Original Article

Measuring the short-term spillover impact of a product recall on a brand ecosystem

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ABSTRACT This research examines the short-term impact of a product recall on a brand ecosystem by investigating the following questions: How do product recall spillover effects spread to (i) the recalled brand's related product categories, (ii) competing brands, and (iii) private label brands? Studying the 2003 Land O'Lakes butter recall case using a difference-in-differences model, our research shows that negative spillovers occur within the same brand family, carry over to private label brands and then quickly dissipate, but do not carry over to competitor brands. Managerial implications and directions for future research are provided.

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INTRODUCTION

Product recalls can create treacherous environments for executives and managers. Recalls may have an immediate negative impact on the company's sales, profits and stock price – and can destroy a company's reputation (Sullivan, 1990; Siomkos and Kurzbard, 1994; Dawar and Pillutla, 2000; Laufer and Coombs, 2006; Rhee and Haunschild, 2006; van Heerde *et al*, 2007; Chen *et al*, 2009). Managers facing product recalls are forced to make difficult decisions

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on short notice with limited and sometimes sketchy information. Furthermore, given the growing proliferation and increasing complexity of products, recalls are becoming more and more common (Cleeren *et al*, 2013). As a result, managing product recalls is becoming an increasingly important issue (Souiden and Pons, 2009).

Product recalls affect thousands of products and millions of consumers each year. In the United States alone, consumer goods are recalled at an average rate of 6.5 products per day (Doering, 2012). These recalls touch many industries: from automobiles and pet foods to riding mowers, baby slides and video games. Some recalls are high profile and affect entire categories (for example, egg recalls) while others only affect individual brands (for example, the Fisher Price toy recall, Birchall, 2010). Recalls may range in severity from alleged consumer deaths (for example, Toyota car recall, Simon, 2010) to minor labeling typos, and vary in size from large recalls (for example, the 1.1 million Toyota automobiles recalled for acceleration problems, Simon, 2010) to smaller recalls (for example, 500 cases of Jelly Bean brand, Foodpoisoning.com). However, it is worth noting that, for every product recall, there are dozens of related brands and products that could be affected. Therefore, looking at the impact of recalls on a broader ecosystem can be even more important for a firm than simply focusing on the brand related to the product recall itself.

For this reason, the concept of a *brand ecosystem* is introduced. We will conceptualize a brand ecosystem as an environment consisting of all brands that could potentially impact and interact with each other in a competitive space. Thus, a brand ecosystem, as it relates to a product recall includes the following: (i) the recalled product itself, (ii) the non-recalled products bearing the same brand name as the recalled product, (iii) competing brands in the same category or competitive space as the recalled product, (iv) private label brands in the same category or competitive space as the recalled product and (v) the ingredient brand[1] associated with the recalled product. Figure 1 illustrates the components of a brand ecosystem.

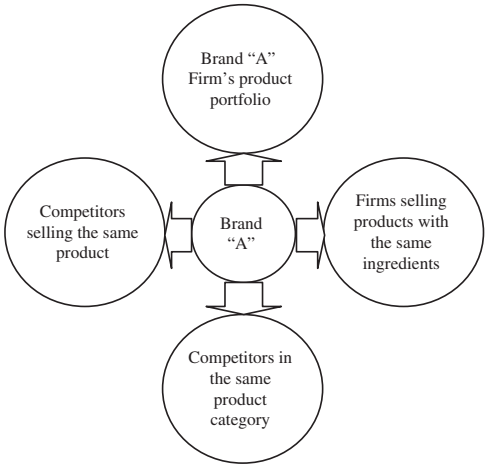

Figure 1: Illustration of a brand ecosystem.

Despite the growth in importance of managing and measuring the impact of product recalls, little academic research has been conducted regarding the spillover effects from a product recall and only a handful of studies have been conducted on a recall's impact on the broader ecosystem. There are good reasons for this, mostly having to do with access and analysis of data. Typically, a company experiencing a product recall will allow researchers access to a subset of the data, allowing them to analyze the product recall and its impact on the core brand. Accessing data on all potentially affected brands is a significantly more difficult task, which requires a large dataset and more advanced modeling tools. However, given the potential importance of the issue, and the growing amount of data available to both managers and researchers, it is arguably worth dealing with the extra complexities as illustrated by the pioneers who successfully studied the field.

  1350-231X **Journal of Brand Management** Vol. 22, 4, 323–339

Thus, the purpose of this research is to propose an approach to measure the short-term impact of a product recall not only on the core brand, but also on the broader brand ecosystem. Such a line of inquiry raises the following questions: How far do spillover effects spread to the brand's related product categories, competing brands, and private label brands? How immediate are these spillovers?

To answer these questions, the present research studied the impact of a Land O'Lakes butter recall on a brand ecosystem during an 8-week period (a 4-week pre-recall period plus a 4-week post-recall period). Through four models, the results show that negative spillovers: (i) occur within the same brand family; (ii) carry over to private label brands and then quickly dissipate; (iii) do not carry over to competitor brands. Additional analyzes were also conducted looking at the negative spillover effects over the weeks immediately following the recall. The findings obtained using the difference-in-differences (DD) approach support the Similarity theory and provide limited support the Dominance theory.

The remaining parts of this article are divided as follows. First, a literature review decorticates empirical results related to the current questions, and describes two theories: the Similarity Theory and the Dominance Theory. Next, the dataset and DD modeling approach are described. Thereafter, main findings are discussed. Finally, the managerial implications, limitations of the study, and directions for future research are provided.

LITERATURE REVIEW

Formally speaking, spillover effects arise when information and perceptions influence beliefs that are not tied to the original information source or perception object (Ahluwalia *et al*, 2001). In simple terms, if something happens to one brand and it affects another, it is a spillover effect.

The impact of spillover effects

Several researchers have examined and documented the impact of spillover effects on brands. Through experiments, John *et al* (1998) showed the dilution of an extension with respect to the parent brand. Using facial tissues and shampoo as stimuli, John *et al* showed that low 'gentleness' and poor 'quality' associations of an extension can dilute consumers' beliefs about a parent brand. Simonin and Ruth (1998) demonstrated that spillovers from brand alliances (that is, co-branding or ingredient branding) can modify attitudes toward partnering brands. Using advertising experiments, Ahluwalia *et al* (2001) showed that spillover effects can occur from one brand attribute to another. For example, in one experiment, consumers' beliefs about the shock absorption attribute of a new running shoe brand were measured after consumers received a booklet containing information about a fake athletic shoe brand. The researchers found that the consumers' beliefs about the shock absorption changed based on information that was not directly related to shock absorption. In a study involving scanner panel data, Balachander and Ghose (2003) found that the advertising of a brand extension can leak over to the parent brand. Taken together, these studies demonstrate the very real nature of spillover effects.

The impact of negative spillovers

Negative spillovers have also received some special attention – particularly from researchers interested in product harm crises. In this stream of research, however, there is little consensus concerning the spillover impacts on the components of the brand ecosystem. Focusing on negative spillovers, Sullivan (1990) analyzed the spillover effects

from a product harm crisis in the car industry and found that after the Audi 5000 automobile had sudden acceleration problems causing drivers' deaths, other Audi models suffered declines in sales whereas its nearest competitor, Mercedes Benz, did not. Sullivan concluded that negative spillovers affect other brands within a family, but do not spill over to competitors. Other researchers disagreed with these results. For instance, Roehm and Tybout (2006) found, in a study of fast food restaurants, that consumers' negative perceptions of one brand can and do spill over to their competitors. They showed how a failure by Burger King carried over to McDonald's (but not to Dairy Queen). Furthermore, van Heerde *et al* (2007) argued that not only do spillovers affect competitors, but a competitor can actually benefit from a poorly run product recall. They conducted a study on the impact of a product recall of Kraft brands (Kraft and Eta) because of salmonella poisoning. In the first 4 weeks after the 5-month long crisis, they found that sales of one of the Kraft brands went down 59 per cent relative to the final 4 weeks before the crisis, while the competitor's brand (Sanitorium) tripled their sales during the same time period, partly because of an aggressive advertising campaign run by Sanitorium during the recall period. A more recent study from Siomkos *et al* (2010) is at odds with the van Heerde *et al* findings. Looking at opportunities and threats for brands in an ecosystem where one brand is experiencing a product harm crisis, Siomkos *et al* posited that consumers should not be receptive to buying competitor brands, especially when the crisis has higher severity and the company involved in the crisis has a strong reputation. Siomkos *et al* also argued that if a well-regarded company has a minor transgression there should not be opportunities for competitors to capitalize on the event.

Still other researchers have suggested that negative spillovers can corrode an entire category. Studying the world's largest product-harm crisis where melamine contaminated milk products caused six deaths and 296 000 children to fall ill, Gao *et al* (2012) surveyed a large sample of Chinese consumers to assess their attitudes and beliefs toward the contaminated and non-contaminated brands and manufacturers. Their 'real life experiment' showed how a food safety scandal negatively spilled over throughout the entire supply chain. Taking a longer-term perspective, Seo *et al* (2014) performed an event study relating stock market performance to negative spillovers in the restaurant industry. Their study researched the Jack in the Box E.coli scare and 73 other unrelated food crises. A key finding from their work is that negative spillovers can linger from past industry crisis events, thereby affecting a current crisis. The authors concluded that the degree of negative contagion among brands in an ecosystem is a function of the presence of a recall (and, relatedly, the duration between the product-harm event and the recall) and similarity among the brands in the ecosystem. Their findings support those from Darke *et al* (2010) who showed that distrust of a brand can extend even to unrelated products/companies. By looking at distrust as a byproduct of negative expectancy disconfirmation, Darke *et al* (2010) concluded that there is a strong negativity bias in spillover effects.

Finally, some of the most recent work has shed light on product harm recovery. Seo *et al* (2013) asserted that the impact of product harm is most acute in the first 2 days following the event, but recovery can occur within a year. In other research, after studying the interactions among marketing mix variables, the extent of negative publicity and the acknowledgment of product harm blame, Cleeren *et al* (2013) concluded that what may be good for the transgressing brand may not be good for the category and *vice-versa*. Indeed, the collection of these works strongly

suggests that negative spillovers within an ecosystem are complicated and intricate.

Clearly, some theoretical frameworks are needed to explain these findings. Why do some recalls harm competing brands, while others do not? What determines which brands, within and without the affected brand family, will be affected? At a more basic level, do recalls of one product cause an upswing or a downswing in competing brands? The Similarity theory and Dominance theory provide some predictive direction.

Similarity theory

The Similarity theory stipulates that spillovers are most likely to occur among brands that are perceived as similar, and least likely to occur among brands that are perceived as different. The underlying idea is that brands that are perceived as closely related (for example, brands from the same family or direct competitors) have many similarities or shared associations for the consumer, and if a brand association is damaged, then the brands sharing this association will suffer collateral damage (Herr, 1989; Dahlén and Lange, 2006; Roehm and Tybout, 2006). For instance, Janakiraman *et al* (2009), looked at attributes (a particular type of association) and found that negative spillover to a competing brand is more likely to occur when the transgressing brand is similar to the competitor in terms of the particular attribute.

The Similarity theory is intuitive and consistent with other theories including Feldman and Lynch's (1988) accessibility-diagnosticity model. This model claims that if a consumer believes that information about the failing brand contains information (a diagnostic toward) relevant to a competing brand, the consumer will generally use his perceptions of Brand A's quality to help infer the quality of Product B. In other words, the stronger the similar associations are between the two brands, products, or categories, the more powerful the 'contamination.' Alternatively, if the contrast between the two brands' associations is significant enough, then spillovers should be reduced (Lei *et al*, 2008). This theory may partly explain why Sanitorium's sales rose in the study by van Heerde *et al* (2007).

Dominance theory

The Dominance theory argues that spillovers between two brands are asymmetrical in nature. More specifically, if a dominant brand receives negative news, it will cast a negative shadow over the entire category (Lei *et al*, 2008). This theory is grounded in the 'contrast model of similarity' developed by Tversky (1977) and Tversky and Gati (1978). This theory suggests that a dominant brand has many strong, unique associations and prototypical features, and that consequently a problem with a dominant brand will impact weaker brands in this 'association matrix,' but a problem with a weaker brand will not affect enough associations to impact the more dominant brand. Using this theory, if Coke has more distinctive associations than RC Cola, for example, consumers will perceive the similarity of RC Cola to Coke less than the similarity of Coke to RC Cola. As a result, Coke should not receive proportionally as many spillover effects from a RC transgression as RC would receive from a Coke transgression (Lei *et al*, 2008). Under this theory, dominance is the key determinant for whether or not spillover takes place, and the directionality of that spillover.

Up to now, very little research has linked these theories to product recalls. In fact, only a handful of studies use real-market data to examine the spillover effects on product recalls (see Sullivan, 1990; Rhee and Haunschild, 2006; van Heerde *et al*, 2007; Chen *et al*, 2009;

Cleeren *et al*, 2013; Seo *et al*, 2014). Still fewer studies employ sales data in their research and none of them take these theories into account. As such, this is an area where the present research makes a contribution.

DATA, PRODUCT RECALL DESCRIPTION AND MODELING APPROACH

In order to tackle the research questions, a large IRI Marketing dataset, which was made available by Bronnenberg *et al* (2008), was accessed. The entire data set contains store-level weekly sales over a 5-year period (2001–2005) for 30 product categories, collected from grocery stores, drug stores and large merchandisers in 47 of the United States.

Land O'Lakes product recall

A Land O'Lakes butter recall provides an excellent case to investigate short-term spillovers because of a product recall. On Sunday 27 July 2003, Land O'Lakes, America's leading producer of butter, margarine, vegetable spreads, milks and other dairy products, issued a voluntary recall of its 1-pound packages of Land O'Lakes brand salted butter sticks (for more details see the PR Newswire press release in Appendix A). The recall was issued because the sticks of butter may have contained small fragments of metal. This butter recall affected 3500 cases of 48 units (126 525 consumer units) in 22 states (see Appendix B) and because of the recall's size and prominence of its national brand, Land O'Lakes received widespread media attention from national news media (for example, *USA Today*), regional media (for example, *Chicago Tribune*) and other popular websites.

Description of the data set adaptation

Because this research is focused on spillover effects on the brand ecosystem, all brands (including private label) of margarines, butter blends (which form a distinct category from 'butter'), vegetable spreads, and sprays were extracted for analysis. This gives us the opportunity to study spillover effects from the Land O'Lakes butter recall on related categories. The presence of private label and other strong national brands (for example, Parkay, Blue Bonnet, I Can't Believe It's Not Butter) that compete head-to-head with Land O'Lakes makes this product recall case study an appealing one to investigate. It is also important to recognize that the Land O'Lakes recall is a best-case scenario of a recall. There were no reports of injuries, illnesses, or deaths associated with the consumption of the recalled product, and Land O'Lakes appears to have executed its recall successfully. No criticisms of the company's handling of the recall were found during an extensive online search, and Land O'Lakes seems to have effectively involved the US Food and Drug Administration (FDA) and retailers in its recall recovery plans. Furthermore, while the butter recall had been issued, there is no evidence that availability of Land O'Lakes butters, margarines, and spreads was affected. Any spillover effect that occurs here will be occurring under the best possible case of negative news.

As this study is only looking at the short-term impacts of the spillover, and consistent with the short-term evaluation of sales fluctuations by van Heerde *et al* (2007), 8 weeks of data were used: 4 weeks representing the pre-recall period (from 30 June 2003 to 27 July 2003), and a 4-week period of data representing the post-recall period (from 28 July 2003 to 24 August 2003). The product recall affected 22 states (see Appendix B), and four US cities (Boston, Chicago, Los Angeles and Minneapolis) were selected

  1350-231X **Journal of Brand Management** Vol. 22, 4, 323–339

for the analysis. Two cities, Chicago and Minneapolis, represent recall cities while the two other cities, Los Angeles and Boston, represent non-recall cities. These cities were carefully selected. All are large, progressive cities with diverse populations living in metropolitan areas, and have large university bases. Chicago was chosen as a treatment because regional press (for example, *Chicago Tribune*) carried the story which would help accentuate a finding. Minneapolis was chosen because Land O'Lakes is based in Minnesota, and a news event involving one of the largest employers in the state would be more likely to capture regional media attention. It is important to point out that national news media carried information about this product recall so that all markets were subjected to the recall information – but some likely received more of it.

Land O' Lakes and the similarity model

The Similarity theory would suggest that as margarine and butter are closely related, a recall of Land O'Lakes butter would result in a decrease in sales of Land O' Lakes margarine. Why? While margarine is not butter and has several different associations than butter (having lower fat content, and being an artificial substitute for 'natural' butter, for example), most anecdotal evidence suggests that the similarity between butter and margarine is greater than the contrast between these two categories: retailers place butter and margarine next to one another, for example, while brand names like 'I Can't Believe It's Not Butter brand margarine' explicitly promote similar associations between margarine and butter, and both products are offered in the same size stick and tub formats. Taken as a whole, the similar shared associations between the two categories are likely to be stronger than the differentiating category points. As such, the Similarity theory suggests that there is likely to be spillover from the butter to margarine categories.

At the level of the brand, products from the same brand should be perceived as more similar than products from different brands. Land O'Lakes margarine shares the same brand name, logo, packaging scheme, in-store displays and manufacturing facilities as its butter counterpart. As such, Land O'Lakes should incur more spillover effects from the butter recall than its Parkay, Blue Bonnet, I Can't Believe It's Not Butter, Parmalat and private label competitors. So if the Similarity theory holds in this case, a Land O'Lakes butter recall should result in a significant negative impact on Land O'Lakes margarine, but have far less of an effect on the competitors' margarine sales.

Land O' Lakes and the dominance theory

Land O'Lakes is America's #1 brand of butter according to the company's website[2], with 'a 99 per cent awareness-to-familiarity ratio indicating that consumers not only have awareness, but a good understanding of what the brand offers them'.[3] The brand is one of only a few national butter/margarine brands, and is as iconic of butter and margarine as Porsche is of sports cars. Land O'Lakes' recall should predictably cast a shadow over its competitors' brands, and cause their overall sales to drop. In fact, Dominance theory can make even more nuanced predictions, as it can apply to both branded and private label competitors. For example, since the strongest competitor brands (Blue Bonnet, Parkay, I Can't Believe It's Not Butter) will have more prominent and unique associations that could shield them from the brunt of the impact, the branded competitors will be less likely to experience negative spillovers from the Land O'Lakes recall than the private label brands.

The difference-in-differences approach

To investigate the spillover effect from brand-to-brand and category-to-category using pre-recall and post-recall data, the difference-in-differences (DD) approach was selected. The DD approach has been used extensively in economics to model changes to examine before-and-after patterns (see Meyer, 1995 for a discussion on the DD use in economics as a quasi-experiment method). The approach gained prominence in economics research when Card and Krueger (1994) used DD to model minimum wage disparities because of state-specific regulations. Davis (2005) adopted DD for his analysis of how housing prices were affected by the detection of cancer clusters. In marketing, the DD has been employed by Danaher *et al* (2010, 2013) who gauged the impact of NBC's decision to remove its content from iTunes using a DD model. Danaher *et al* (2013) advocated for the DD model using the following explanation:

> To establish causation in such an environment, economists and social scientists often use a difference-in-differences strategy. The basic idea of a diff-in-diff approach is to identify a "control" group of individuals, regions, or products that can aid in estimating the counterfactual of what would have happened to the "treated" group if the treatment had not happened. (p. 2)

For our research, the DD model suggests that sales measured by sales unit in a recall city will be affected by the recall, while sales in a non recall city will not be affected by the recall. In the DD model, the difference between pre-recall sales and post-recall sales in a recall city is compared with the difference in pre-recall sales and post-recall sales in a non-recall city. Thus, for each variable, the unit of analysis was the store-level (i) and 8 time-periods (t, one for each week) were possible (4 weeks for the pre-recall and 4 weeks for the post-recall). The DD equation is presented in (1), where the first three variables preceded by a β coefficient are the common variables used for a DD model similarly to Danaher *et al* (2010, 2013) while the variables preceded by a γ coefficient are control variables:

$$\begin{aligned}\log(\text{Sales})_{it} = {} & \beta_0 + \beta_1\,\text{RecallCity}_i + \beta_2\text{PostRecall}_{it} \\ & + \beta_3(\text{RecallCity}_i * \text{PostRecall}_{it}) \\ & + \gamma_1\log(\text{Sales})_{i,t-1} + \gamma_2\log(\text{CompSales})_{i,t-1} \\ & + \gamma_3\text{Promotion}_{it} + \gamma_4\text{Advertisement}_{it} \\ & + \gamma_5\text{Coupon}_{it} + \varepsilon_{it,} \qquad (1)\end{aligned}$$

Table 1 presents a description of all of the model variables, and additional specifications related to each variable are described below:

Sales. This study models sales in units. Following the tradition in sales modeling, sales were logged to facilitate a normal distribution and also interpretation (Leeflang *et al*, 2000).

Interaction of $RecallCity_i$ and $PostRecall_{it}$. The key variable in the model is the interaction of $RecallCity_{it}$ and $PostRecall_{it}$. This variable shows the effect that the recall had on sales in a recall city compared to what happened to sales in a non-recall city.

Time controls. To control for time effects, two variables were created: (1) $\log(\text{Sales})_{i,t-1}$ and (2) $\log(\text{CompSales})_{i,t-1}$. These variables adjust based on the brand's and the competitors' brands' sales (in units) in the week immediately preceding the current week. The purpose of these variables is to capture the trend lines of sales for the brand and the competitors' brands.

Marketing mix control variables. The IRI database contains product information related to price promotion, advertising and couponing. Since these marketing mix variables can have a clear impact on sales, they were incorporated in the model.

1350-231X **Journal of Brand Management** Vol. 22, 4, 323–339

The promotion variable is a price reduction flag, and activates if the price reduction is 5 per cent or greater. 18.9 per cent of observations were subject to such price discounts (see Table 1). Regarding advertising, the IRI data identifies products supported by small, medium, and large size ads. Since only .1 per cent of observations were concerned with advertising, the variable was coded according to the "presence" or the "absence" of advertising. The $Coupon_{it}$ variable refers to the presence of a rebate or traditional coupon. Very few products were on couponing during the 8-week period studied (see Table 1).

RESULTS

Four models were estimated to represent the first four components of the brand ecosystem. These models were estimated through Ordinary Least Squares (OLS) regression using SAS 9.2. Based on Equation (1), Model 1 explores the impact of the Land O'Lakes butter recall on all Land O'Lakes branded products related to butter (margarine, butter blends, vegetable spreads and sprays); Model 2 examines the Land O'Lakes butter recall on Land O'Lakes margarines; Model 3 explores the effect of the recall on Land O'Lakes branded competitors' margarines (Parkay, Can't Believe It's Not Butter, Blue Bonnet and Parmalat); and Model 4 deals with the effect of the recall on private label margarines. In Model 3, since there was not enough variance in the $Coupon_{it}$ variable, it was excluded from the model. $Advertisement_{it}$ and $Coupon_{it}$ variables were excluded from Model 4 because there were no ads or coupons associated with private label margarines during the periods studied. Results for the 8-week period (4-weeks pre-recall, 4-weeks post recall) are presented in Table 2. The results from models 1 to 4 show an adjusted R2 ranging from 57.31% to 69.54%.

After studying the 4 week pre-recall and 4 week post-recall short-term sales fluctuations, 5 additional analyses were run for each of the four models in order to capture how spillovers change over the weeks following the recall. These analyses compare the 4-week pre-period with post-recall periods of different durations (ranging from a 1-week post-recall period to a 6-week post-recall period). These results are presented in Tables 3 to 6.

There are five key conclusions from this study which are summarized below.

Table 1: Description of variables used in the DD model and descriptive statistics

Variable name	*Description*	*Mean (SE)*
$Log(Sales_{it})$	Log of the sales in units of product *i* at time *t*	15.21 (23.76)
$RecallCity_i$	Dummy variable = 1 if the city experienced a Land O'Lakes butter recall; = 0 otherwise	0.3054 (0.4057)
$PostRecall_{it}$	Dummy variable = 1 for the post-recall weeks = 0 otherwise	0.5592 (0.4965)
$log(Sales)_{i,t-1}$	Log of the sales in units of product i in time $t-1$	15.37 (23.94)
$log(CompSales)_{i,t-1}$	Log of the sales in units of all products competing with product *i* at time $t-1$	523.45 (492.66)
$Promotion_{it}$	Dummy variable = 1 if there is a promotion of product *i* at time *t*; = 0 otherwise	0.1891 (0.3916)
$Advertisement_{it}$	Dummy variable = 1 if there is an advertisement of product *i* at time *t*; = 0 otherwise	0.00136 (0.0369)
$Coupon_{it}$	Dummy variable = 1 if there is a coupon of product *i* at time *t*; = 0 otherwise	0.0005231 (0.0229)

Table 2: Estimates of the four difference-in-differences models over a 4-week period before and a 4-week period after the product recall

Variables	*Model 1*	*Model 2*	*Model 3*	*Model 4*
Intercept	0.1876***	0.0220	−0.17637***	−0.2727**
	(0.0290)	(0.1287)	(0.0408)	(0.1045)
RecallCity$_i$	0.0750***	−0.3023***	0.0223	−0.0932***
	(0.0220)	(0.0536)	(0.0175)	(0.0459)
(PostRecall$_{it}$)	0.0501**	0.0363	0.0166	−0.0755***
	(0.0179)	(0.0514)	(0.0130)	(0.0275)
(RecallCity$_i$) * (PostRecall$_{it}$)	−0.1710***	−0.2529***	0.0092	−0.0044
	(0.0297)	(0.0693)	(0.0232)	(0.0600)
log(Sales) $_{i,t-1}$	0.7100***	0.5348***	0.6787***	0.7877***
	(0.0071)	(0.1929)	(0.0053)	(0.0109)
log(CompSales) $_{i,t-1}$	0.0624***	0.2525***	0.1433***	0.1631***
	(0.00489)	(0.0256)	(0.0082)	(0.0214)
Promotion$_{it}$	0.3201***	0.4546***	0.4302***	0.3854***
	(0.0195)	(0.0503)	(0.0132)	(0.0397)
Advertisement$_{it}$	0.6109***	0.5211***	0.9285***	—
	(0.0644)	(0.1311)	(0.2428)	
Coupon$_{it}$	0.2598**	0.8926***	—	—
	(0.0961)	(0.1815)		
N	9301	1511	16 828	2956
Adjusted R^2	0.6013	0.6383	0.5731	0.6954

Note: * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$. Model1: regression for Land O'Lakes only, Model2: regression for Land O'Lakes margarine only, Model3: regression for all competitors excluding private label where product type = margarine, Model4: Regression for private label margarine only.

Taken together, the models' estimates support the Similarity theory but only slightly support the Dominance theory.

Conclusion 1: Spillovers impacted both Land O'Lakes margarine and the overall Land O'Lakes brands.

The most obvious finding involves spillovers. Spillovers do indeed happen, as predicted by the Similarity theory. As shown in Table 2, these spillover effects are a prominent across the Land O'Lakes brand. The results from Model 1 reveal that there is a prominent interaction effect between RecallCity_{it} and Post-Recall_{it}. More specifically, this means that the recall had a significant negative impact on sales ($\beta_3 = -0.1710$, $P < 0.001$). In other words, the entire Land O'Lakes umbrella family is adversely affected by the butter recall. Deeper investigation of the results from Model 1 (Table 3) reveals that Land O'Lakes overall sales are immediately significantly negatively affected following the recall (1 week after the recall). Furthermore, the significant negative impact (all $P's < 0.05$) is consistently seen throughout the 6-week time period. The results from Model 2, as shown in Table 2, which captures the impact of the Land O'Lakes' butter recall on Land O'Lakes margarine sales, also showed strong support for the Similarity theory. Thus, the recall has a highly significant effect ($P < 0.001$) on lowering margarine sales ($\beta_3 = -0.2529$). Overall, the results from both models (Model 1 and Model 2) are consistent with the ones of Sullivan (1990).

Conclusion 2: Branded competitors do not receive spillover effects.

Unlike what the Dominance theory would assert, there are no signs of the recall having hurt brands that are significantly weaker than Land O'Lakes in related categories. These findings related to Model 3 consider all branded

Table 3: Estimates of the difference-in-differences for model 1 (regression for Land O'Lakes only) using a 4-week pre-period and different post-periods (1–6 weeks)

Variables	*1 week*	*2 weeks*	*3 weeks*	*4 weeks*	*5 weeks*	*6 weeks*
Intercept	0.2166***	0.2568***	0.2393***	0.1876***	0.1769***	0.1839***
	(0.0379)	(0.0393)	(0.0337)	(0.0290)	(0.0262)	(0.0240)
$RecallCity_i$	0.0719**	−0.0251	0.0205	0.0750***	0.0577**	0.0318
	(0.0228)	(0.0314)	(0.0259)	(0.0220)	(0.0196)	(0.0178)
$(PostRecall_{it})$	0.0222	0.0019	0.0339	0.0501**	0.0511**	0.0489***
	(0.0307)	(0.0246)	(0.0209)	(0.0179)	(0.0161)	(0.0147)
$(RecallCity_i) * (PostRecall_{it})$	−0.2617***	−0.0931*	−0.1063***	−0.1710***	−0.1579***	−0.1313***
	(0.0508)	(0.0406)	(0.0344)	(0.0297)	(0.0268)	(0.0246)
$log(Sales)_{i,t-1}$	0.7016***	0.7025***	0.7073***	0.7100***	0.7202***	0.7223***
	(0.0095)	(0.0093)	(0.0082)	(0.0071)	(0.0065)	(0.0059)
$log(CompSales)_{i,t-1}$	0.0585***	0.0575***	0.0522***	0.0624***	0.0617***	0.0579***
	(0.0068)	(0.0067)	(0.0057)	(0.00489)	(0.0044)	(0.0041)
$Promotion_{it}$	0.4139***	0.3628***	0.3985***	0.3201***	0.2857***	0.2975***
	(0.0276)	(0.0273)	(0.0228)	(0.0195)	(0.0172)	(0.0157)
$Advertisement_{it}$	0.3627***	0.7271***	0.9701***	0.6109***	0.6269***	0.6310***
	(0.0826)	(0.0998)	(0.1112)	(0.0644)	(0.0635)	(0.0628)
$Coupon_{it}$	0.4754***	0.3006**	0.2605**	0.2598**	0.2622**	0.2712**
	(0.1425)	(0.0981)	(0.0899)	(0.0961)	(0.0952)	(0.0942)
N	3226	5178	7246	9301	11 363	13 384
Adjusted R^2	0.6069	0.6040	0.5991	0.6013	0.6047	0.6097

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

Table 4: Estimates of the difference-in-differences for model 2 (regression for Land O'Lakes margarine only) using a 4-week pre-period and different post-periods (1–6 weeks)

Variables	*1 week*	*2 weeks*	*3 weeks*	*4 weeks*	*5 weeks*	*6 weeks*
Intercept	−0.0051	0.1407	0.0962	0.0220	0.0961	0.1078
	(0.1702)	(0.1724)	(0.1449)	(0.1287)	(0.1161)	(0.1052)
$RecallCity_i$	−0.3545***	−0.4710***	−0.4322***	−0.3023***	−0.3083***	−0.3193***
	(0.0561)	(0.0714)	(0.0616)	(0.0536)	(0.0476)	(0.0429)
$(PostRecall_{it})$	0.0432	−0.1460*	−0.0824	0.0363	0.0667	0.0449
	(0.0870)	(0.0713)	(0.0595)	(0.0514)	(0.0462)	(0.0419)
$(RecallCity_i) * (PostRecall_{it})$	−0.3353***	−0.0548	−0.0820	−0.2529***	−0.2537***	−0.1920***
	(0.1168)	(0.0957)	(0.0799)	(0.0693)	(0.0629)	(0.0573)
$log(Sales)_{i,t-1}$	0.5171***	0.5350**	0.5293***	0.5348***	0.5592***	0.5664***
	(0.0250)	(0.0246)	(0.0213)	(0.1929)	(0.0178)	(0.0162)
$log(CompSales)_{i,t-1}$	0.2686***	0.2501	0.2518***	0.2525***	0.2246***	0.2181***
	(0.0346)	(0.0245)	(0.0287)	(0.0256)	(0.0234)	(0.0213)
$Promotion_{it}$	0.7355***	0.5154***	0.5857***	0.4546***	0.3585***	0.3369***
	(0.0716)	(0.0672)	(0.0576)	(0.0503)	(0.0436)	(0.0399)
$Advertisement_{it}$	−0.3290*	0.8450***	1.6277***	0.5211***	0.6029***	0.6347***
	(0.1677)	(0.2229)	(0.2597)	(0.1311)	(0.1283)	(0.1252)
$Coupon_{it}$	1.1299***	0.9135***	0.8637***	0.8926***	0.9101***	0.8921***
	(0.2645)	(0.1884)	(0.1856)	(0.1815)	(0.1801)	(0.1766)
N	570	843	1178	1511	1859	2190
Adjusted R^2	0.6549	0.6505	0.6460	0.6383	0.6394	0.6467

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

Table 5: Estimates of the difference-in-differences for model 3 (regression for all competitors excluding private label where product type = margarine) using a 4-week pre-period and different post-periods (1–6 weeks)

Variables	*1 week*	*2 weeks*	*3 weeks*	*4 weeks*	*5 weeks*	*6 weeks*
Intercept	−0.1724***	−0.1256***	−0.1699***	−0.17637***	−0.1842***	−0.1659***
	(0.0529)	(0.0545)	(0.0461)	(0.0408)	(0.0372)	(0.0340)
$RecallCity_i$	0.0224	−0.0590*	−0.0037	0.0223	0.0232	0.0348*
	(0.1737)	(0.0249)	(0.0203)	(0.0175)	(0.0156)	(0.0142)
$(PostRecall_{it})$	0.1226***	0.0167	0.0128	0.0166	0.0276*	0.0165
	(0.0209)	(0.0178)	(0.0149)	(0.0130)	(0.0116)	(0.0106)
$(RecallCity_i) * (PostRecall_{it})$	−0.0611	0.0500	0.0226	0.0092	0.0017	−0.0120
	(0.0378)	(0.0317)	(0.0266)	(0.0232)	(0.0209)	(0.0192)
$log(Sales)_{i,t-1}$	0.6915***	0.6933***	0.6818***	0.6787***	0.6805***	0.6810***
	(0.0071)	(0.0072)	(0.0060)	(0.0053)	(0.0048)	(0.0044)
$log(CompSales)_{i,t-1}$	0.1378***	0.1326***	0.1412***	0.1433***	0.1455***	0.1412***
	(0.0108)	(0.0111)	(0.0093)	(0.0082)	(0.0074)	(0.0068)
$Promotion_{it}$	0.4072***	0.4459***	0.4295***	0.4302***	0.3893***	0.3957***
	(0.0194)	(0.0176)	(0.0151)	(0.0132)	(0.0117)	(0.0107)
$Advertisement_{it}$	—	0.8656***	0.9267***	0.9285***	1.0256***	1.0280***
		(0.2438)	(0.2436)	(0.2428)	(0.2278)	(0.2281)
$Coupon_{it}$	—	—	—	—	—	−0.0207
						(0.1831)
N	6269	9348	13 101	16 828	20 609	24 404
Adjusted R^2	0.5769	0.5892	0.5779	0.5731	0.5721	0.5711

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

competitors of Land O'Lakes, and measure how their collective margarine sales would be impacted by the Land O'Lakes butter recall. As shown in Table 2, the aggregate sales of branded competitors (Parkay, Blue Bonnet, Parmalat and I Can't Believe It's Not Butter) did not experience a significant rise or fall in sales ($\beta_3 = 0.0092$, $P = 0.6918$). These results are consistently seen in the 6 weeks following the recall (Table 5) where all estimates of the $(RecallCity_i)^{\star}(Post\text{-}Recall_{it})$ interaction are statistically non-significant (all $P's > 0.05$).

It is also interesting to point out that the results also do not support the assertion of Darke *et al* (2010) that negative spillovers straddle across different brands. This may be because of the fact that the dependent variable used by Darke *et al* was 'distrust,' and Land O'Lakes may not have 'earned' consumer distrust because of their effective handling of the recall and the lack of harm caused by the recalled product. The findings do, however, support Siomkos *et al's* (2010) position that competitors should not be able to capitalize on a well regarded brand's 'mild' crisis.

Conclusion 3: Private label brands slightly suffer spillover effects immediately but these negative spillovers dissipate quickly.

The Dominance theory would predict that the private label brands should be the competitors that suffer the most. This is partly true. As shown in Table 2, using a 4-week period as the pre-recall period and 4-week period as the post-recall period, as in the case of branded margarines, private labels did not experience a significant change in sales ($\beta_3 = -0.0044$, $P = 0.9416$) from the Land O'Lakes butter recall. However, closer inspection of the results in Table 6 show that, in the week immediately following the Land O'Lakes recall, unlike their nationally branded rivals, private label brands experienced a statistically significant drop in sales ($\beta_3 = -0.2078$, $P = 0.0427$). This sales drop fades quickly

Table 6: Estimates of the difference-in-differences for model 4 (Regression for private label margarine only) using a 4-week pre-period and different post-periods (1–6 weeks)

Variables	*1 week*	*2 weeks*	*3 weeks*	*4 weeks*	*5 weeks*	*6 weeks*
Intercept	−0.1929	−0.2951*	−0.2323*	−0.2727**	−0.3377***	−0.3310***
	(0.1343)	(0.0218)	(0.1101)	(0.1045)	(0.0913)	(0.0828)
$RecallCity_i$	−0.0930	−0.2518***	−0.0630	−0.0932***	−0.0707	−0.0789*
	(0.0480)	(0.0687)	(0.0532)	(0.0459)	(0.0408)	(0.0368)
$(PostRecall_{it})$	−0.0146	−0.1981***	−0.1185***	−0.0755***	−0.0436	−0.0381
	(0.0470)	(0.0385)	(0.0315)	(0.0275)	(0.0246)	(0.0224)
$(RecallCity_i) * (PostRecall_{it})$	−0.2078*	0.1428	−0.0224	−0.0044	0.0055	−0.0306
	(0.1024)	(0.0838)	(0.0684)	(0.0600)	(0.0539)	(0.0491)
$log(Sales)_{i,t-1}$	0.7616***	0.7796***	0.7787***	0.7877***	0.8043***	0.8089***
	(0.0154)	(0.0153)	(0.0123)	(0.0109)	(0.0099)	(0.0091)
$log(CompSales)_{i,t-1}$	0.1584***	0.1929***	0.1644***	0.1631***	0.1641***	0.1592***
	(0.0290)	(0.0280)	(0.0224)	(0.0214)	(0.0194)	(0.0175)
$Promotion_{it}$	0.4589***	0.3723***	0.3893***	0.3854***	0.3385***	0.3624***
	(0.0575)	(0.0561)	(0.0450)	(0.0397)	(0.0351)	(0.0301)
N	922	1652	2311	2956	3605	4248
Adjusted R^2	0.6702	0.6873	0.6938	0.6954	0.7041	0.7120

Note: * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$. The variables $Advertisement_{it}$ and $Coupon_{it}$ were excluded from this model since private labels were not advertised nor promoted using couponing.

(Table 6) and all subsequent post-recall periods analyzed show non-significance ($P's > 0.05$). In short, there is some short-lived support for the Dominance theory in Model 4.

Conclusion 4: The timing of impact for a recall on the brand ecosystem is very short.

As related to Conclusion 1 and Conclusion 3, one of the most interesting observations involves how quickly the brand ecosystem is affected by a recall. The findings show how quickly Land O'Lakes overall, Land O'Lakes margarine sales and private labels sales dropped off as soon as butter received a recall. Tables 3, 4 and 6 (all $P's < 0.05$) consistently show significant sales drops in the week immediately following the recall. The effects of the product recall are indeed immediate in the brand ecosystem, which has significant implications for when and how managers deal with a product recall. These findings support and are consistent with the conclusions from Seo *et al* (2013).

Conclusion 5: Promotion, advertising and couponing positively influence sales for the entire brand ecosystem.

In all models, the marketing mix instruments (promotion, advertising and couponing) are related to a positive impact on their related brand ecosystem component unit sales (for γ_3, γ_4 and γ_5, 46 of the 48 $P's < 0.05$). While this should not be surprising, it may be an important consideration for brand recovery plans.

IMPLICATIONS

There are several implications of this study and some promising ideas for follow-up research. The first implication relates to the marketing contribution of the DD model. The DD approach has been effectively used in economics, and we employed it in a marketing study of a tumultuous managerial problem (product recall). The model that we presented is easily adaptable (and generalizable) to study other managerial issues such as any type of product-harm crises.

A second implication relates to the brand ecosystem. On the basis of our study of the Land O'Lakes product recall, managers of brands that are similar to brands that suffer

setbacks are likely to be affected by the negative event, and have a short time to react. A firm would be well-advised to set up processes and systems to avoid potential bad events – but if one does 'slip through the cracks,' bad-event response protocols are an important insurance policy.

A third implication involves consumers. According to our results, consumers seem to think in terms of brands, not categories. As such, a brand-house (corporate) strategy can be a double-edged sword. On the plus side, it can facilitate brand awareness (Seo *et al*, 2014), leverage positive associations within the brand family (Ahluwalia *et al*, 2001) and be a cost-effective way to build a brand; on the negative side, the brand house is vulnerable to negative spillovers from a product recall or product harm crisis. Under this line of thinking, a 'house of brands' strategy would be more advantageous than a 'branded house' strategy (Aaker, 2004) during times of trouble. Managers can benefit from this insight in order to balance sales losses of the recalled brand family; a firm may want to advertise other brands in its portfolio to mitigate losses in the recalled brand portfolio. At the same time, there are implications for competitors. Given the significance impact on sales that marketing mix tools demonstrated, competitors may be able to increase their sales through advertising, coupons, promotions and other tools during the time when the recall spillovers are affecting the troubled brand. This implication helps to explain why Sanitorium was able to increase their short-term sales in the study by van Heerde *et al* (2007) and supports Cleeren *et al* (2013)'s assertion that marketing mix tools can help overcome product harm crises for the brands in the ecosystem as well as for the entire category.

A final implication relates to the theoretical contribution of this article. As previously stated, this article provides a new way of looking at product recalls – more specifically it provides two theories, Similarity theory and Dominance theory to help explain why negative spillovers occur and how far they might spread. While almost all research to date has focused on severe product harm crises and recalls to show spillover effects (automobile deaths, child deaths, sickness from E. coli and so on), this research shows how sensitive a brand ecosystem is to the 'mildest' form of product harm recall under the best bad news condition. (see Limitations and Further Research).

LIMITATIONS AND FURTHER RESEARCH

While this article helps to shed light on negative spillovers, it also has several limitations. First, caution must be given to the generalizability of the findings. The study here examined the impact of a recall in a low involvement /utilitarian product category that is highly fragmented. How the effects of similarity and dominance might play out in a high involvement / hedonic or more oligopolistic category needs further investigation.

It is important to note that this research is also a starting point for other related studies. As emphasized in this article, the Land O'Lakes recall was a best-case scenario of bad news: the crisis was a relatively mild one in that there were no reports of illness or deaths; the source of the contaminated butter seems to have been limited to one (or few) plant making a fast recovery possible; the recall was handled in a timely manner with Land O'Lakes voluntarily accepting responsibility for the problem (Appendix A); stakeholders (FDA, retailers) were notified and involved in the recall (Appendix A); and Land O'Lakes itself was a market share-leader-high equity brand, suggesting it would have a natural buffer to bad news (Cleeren *et al*, 2008). How might spillovers have changed had Land O'Lakes bungled its recall, or if consumers who consumed the metal

  1350-231X **Journal of Brand Management** Vol. 22, 4, 323–339

fragments were harmed? Seriously harmed? Indeed, studying the severity and handling of bad events may have different implications for the brand ecosystem. While the purpose of this study was to investigate brand-to-brand and category-to-category spillovers, to fully test the Dominance theory, we would have to replicate this study looking directly at butter. A follow-up study on the impact of a product recall may indeed support the Dominance theory as more evidence is still needed for generalizations. How far would Land O'Lakes butter stick recall spread within and beyond margarine? Are margarine formats (tubs and sticks) affected equally? This study only looked at the short-term spillover impact of the recall. What happens to sales in the brand ecosystem in the medium and long term? These research questions then naturally lead to brand recovery questions. What is the best way for a recalled brand to regain sales? The findings suggest that the marketing mix has an important role to play in recovery, but what is the optimal recovery mix? What role might social media play in negative spillover contagion? Through this article, we hope to spark more interest in these important topics.

NOTES

1 An ingredient brand is a branded material or component part that is contained within another branded product (see Kotler and Pfoertsch, 2010, or Keller, 2013, p 244).

2 http://www.landolakesinc.com/business/default.aspx, accessed May 17, 2013.

3 http://www.landolakesinc.com/businesses/FullStory/ECMD2-0016382, accessed June 17, 2015.

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CORRECTION

This paper has been corrected online: 21 July 2015 please visit the corrigendum for details: doi: 10.1057/bm.2015.23

APPENDIX A

Land O' Lakes press release

Voluntary Recall of LAND O' LAKES® Salted Stick Butter In One-Pound Packages.

ARDEN HILLS, Minnesota, 27 July /PRNewswire/ – Land O'Lakes Inc. today initiated a voluntary recall of approximately 3500 cases of LAND O' LAKES® Salted Stick Butter in one-pound packages because it may contain small fragments of metal. There have been no reports of injury or illness associated with the consumption of the product covered by this recall.

The affected product was distributed in Alabama, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Mississippi, Montana, Nebraska, North Carolina, North Dakota Oklahoma, South Carolina, South Dakota, Tennessee, Texas, Wisconsin, and Wyoming. The product was sold to consumers in retail grocery stores between June 11, 2003, and July 27, 2003.

The recalled product potentially affected has one of the following production codes:

(Date) KE 107P
(Date) KE 108P
(Date) KE 109P

The code can be found above the Nutrition Facts on the package.

The voluntary recall is only for the product with the production codes noted above. No other butter products or production codes or any other LAND O' LAKES® products are part of this voluntary recall.

'We are initiating this precautionary recall because the safety and health of our consumers are our first concern,' said Jack Gherty, Land O'Lakes president and chief executive officer. 'We're working with the FDA to ensure any product that has not yet been consumed is removed from the marketplace and consumers' homes as quickly as possible.'

All the product was produced at Land O'Lakes Kent, Ohio, manufacturing facility.

Consumers who have purchased LAND O'LAKES® Salted Stick Butter in one-pound packages with one of these production codes are asked to return it to the place of purchase for a full refund.

Consumers with questions may contact the company toll-free at 1-877-585-2365 or visit our website at www.landolakes.com/ for further information.

Website: www.landolakes.com/

APPENDIX B

Graphical representation of states affected by the Land O'Lakes butter recall

States affected by the recall: Alabama, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, North Carolina, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, Wisconsin and Wyoming.