles of brand familiarity and crisis relevance in determining the impact on brand evaluations. *Journal of Business Research*, 62(4), 509-516.
- Dutta, S., & Pullig, C. (2011). Effectiveness of corporate responses to brand crises: The role of crisis type and response strategies. *Journal of Business Research*, 64(12), 1281-1287.

- Eilert, M., Jayachandran, S., Kalaighnam, K., & Swartz, T. A. (2017). Does it pay to recall your product early? An empirical investigation in the automobile industry. *Journal of Marketing*, 81(3), 111-129.
- Hartman, R.S. (1987). Product quality & Market efficiency: The effect of product recalls on resale prices and firm valuation. *Review of Economics and Statistics*, 69 (2), 367-372.
- Haunschild, P.R., & Rhee, M. (2004). The role of volition in organizational learning: The case of automotive product recalls. *Management Science*, 50(11), 1545–1560.
- Hora, M., Bapuji, H., & Roth, A. (2011). Safety hazard and time to recall: The role of recall strategy, product defect type, and supply chain player in the U.S. toy industry. *Journal of Operations Management*, 29(7/8), 766-777.
- Jayaraman, V., Patterson, R.A., & Rolland. R. (2003). The Design of Reverse Distribution Networks: Models and Solution Procedures. *European Journal of Operational Research*, 150 (1), 128–49.
- John, D. R., Loken, B., & Joiner, C. (1998). The negative impact of extensions: can flagship products be diluted? *Journal of Marketing*, 62(1), 19-32.
- Kashmiri, S., & Brower, J. (2016). Oops! I did it again: Effect of corporate governance and top management team characteristics on the likelihood of product-harm crises. *Journal of Business Research*, 69(2), 621-630.
- Kavilanj, P. (2010). Tylenol recall: FDA slams company. CNN. Available at http://money.cnn.com/2010/01/15/news/companies/over_the_counter_medicine_recall/. Accessed on November 27, 2015.
- Laufer, D., Gillespie, K., McBride, B., & Gonzalez.S. (2005). The role of severity in consumer attributions of blame: Defensive attributions in product-harm crisis in Mexico. *Journal of International Consumer Marketing*, 17(2/3), 33-50.
- Liu, A. X., Liu, Y., & Luo, T. (2016). What drives a firm's choice of product recall remedy? The impact of remedy cost, product hazard, and the CEO. *Journal of Marketing*, 80(3), 79-95.
- MacKenzie, E. J., Shapiro, S., & Eastham, J. N. (1985). The Abbreviated Injury Scale and Injury Severity Score: levels of inter-and intrarater reliability. *Medical care*, 823-835.
- Majid, K.A., & Bapuji, H. (2018). Institutional differences and integration difficulties: how location of headquarters and component sourcing affect firm responsiveness. *International Marketing Review*, 35(5), 850-868.
- Muralidharan, E., Bapuji, H., & Hora, M. (2019). The More I Err, the Less I Pay: Effect of Firm Recall Experience and Recall Severity on Remedy to Consumers. *European Journal of Marketing*, 53(5), 916-943.
- Muralidharan, E., Bapuji, H., & Laplume, A. (2015). Influence of institutional profiles on time to recall. *Management Research Review*, 38(6), 605-626.
- Neter, J., Kutner, M. H., Nachtsheim, C. J., & Wasserman, W. (1996) *Applied Linear Statistical Models*. (4th ed.). New York: McGraw-Hill.
- Ni, J., Flynn, B. B., & Jacobs, F. R. (2016). The effect of a toy industry product recall announcement on shareholder wealth. *International Journal of Production Research*, 54(18), 5404-5415.
- Ni, J., & Huang, X. (2017). Discovery-to-recall in the automotive industry: a problem-solving perspective on investigation of quality failures. *Journal of Supply Chain Management*, 54(2), 71-95.
- Noggle, R., & Palmer, D. E. (2005). Radials, rollovers and responsibility: An examination of the Ford-Firestone case. *Journal of Business Ethics*, 56(2), 185-204.

- Pearson, C.M., & Clair, J.A. 1998. Reframing Crisis Management. *Academy of Management Review*, 23(1): 59-76.
- Reilly, R.J., & Hoffer, G.E. (1983). Will retarding the information flow on automobile recalls affect consumer demand? *Economic Inquiry*, 21(3), 444-447.
- Rhee, M., & Haunschild, P.R. (2006). The Liability of a Good Reputation: A Study of Product Recalls in the U.S. Automotive Industry. *Organization Science*, 17 (1), 101–17.
- Roschk, H., & Gelbrich, K. (2014). Identifying appropriate compensation types for service failures: A meta-analytic and experimental analysis. *Journal of Service Research*, 17(2), 195-211.
- Shah, R., Ball, G. P., & Netessine, S. (2017). Plant operations and product recalls in the automotive industry: An empirical investigation. *Management Science*, 63(8), 2439-2459.
- Siomkos, G.J. (1989). Managing product-harm crises. *Industrial Crisis Quarterly*, 3(1), 41 60.
- Snyder, P., Hall, M., Robertson, J., Jasinski, T., & Miller, J. S. (2006). Ethical rationality: A strategic approach to organizational crisis. *Journal of Business Ethics*, 63(4), 371-383.
- Thirumalai, S., & Sinha, K. K. (2011). Product recalls in the medical device industry: An empirical exploration of the sources and financial consequences. *Management Science*, 57(2), 376-392.
- Thomsen, M.R., & McKenzie, A.M. (2001). Market Incentives for Safe Foods: An Examination of Shareholder Losses from Meat and Poultry Recalls. *American Journal of Agricultural Economics*, 83 (3), 526-538.
- Tiwari, S. (2019). Why do Firms Delay Recalls? The Effects of Firm Type and Country of Origin. *Presented at the Annual Conference of the Administrative Sciences Association of Canada*. St. Catharines, Canada.
- Ulrich, K.T., & Ellison, D.J. (2005). Beyond make-buy: Internalization and integration of design and production. *Production and Operations Management*, 14(3), 315–331.
- Vassilikopoulou, A., Lepetsos, A., Siomkos, G., & Chatzipanagiotou, K. (2009). The importance of factors influencing product-harm crisis management across different crisis extent levels: A conjoint analysis. *Journal of Targeting, Measurement and Analysis for Marketing*, 17(1), 65-74.
- Wood, L. C., Wang, J. X., Olesen, K., & Reiners, T. (2017). The effect of slack, diversification, and time to recall on stock market reaction to toy recalls. *International Journal of Production Economics*, 193, 244-258.
- Wong, C. Y., Arlbjørn, J. S., & Johansen, J. (2005). Supply chain management practices in toy supply chains. *Supply Chain Management: An International Journal*, 10(5), 367-378.
- Wowak, K. D., Ball, G. P., Post, C., & Ketchen Jr, D. J. (2021). The influence of female directors on product recall decisions. *Manufacturing & Service Operations Management*, 23(4), 895-913.

Table 1: Descriptive Statistics

No		Mean	SD	1	2	3	4	5	6	7	8	9	10
1	Time to recall ^a	6.08	0.94	1									
2	No of Units ^a	9.58	2.22	0.25**	1								
3	Average Price ^a	2.48	1.21	-0.01	-0.06	1							
4	SC Player-Company	0.40	0.49	0.07*	0.17**	0.39**	1						
5	SC Player-Distributor	0.36	0.48	0.05	-0.09*	-0.34**	-0.61**	1					
6	Public Company	0.32	0.47	-0.06	0.26**	0.05	0.05	-0.33**	1				
7	Made in China	0.74	0.44	-0.15**	0.09**	-0.09*	-0.04	0.01	0.08*	1			
8	Severity	0.40	0.49	0.06	0.33**	0.36**	0.31**	-0.23**	0.13**	0.10**	1		
9	Recall Experience	1.05	2.18	0.06	0.20**	0.06	0.21**	-0.24**	0.35**	-0.00	0.17**	1	
10	Defect Type-Design	0.70	0.46	0.20**	0.14**	-0.08*	0.03	-0.04	-0.00	-0.07	0.16**	0.04	1

a) N=833 observations. ** Correlation significant at 0.01 level (2-tailed). * Correlation significant at 0.05 level (2-tailed)

b) ^a These variables are transformed using a natural log transformation.

c) “SC Player-Company”, “SC Player-Distributor”, “Public Company”, and “Made in China” are dummy variables that take the value of one when true, and zero otherwise.

Table 2: Results from OLS Regression for Time to recall

Variables	Model-1	Model-2	Model-3
Observations	833	833	833
Constant	4.92*** (0.19)	4.75*** (0.22)	4.96*** (0.23)
No of Units ^a	0.12*** (0.02)	0.12*** (0.02)	0.12*** (0.02)
SC Player-Company	0.16 [†] (0.09)	0.15 [†] (0.09)	0.10 (0.09)
SC Player- Distributor	0.16 [†] (0.09)	0.20* (0.09)	0.14 (0.09)
Public Company	-0.17* (0.08)	-0.18* (0.08)	-0.19* (0.08)
China	-0.29*** (0.08)	-0.27** (0.08)	-0.27** (0.08)
Recall Experience		0.01 (0.02)	-0.05* (0.02)
Defect Type-Design		0.30*** (0.07)	0.10 (0.09)
Average Price ^a		0.04 (0.03)	-0.01 (0.04)
Severity		-0.09 (0.08)	-0.85*** (0.22)
Severity X Experience (H1)			0.10** (0.03)
Severity X Design (H2)			0.51** (0.15)
Severity X Price (H3)			0.11 [†] (0.06)
R ²	0.171	0.189	0.215
Change in R ²		0.018	0.026

Note: Standard Errors in parentheses

Dependent Variable = Time to recall

^a These variables are transformed using natural log transformations

Year dummies have been added in all the models

[†]p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001

Table 3: Supplementary Results

	All Recalls	No Incidents, Injuries, or Deaths	Incidents, Deaths, & Injuries	Only Incidents, no Deaths & Injuries	Deaths & Injuries
Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Observations	833	499	334	212	122
Constant	4.82*** (0.21)	5.14*** (0.28)	4.27*** (0.39)	4.05*** (0.53)	4.23*** (0.72)
Number of Units ^a	0.11*** (0.02)	0.11*** (0.02)	0.14*** (0.03)	0.18*** (0.04)	0.11* (0.05)
SC Player-Company	0.14 (0.09)	-0.02 (0.12)	0.07 (0.14)	0.20 (0.16)	-0.06 (0.31)
SC Player-Distributor	0.19* (0.09)	0.20 [†] (0.11)	-0.10 (0.16)	-0.11 (0.19)	-0.22 (0.32)
Public Company	-0.19* (0.08)	-0.16 (0.11)	-0.24* (0.11)	-0.01 (0.15)	-0.73** (0.20)
China	-0.28*** (0.08)	-0.24* (0.10)	-0.30* (0.13)	-0.48** (0.17)	-0.13 (0.21)
Recall Experience	0.01 (0.02)	-0.05* (0.02)	0.04 [†] (0.02)	0.02 (0.03)	0.09* (0.04)
Defect Type-Design	0.28*** (0.07)	0.17 [†] (0.10)	0.61*** (0.12)	0.60*** (0.15)	0.55* (0.22)
Average Price ^a	0.03 (0.03)	0.02 (0.04)	0.08 [†] (0.05)	0.13* (0.06)	0.11 (0.08)
R ²	0.188	0.230	0.322	0.394	0.456

Note: Standard Errors in parentheses

Dependent Variable = Time to recall

^a These variables are transformed using natural log transformations

Year dummies have been added in all the models

[†]p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001

Figure 1: Recall Experience and Time to Recall – Role of Hazard Severity

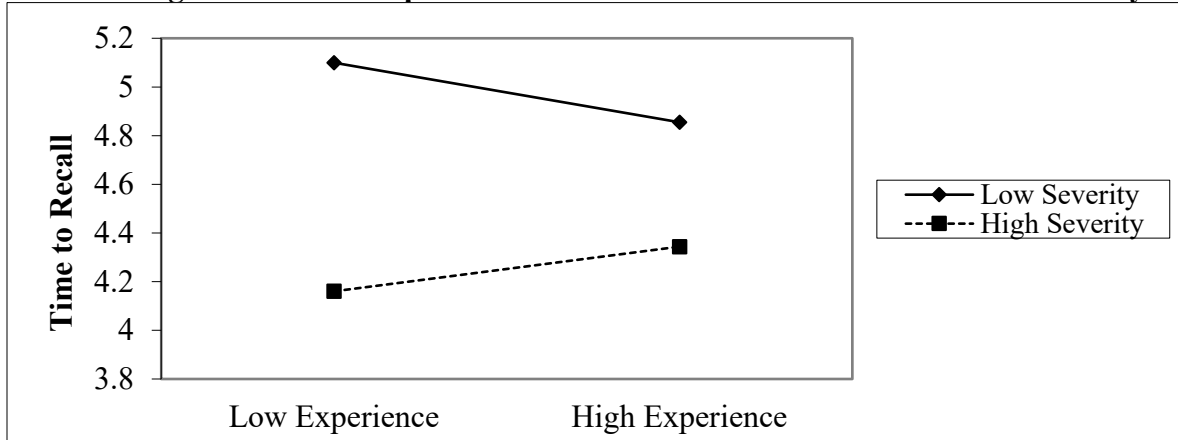


Figure 2: Defect Type and Time to Recall- Role of Hazard Severity

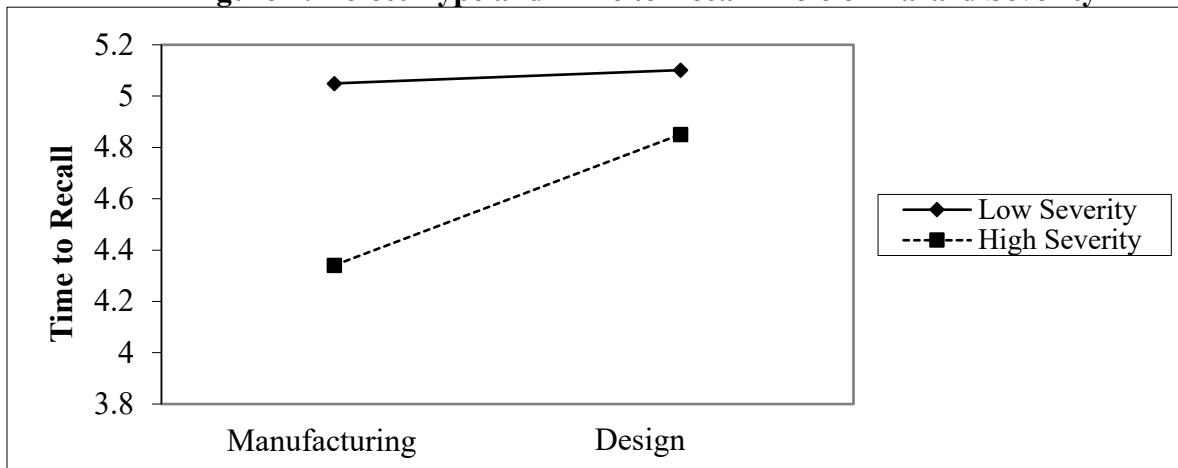


Figure 3: Product Price and Time to Recall- Role of Hazard Severity

