Food Safety Recall Events in the United States Traced to Domestic and International Corporate Parents, 2000-2009

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Background

Over the Period of 2000-2009 there have been over 2,400 food related recall events in the United States. Food recalls are primarily voluntary procedures initiated by firms with oversight by USDA and FDA. This study examines the risk of recall recurrence using survival and hazard analysis procedures from statistics. It investigates the recall events traced back to the corporate parent of the recalling firm.

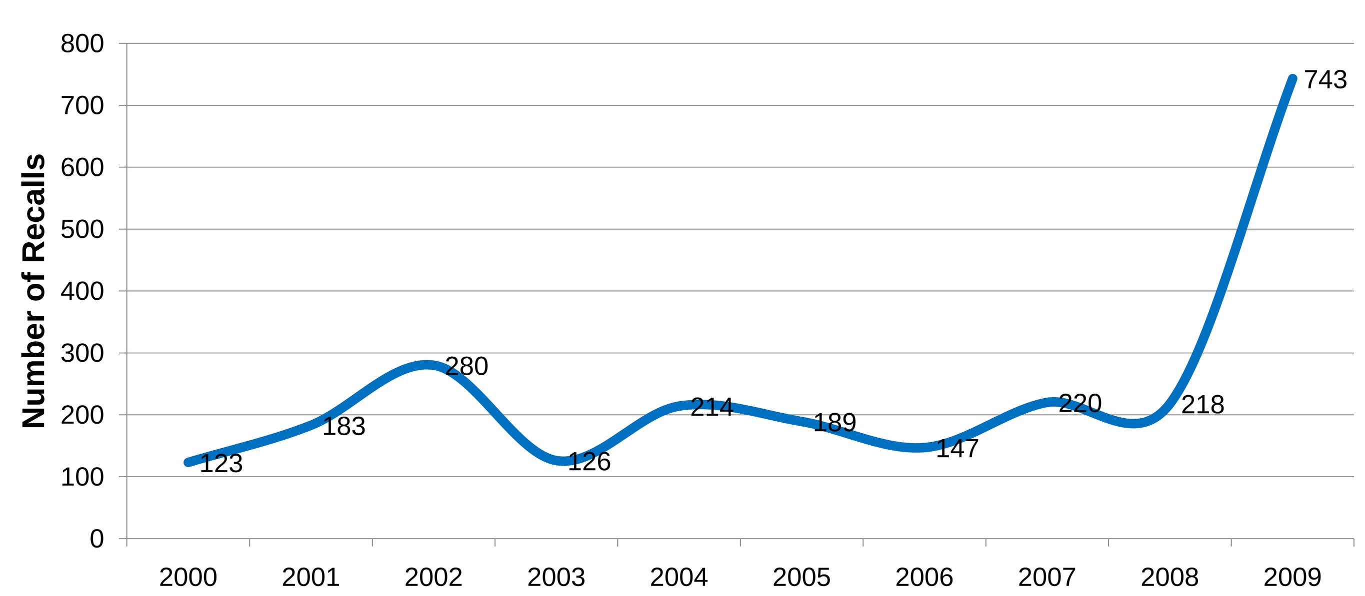
It is generally perceived that a food recall event is an adverse occurrence for a firm that could lead to publicity problems, financial harm, and potential failure of the firm. Recall are the result of a risk assessment by the firm. A firm manager must decide whether to bring a product off of the shelf and experience direct financial loss or to jeopardize the consumer with the possibility of indirect financial damage.

In this research, we will focus on firms that experience multiple recall events and will employ statistical methods to ascertain the risk of recurrence of these events. We will utilize economic and management theory of bounded rationality and principal-agent theory to defend our presumptions and expectations. We will also present several interesting findings that we feel are valuable contributions to the current understanding of food safety.

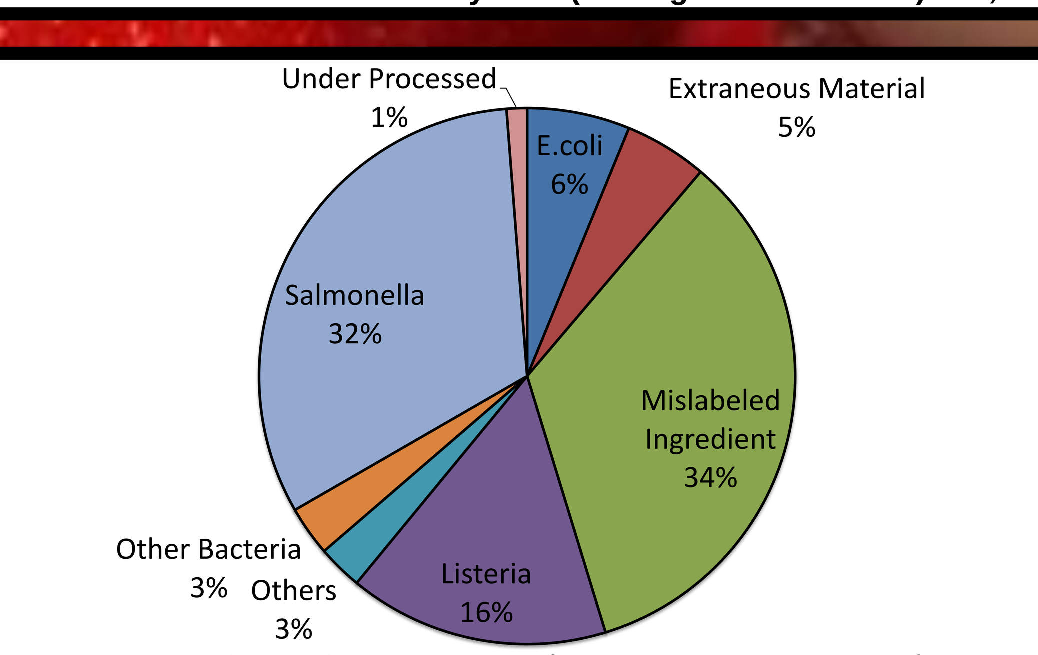
Data Description

Recall event data were collected from press releases issued by USDA's FSIS division on its Recall Case Archive website and FDA on its Archive for Recalls, Market Withdrawals and Safety Alerts website. This data includes date of the recall event; firm; city and state of the firm involved; type of firm involved as manufacturer, retailer, or a combination of the two; recall problem; how the problem was discovered; and contact information. Additional information, albeit not as exhaustive, is available on recall class as a measure of recall severity, illnesses reported, total pounds recalled, and the number of states to which the product was distributed. In this original dataset, there were 2,443 recall events reported.

Corporate level firm data were collected from the Hoover's Company Information Database that include sales figures, number of employees, percentage of sales growth, percentage of employee growth, a binary variable equal to one if a firm has a brand and zero otherwise, and the number of brands per firm. Corporate structure data were collected from the Food Business Review Database, the Funding Universe Database, and MintGlobal that related the parent companies to their subsidiaries. After merging the recall data and the corporate information, a dataset of 1.125 recall events involving 522 firms was created.



Trend of Recall Events by Year (Through October 2009) *n=2,443*



Problems Associated with Recall Events (January 2000-October 2009) *n=2,443*

Methodology

In our study, survival is equivalent to risk of recurrence and we may be able to say something about proactive indicators of the next recall event. In this analysis, the event will be defined as the occurrence of a food safety recall by an individual firm, given that the same firm previously had a product recall.

Defining T as the survival time, the survival function $S(t)$, is the probability that an individual (or firm in our case) survives longer than t without a failure (recall) event. In our analysis, T is defined as the duration without a recall event.

$$(1)\ S(t) = \Pr(T>t)$$

The hazard function, $h(t)$, will be defined as the probability that a firm experiences the event in a small time interval s, given that the firm has survived up to the start of this interval.

$$(2)\ h(t) = \lim_{s\to 0} \Pr\frac{(\text{event in } (t, t+s) \mid \text{survival up to } t}{s}$$

Cox's proportional hazard model is estimated to determine the relationship of the response to our explanatory variables. The Cox regression is semi-parametric as it does not require the probability distribution for the survival time to be specified. The Cox model allows for the form of dependence of $h(t)$ on t to remain unspecified as given by:

$$(3)\ h(t) = h_0(t)\exp(\boldsymbol{\beta}'\mathbf{x})$$

From here, the regression parameters, $\boldsymbol{\beta}$, can now be estimated by maximizing the partial likelihood function. From the estimated regression parameters, we can calculate hazard ratios associated with each covariate. The hazard ratios are calculated as:

$$(4)\ HZ_i = \exp(\beta\ i).$$

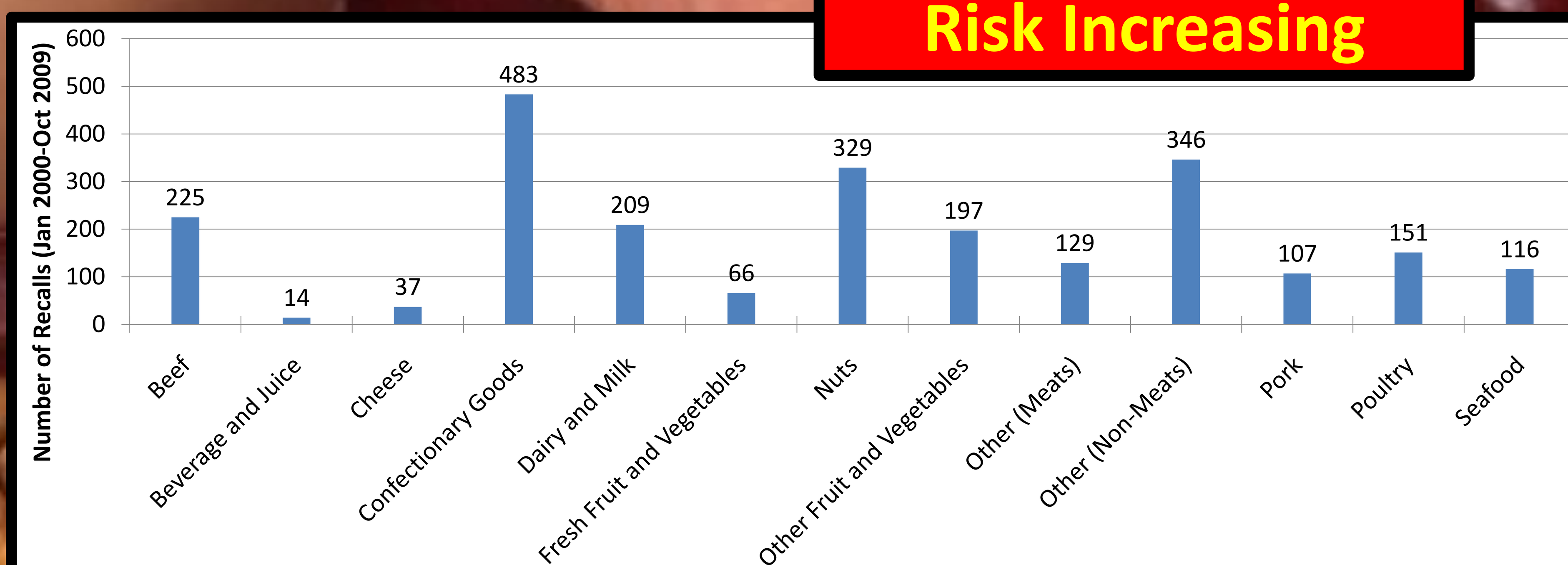
The hazard ratios can be interpreted as follows: an increase in a continuous explanatory variable by n unit(s) will result in $|1-(HZ)^n|$ percent increase in the hazard rate if the $HZ>1$ (SAS Institute Inc. 2009). Hazard ratios greater than one indicate a positive association of that variable with recall risk.

Variable Selection

The size of the firm, as Coase (1937) explains it, can be interpreted as volume or sales. Coase (1937) argues that efficiency within the firm tends to decrease as the firm becomes larger. As a firm gets larger, the entrepreneur or management must organize an increasing number of transactions, both monetary and physical. These transactions will also become more spatially distributed and dissimilar in kind. The costs of organizing these transactions will eventually force the firm to reach a point where the costs of organizing an additional transaction within the firm are equal to the costs of carrying out the transaction in the open market. As the firm expands either vertically or horizontally, additional employment of workers or technology will be required. However, as production levels and/or goods become more diverse, upper management will face a mounting problem of organization and supervision. We will examine firm size as measured by sales and number of employees as explanatory factors for food safety.

According to principal-agent theory (Spence, 1973) a higher quality producer has an incentive to characterize its product as distinct from a lower quality product. One method to create this distinctive image is through branding and the subsequent advertising and goodwill opportunity costs that accompany it. Branding at its essence can be thought of as a principal-agent signaling device where the producing firm is the agent conveying meaningful information to the principal or consumer of the product. In the case of the food sector, the conveyance mechanism is brand reputation and the meaningful information is safety and quality of the product. For these reasons, branding of products and number of brands appear to be very reasonable explanatory factors when considering food safety.

More Brands Are Risk Increasing



Frequency of Products Recalled by Product Types *n=2,443*

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Hypotheses

We contend that the growing *size of a firm will **not** lead to safer* and more stringent food safety practices and therefore will increase the risk of recurrence of recall events. We expect that, controlling for firm branding, an increase in the size of a firm will increase the risk of recurrence of recall events and therefore the hazard ratios for the firm size variables will be greater than one (FS denotes firm size). That is:

$$(1)\ \text{H}_1 : HZ_{FS} \geq 1$$
$$\text{H}_{A1} : HZ_{FS} < 1$$

Also, we contend that both *product branding and a growing portfolio of brands will decrease the risk* of recurrence of recall events with the likelihood that branding is a signal of higher quality, safer products. We expect that, controlling for firm size, branding and an increasing portfolio of brands will decrease the risk of recurrence of recall events and therefore the hazard ratios for the branding variables will be less than one (B denotes brand). That is:

$$(2)\ \text{H}_1 : HZ_B \geq 1$$
$$\text{H}_{A2} : HZ_B < 1$$

Results

Model 1: $h(t) = \log h_0(t) + \beta_1 MRS + \beta_2 BYN$

Where *MRS* is sales measured in millions of dollars and *BYN* is a binary variable equal to one if a firm has a brand.

Variable	Parameter Estimate	Pr > Chi Sq	Hazard Ratio
Sales	0.00952	<0.0001	1.010
Branding	0.81547	<0.0001	2.260

Given that one recall has occurred and controlling for branding, a $1 billion increase in sales is associated with a 1.0% increase in the risk of recall recurrence. Controlling for sales, the fact that a firm brands is associated with a 126.0% increase in the risk of recall recurrence.

Model 2: $h(t) = \log h_0(t) + \beta_1 MRE + \beta_2 BYN$

Where *MRE* is employees measured in thousands of employees and *BYN* is a binary variable equal to one if a firm has a brand.

Variable	Parameter Estimate	Pr > Chi Sq	Hazard Ratio
Employees	0.00343	<0.0001	1.003
Branding	0.83212	<0.0001	2.298

Given that one recall has occurred and controlling for branding, an increase in the number of employees by 1,000 is associated with a 0.3% increase in the risk of recall recurrence. Controlling for employees, the fact that a firm brands is associated with a 129.8% increase in the risk of recall recurrence.

Model 3: $h(t) = \log h_0(t) + \beta_1 MRS + \beta_2 NBS$

Where *MRS* is sales measured in millions of dollars and NBS is the number of brands owned by a firm.

Variable	Parameter Estimate	Pr > Chi Sq	Hazard Ratio
Sales	0.01191	<0.0001	1.012
Number of Brands	0.01802	<0.0001	1.018

Given that one recall has occurred and controlling for the number of brands a firm has, an increase in sales by $1 billion is associated with a 1.2% increase in the risk of recall recurrence. Controlling for sales, an increase in the number of brands by one associated with a 1.8% increase in the risk of recall recurrence.

Conclusions and Applications

Consistently, in models 1, 2, and 3, we found that the firm size variables corresponded with our hypothesis that an increase in firm size will increase the risk of recurrence of a recall event. This is evidence that the existence of **bounded rationality** in terms of food safety may be a factor influencing the risk of recall recurrence. Larger firms are less able to effectively manage across multiple productions.

Consistently, in models 1, 2, and 3, we found that the branding variables did not correspond with our hypothesis that branding or an increase in the number of brands by a firm would reduce the risk of recurrence of a recall event. Therefore, we rejected our initial hypothesis concerning brands. The reasons are not clear from our research. However the firms in our sample demonstrate proliferation of brands making it unimportant to protect each of them. Alternatively, managers could be reaping the benefits in past investments in goodwill making it possible to survive the negative reactions of recall events.

Citations:

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